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aquatic biology

SOQUEL CREEK LAGOON MONITORING REPORT, 1998

June, 1999
Project #106-08

Prepared for

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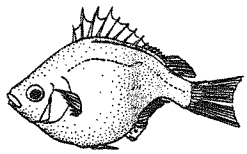

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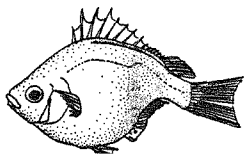
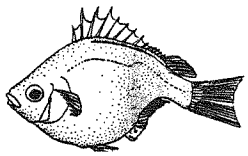


SOQUEL CREEK LAGOON MONITORING REPORT, 1998

ACKNOWLEDGMENTS

We appreciate the efforts of the Capitola Public Works Department and Bill Casalegno, heavy equipment operator, in maintaining the lagoon. In typical fashion, Nels Westman and other volunteers effectively removed flowers after the Begonia Festival in September. We thank Nels and Susan Westman for the loan of their boat for the fall fish censusing.

We are grateful to the volunteers who do the annual fish censusing at the lagoon. They come mainly from Friends of Soquel Creek and Earthlinks, with other interested volunteers like Gary Quail. This long-term sampling was in its seventh year in 1998, providing a valuable index of fluctuation in fish populations in the lower Soquel Creek watershed. All volunteers are very welcome on the first two Sunday mornings of each October. Kids enjoy the experience along with the rest of us.



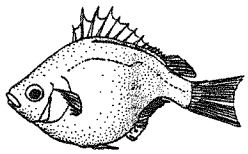
REPORT SUMMARY

Habitat conditions in the 1998 lagoon followed a wet winter. Sandbar construction was delayed until July because of high streamflows. Algae and pondweed did not become dense until the last week of August, at which time surface algae covered 15% of the lagoon. The warmest lagoon conditions occurred a week before the Begonia Festival in September. However, water temperature was cooler all summer, compared to the 1997 conditions associated with less baseflow. Saltwater entered the 1998 lagoon during only one episode in early August, and was flushed out before the next two-week monitoring.

Results from a temperature data logger stationed at Nob Hill from July 23 to September 4 indicated that diurnal water temperature from lagoon in-flow water fluctuated 5-6 C each day. During the 20-day period from July 25 to August 14, water temperature rose above 21 C for several hours each day, with a period maximum of approximately 23.5 C on August 3. Daily maxima still were approaching 21 C on September 4. The warmest monitored lagoon water temperature occurred on September 8. We may expect even higher water temperature in years that have much lower baseflow. We may assume that lagoon temperatures were at least 1-2 C higher than the in-flow stream temperature. Noting that the upper temperature tolerance for coho salmon is approximately 20 C (J. **Smith, personal communication**) and they typically prefer water temperatures below 16 C, considerably more stream shading will be required to make lower Soquel Creek habitable for this species.

Oxygen levels were generally rated "good" throughout the summer. Lagoon levels were mostly in the "fair" range through the summer rather than "good", despite the high baseflow. Leakage around the flume and difficulty in managing the flume entrance prevented deeper conditions.

Noble Gulch continued to pollute the lagoon in 1998, as indicated by the periodic filamentous algal blooms at its mouth. Gray water plumes were noted leaving the Gulch in 3 of the 7 monitorings. All storm drains leading to the lagoon should ideally be redirected away from the lagoon in summer. Included in these is



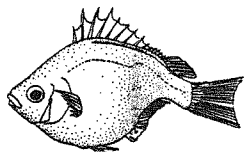
underground culvert draining Noble Gulch. By minimizing the stream inflow from Noble Gulch, there may be a reduction in nutrients and bacteria entering the lagoon. Algae production may be reduced. Another drain into the lagoon is situated under the railroad trestle, where slight oxygen depletion has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

The gulls are a primary source of pollution, both for bio-stimulating nutrients and bacteria. They forage through the human refuge left on the beach. They bathe in the lagoon. They roost on the buildings surrounding the lagoon. Reducing the gull population at Soquel Creek Lagoon would be a major step in reducing pollution. A better method of refuge disposal is needed. The refuge cans currently on the beach have no lids. The gulls have excellent refuge access and commonly drag it out of the cans. Refuse cans with lids that were gull-proof and that were usable by the public may reduce gull numbers. Regarding roosting, there are methods available to make buildings' roofs inhospitable to gulls.

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

Regarding pollution from urban runoff, maintenance of existing silt and grease traps on storm drains is critical to reducing pollution by petro-chemicals. All new drainage systems from new development and parking lots should be installed with effective traps and percolation basins to encourage winter percolation of storm runoff.

Lagoon water quality is better with more summer stream inflow from the Creek. Water quality generally worsens at the end of each dry season as stream inflow declines. On 19 September 1998, the Coastal Watershed Council measured streamflow with a flowmeter at Nob Hill to be 6.91 cubic feet per second (cfs) (**Table 3; Appendix B**). The lowest estimated summer baseflows in



1995, 1996 and 1997 had been approximately 2.5 cfs, 2.25 cfs and 1 cfs, respectively. In 1994, in-flow declined below 1 cfs by late July and to an estimated 0.05 cfs by late September.

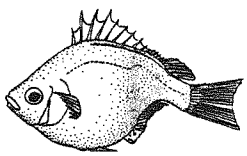
With more summer baseflow entering the lagoon, when tidal overwash occurs or saltwater backflushes into the lagoon through the flume, the saltwater is flushed out more quickly to reduce lagoon heating. To maximize summer baseflow, water percolation into the Soquel Creek aquifer during the rainy season must be maximized while surface runoff is minimized. Both direct summer water diversion and pumping from the underflow of the Creek reduce summer baseflow. They should be curtailed quickly to protect lagoon habitat if surface flow becomes discontinuous in Soquel Village.

In 1995-97 and again in 1998, apparently vandals working at night created gaps found between the flashboards in the flume inlet. This caused partial draining of the lagoon. Vandalism occurred on weekends, and was sometimes correlated with prior high water levels in the lagoon. The flashboards need to be secured against vandalism on the one hand, while allowing addition or removal of boards for management.

When the estuary periphery and lateral channel across the beach were sampled before sandbar construction, captured fish included young-of-the-year steelhead (Oncorhynchus mykiss), prickly sculpins (Cottus asper), threespine stickleback (Gasterosteus aculeatus), juvenile Sacramento suckers (Catostomus occidentalis) and one starry flounder (Platichthys stellatus).

Passage for steelhead smolts was excellent during the out-migration season in 1998. Our steelhead population estimate for fall 1998 was 671 juveniles +/- 74. Other species captured by number were 95 juvenile Sacramento suckers, one prickly sculpin and low numbers of threespine stickleback. No tidewater gobies (Eucyclogobius newberryi) were detected.

In 1998, artificial sandbar breaching occurred on 7 November to prevent flooding. Stormflow occurred at high tide, inhibiting outflow through the flume. The sandbar remained open afterwards.



New Recommendations and Important Recommendations not Yet Implemented

1. Replace the open, lid-less refuse cans on the beach with those with gull-proof lids and convenience in use. Use enough refuse cans to satisfy the demand for refuse disposal.

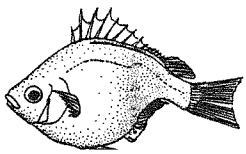
2. Look into screening the railroad trestle in order to discourage roosting and nesting by rock doves.

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

4. 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 filled with flashboards as before, if secured against vandals. In this way, vandalism would be prevented, and flooding may be more easily prevented before the sandbar breaches. Also, with this louver system the early, small stormflows of fall would be less likely require premature sandbar breaching to prevent flooding. With the louver design, the lagoon level may be easily maintained in summer, thus preventing the lagoon level from fluctuating into the "poor" range as occurs with the old flashboard system when boards are not been added quickly as streamflow declines in summer.

5. As stated in previous reports, if the streamflow in Soquel Creek in the vicinity of Soquel Village approaches the point of losing surface flow, notify Tiedemann Nursery and the Fish and Game Department of the streamflow conditions so that direct water pumping from the stream may be reduced or discontinued until flow returns. Loss of surface flow should be prevented.

6. Regarding the Begonia Festival, recommend surfboard paddling rather than wading for float propulsion. If wading is chosen by

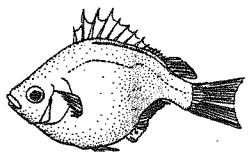


participants, recommend that the organizers to set a limit of 3 waders per float. Allow passage of floats in one direction only, presumably downstream, instead of down the lagoon and then back up through the lagoon before dismantling.

7. The City is recommended to 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 is recommended to 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 is recommended to 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.



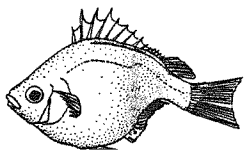
LAGOON AND ESTUARY FORMATION

This was the eighth year of monitoring sandbar construction at Soquel Creek Lagoon. Seven previous monitoring reports were completed for past years (**Alley 1991-97**). Sandbar closure in 1998 was delayed in 1998 because of the high streamflow volume. The City utilized a 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**).

Results of Fish Sampling Prior to Sandbar Construction

On 29 June, 1998, Ed Morrison of the City of Capitola Public Works Department assisted Don Alley, fisheries biologist, in making 20+ seine hauls in the lateral channel leading southeast from the main estuary across the beach. The seine was 30 feet x 4 feet x 1/8-inch mesh. Streamflow was measured at 22.6 cubic feet per second (cfs), having been measured on 17 June at 31.2 cfs. Alley decided to have the lateral channel blocked off with a sand berm from the main estuary prior to fish rescue because streamflow was too great to allow effective seining. The lateral channel was allowed to partially dewater before seining began. Fish captured in the lateral channel and along the east estuary margin included 46 young-of-the-year steelhead (Oncorhynchus mykiss) ranging in in size from 40-70 mm Standard Length, 400+ prickly sculpins (Cottus asper) ranging in size from 20-100 mm Standard Length, less than 10 threespine stickleback (Gasterosteus aculeatus), less than 10 juvenile Sacramento suckers (Catostomus occidentalis) and one starry flounder (Platichthys stellatus). Fishes were placed in a live-car after each seine haul to be relocated in the deepest portion of the main estuary periodically after every few seine hauls.

No tidewater gobies (Eucyclogobius newberryi) were captured. If tidewater goby had been found, they would have been transported even further upstream where cover existed. Tidewater gobies were apparently absent in late June, 1998. One tidewater goby had been captured in the lower lagoon the previous fall, 1997.



As required in the permit, the fisheries biologist was present during all activities that could affect 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.

Monitoring of Sandbar Construction

29 June 1998. The first activity accomplished on 29 June was the construction of channel along the east side of the flume. Then a berm was graded across the upstream end of the lateral channel. The estuary then began to drain and fill with the tides along the new channel. It drained more after the new channel was constructed, and 40+ prickly sculpin, approximately 10 frog tadpoles and one adult Sacramento sucker were rescued from puddles along the bulkhead as the estuary drained. After the fish rescue in the lateral channel, the equipment operator began to cover the lateral channel with sand to make more beach.

2 July 1998. On 2 July the would-be lagoon basin was enlarged along the western margin. A berm was created along the west side of the existing, narrow estuary at low tide. Then the bulldozer was used to excavate behind the berm to enlarge the west side. No excavation was done in the watered channel. The sandbar remained open over the Fourth of July weekend.

6 July 1998. On 6 July, sand had been stockpiled along the west edge of the flume. Alley began raking kelp out of the estuary at 0630 hr. He had removed approximately 1/3 of the plant material when the City closed off the sandbar as the tide turned to prevent more kelp from entering the estuary overnight. Morrison was misinformed by other Public Works staff that daylight could be seen end to end through the flume. Therefore, it was

mistakenly assumed that the flume would be open enough to pass streamflow to the bay. However, this was not the case, with the passageway actually still plugged with sand and kelp in the middle portion of the flume. The lagoon filled considerably overnight to within one foot of the piling bolt, leaving the flume inlet covered with more than one foot of water depth.

7 July 1998. The sandbar was breached to prevent further lagoon filling, and the estuary drained quickly to a low level. All kelp was scoured out of the estuary. One steelhead juvenile was beached during the draining. It was rescued alive, but appeared lethargic for a moment as it floated in the channel. No other fishes were noted on the dewatered estuary bottom. The channel to the ocean was 20 feet wide, and considerable sand was lost to the bay. Ed Morrison and crew spent the day flushing out the flume from overhead portals to make sure it was passable for water. The sandbar was left open through the night.

8 July 1998. The estuary was draining at low tide at 0630 hr. Alley and one Public Works staff member raked approximately 95% of the kelp out of the estuary before the sandbar was closed at 0840 hr. This was just as the tide turned, and a small amount of seawater may have entered the lagoon before sandbar closure. A deep thalweg existed along the restaurant margin. Plastic visquine had been laid down around the flume entrance and covered with sand by the bulldozer before sandbar closure. This preparation was intended to prevent water from leaking out of the lagoon along the flume.

9 July 1998. Alley monitored the lagoon in afternoon to note that water was traveling freely out of the flume at a flow of approximately 15 cfs. Screens were covering the inlet. The gage height was 1.56 feet on the bulkhead. The sandbar had remained intact despite a high tide of 6.0 the previous night.

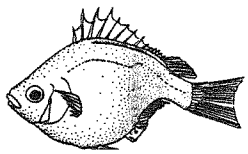
Effects of Sandbar Construction on Tidewater Gobies in 1998

Tidewater gobies apparently did not use the lower estuary in late June, 1998. If tidewater gobies were present in the estuary, it was likely that they used habitat upstream of the construction area, where there was less tidal fluctuation and salinity. No mortality of tidewater goby was observed during construction activities. However, artificial water level fluctuations were created during the sandbar construction activities. The estuary receded after the lateral channel was blocked and the new channel was constructed. This caused stranding of fish species other than tidewater goby in puddles along the bulkhead. However, no tidewater goby had been present there. This would require tidewater gobies to retreat to deeper water as water surface receded in the upper estuary. There were likely few or no tidewater gobies left in Soquel Creek after the torrential stormflows of the previous winter. The channel lacks sheltered backwaters for fish to escape high winter water velocities.

When the sandbar was closed overnight on 6 July to prevent incursion of kelp, followed by reopening in the morning to allow more kelp-raking, tidewater goby nests may have been destroyed on 7 July when the sandbar breach resulted in drainage to especially low levels with some channel scouring. This was more extreme than typical fluctuations of an open estuary. Some non-goby species may have washed into the bay from the estuary.

In 1998, only one artificial sandbar closing and one artificial opening were required for sandbar construction. This was as quickly as can be expected for completion of the process. However, the draining after the artificial opening of a very full lagoon on 7 July was excessive because the flume had been mistakenly allowed to remain plugged overnight before re-opening. As Ed Morrison stated, more care must and will be taken in the future to insure that the flume is indeed open before the sandbar is temporarily closed during the lagoon preparation process.

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. Kelp removal and sandbar closure create better fish habitat for tidewater goby and steelhead than if the sandbar was allowed to close naturally. Natural closure would allow considerable kelp and sea grass to become trapped in the lagoon to decompose. Saltwater would also be trapped to create an unmixed, anoxic lagoon bottom, which would collect heat and raise lagoon temperature. The naturally formed sandbar would be lower in stature, allowing more tidal overwash of saltwater during especially high tides, further elevating water temperature.

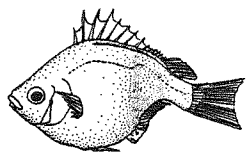
Recommendations for Lagoon Preparation and Sandbar Construction

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.

It is best to minimize time required to stockpile sand, rake out the decomposing organic material and prepare the flume inlet for fish passage. This will minimize the number of instances of artificial fluctuation of lagoon water level. Sufficient City staff should be assigned to quickly rake out decomposing kelp and clear the sand-filled flume.

3. Dispose of kelp in the Bay rather than bury it in the sandbar. Disperse it up and down the beach. Continue to include this in the Fish and Game permit for sandbar construction. County environmental health approved this method so long as kelp is spread over a wide area (**J. Ricker, 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.

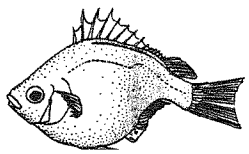
6. During sandbar construction, continue to close the lagoon each day before the incoming tide can wash salt water and kelp into the lagoon. Re-open the sandbar and unplug the flume, if necessary, each morning at low tide to drain out more kelp.

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 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.

8. Seal off storm drains on the west side of the street in front of the Esplanade. This should occur from May 15 to the time of sandbar breaching in the fall. Remind restaurant owners that sidewalk cleaning during the summer is to be done by steam cleaning rather than by water hose. Seal sidewalk grates along the Esplanade during the same period. 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. 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.

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



11. 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 1998-99 Rainy Season.

7 November 1998. Near dawn on this day, the lagoon level was 8-10 inches above the flume. The screens and boards were removed from the flume entrance by 0730 hr. The lagoon continued to rise. High tide was at 1030 hr that day, adding to the difficulty of the flume to pass the streamflow. The lagoon was breached by the City at 1000 hr when the lagoon level had reached a point, 2 inches from the piling bolt. The bulk of the storm was to come.

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

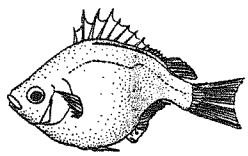
1993 monitoring report, management options to delay sandbar breaching include installation of a perimeter fence around the flume inlet to collect algae and the opening of the first flume portal behind the flume inlet. The portal must be screened and isolated from human access to prevent a hazard to public 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.

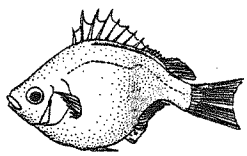
4) If the sandbar breaches early in the rainy season, followed by a period of 2-4 weeks of a reformed sandbar that prevents water exchange with the ocean, attempt to pull the decomposing kelp out of the stagnating lagoon. Open the flume and encourage streamflow out with the shroud installed.

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 and 1997 reports, 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 and closing of the flume entrance. The other side of the flume entrance may have secured wooden flashboards, as is presently the case. Flashboards may be removed to remove sand from the flume at the beginning of the summer season or at the end to maximize



flume capacity during small, fall storms. With the louvers in place, flooding may be more easily prevented before the sandbar breaches. Also, early, small stormflows would be less likely to breach the sandbar prematurely with this louver design. During the summer months, operation of the louvers would make it easy to maximize the lagoon height as the streamflow declined through the summer. As the streamflow dropped, the louvers could be progressively closed. The present effort of removing screens and replacing them with smaller screens and boards as the streamflow declines could be much reduced, thus saving many hours of labor and doing a better job of maximizing lagoon water depth.



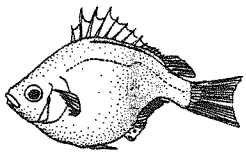
Rating Criteria

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.

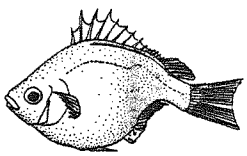
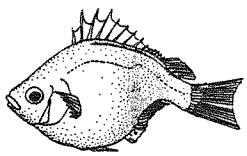


Table 1. Temperature Conversions From Degrees Celsius to Degrees Farenheit.

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.

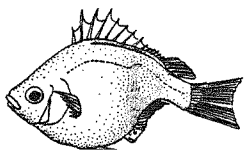
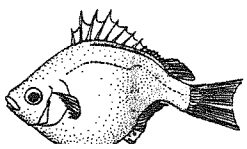


Table 3. Water Quality Ratings in Soquel Creek Lagoon, 1998, Within 0.25 Meters Off the Bottom.

Date	Flume Passage	Gage Height	Water Temperature	Oxygen	Salinity	Lagoon In-flow (cfs) visual est.
12Jul98	open	good 2.27	good	good	good	12-15
22Jul98	open	fair 1.91				
24Jul98	open	fair 1.91	good	good	good	
26Jul98	open	fair 1.93				
3Aug98	open	poor 1.83				
7Aug98	open	fair 1.88	good	good	good fair good good	
10Aug98	open	fair 2.00				
17Aug98	open	fair 1.98				
23Aug98	open	fair 1.98	good	good good fair good	good	6
8Sep98	open	fair 2.09	fair fair fair good	fair good fair fair	good	5
13Sep98	Begonia Festival	good 2.23	good			
20Sep98	open	good 2.21	good	good	good	6.9**

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

**Measured by Coastal Watershed Council on September 19, 1998.

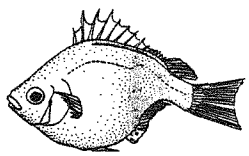


Lagoon Level. The lagoon level was monitored 12 times from 12 July to 20 September, 1998. Several readings were taken by Ed Morrison, Capitola Public Works. In 1998, lagoon level as measured on the staff gage, was rated "good" on 3 occasions, "fair" on 8 occasions, and "poor" on 1 occasion (**Table 3; Figure 2**).

The one "poor" rating came because the screens needed to be changed to restrict flow through the flume entrance. The lagoon level was only "fair" instead of "good" most of the summer, despite the very high baseflow throughout the summer of 1998. This indicated a difficulty in managing the lagoon level as initially high streamflows declined through the summer.

Vandalism likely occurred on the Saturday night before the Sunday, 23 August 1998 monitoring. Fortunately, the baseflow was high enough in 1998, and Alley observed that a flashboard had been dislodged with branches shoved underneath on that Sunday before the lagoon level could drop significantly. In 1995-97, apparently vandals had also created gaps between the flashboards in the flume inlet, causing partial draining of the lagoon. The vandalism occurred on weekends as in 1998, and was sometimes correlated with high water levels in the lagoon prior to vandalism. In 1995, the lagoon nearly drained by Saturday morning before being 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 by city staff when necessary. In the past, wooden wedges have been driven into the gaps between the boards and concrete slots to secure the boards. While the wedges discourage all but the most determined vandals, they do not allow easy temporary removal of boards when surface algae and debris near the flume needs to be drained out or when sandbar breaching is to be prevented by increasing the volume through the flume. During much of the summer, 1997, the shrouds were placed over the inlet to remove saltwater. This also prevented vandalism. However, after a small storm in early October, the shrouds had been removed, and the vandalism occurred.

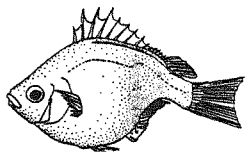


Flume Passability. According to the Management Plan (1990), fish passage is to be maintained until July 1. A flume depth of 12 inches or deeper was desired at the entrance until that time. High baseflow resulted in excellent passage for steelhead smolts in 1998. The sandbar was artificially breached relatively early in 1998 (7 November), and the creekmouth was passable to adult steelhead without the flume passing streamflow.

Water Temperature. Lagoon water temperature was "good" throughout most of the summer within 0.25 meters off the bottom, with it rising into the "fair" range on only one monitoring in early September (**Table 3**). This was an improvement over the 1997 year, when saltwater had entered the lagoon repeatedly, lagoon depth fluctuated more and there was less streamflow leading to a "poor" rating for at least one station on 6 monitorings.

Results from a temperature data logger stationed at Nob Hill from July 23 to September 4 indicated that diurnal water temperature from lagoon in-flow water fluctuated 5-6 C each day (**Figure 4**). During a 20-day period from July 25 to August 14, water temperature rose above 21 C for several hours each day, with a period maximum of approximately 23.5 C on August 3. Daily maxima still were approaching 21 C on September 4. The warmest monitored lagoon water temperature occurred on September 8. The year, 1998, had very high baseflow. We may expect even higher water temperature in years that have much lower baseflow. In 1999, two data loggers will be installed to compare lagoon in-flow water temperature with lower lagoon temperature. We may assume that lagoon temperatures were at least 1-2 C higher than the in-flow stream temperature. Noting that the upper temperature tolerance for coho salmon is approximately 20 C (**J. Smith, personal communication**) and they typically prefer water temperatures below 16 C, considerably more stream shading will be required to make lower Soquel Creek habitable for this species.

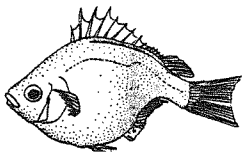
Dissolved Oxygen. Critical oxygen levels are lowest in the early morning after oxygen has been depleted by cell respiration and before plant photosynthesis can produce much oxygen. This was the time that oxygen levels were measured and rated.



Water quality for aquatic life in the lagoon was generally rated "good" with regard to oxygen, salinity and conductivity throughout the water column (**Table** 3), except on the lagoon bottom. Oxygen level was lowest along the lagoon bottom, where at the Stockton Avenue Bridge station the rating was "critical" at one monitoring and "poor" at another (**Appendix B**). The trestle station had two monitorings at the bottom that were rated "poor." This was an improvement over 1997 with its continual saltwater influxes. In 1997 at the bottom 1) near the flume the oxygen was in the "poor" or "critical" range in 8 of 9 monitorings (**Alley 1998**); 2) at Stockton Avenue Bridge the oxygen was in the "poor" or "critical" range in 9 of 9 monitorings; 3) at the railroad trestle the oxygen was in the "poor" or "critical" range in 5 of 9 monitorings and 4) at Noble Gulch the oxygen was in the "poor" or "critical" range in 8 of 8 monitorings. In 1998, within 0.25 meters of the bottom, where steelhead typically hold positions, oxygen levels were in the "fair" to "good" range all summer and fall (**Table** 3; **Figure** 5) and did not reach the poor level. As with water temperature, oxygen levels were worst on September 8.

Salinity. Salinity was not an issue in summer, 1998, except during the week of August 3. There were high tides of 6.0 feet and higher toward the end of the week, but saltwater apparently entered the lagoon earlier in the week. The sandbar was built higher with equipment earlier in the week. Saltwater was detected in low spots near the Stockton Avenue Bridge on August 7, and water temperature at the bottom increased in very localized areas (**Appendix B**). It was unlikely that this one episode of saltwater influx negatively affected steelhead because it was not re-occurring through the season, as had occurred in 1997. The algae and pondweed growth increased rapidly in Reaches 2 and 3 during the two weeks following this influx (**Appendix B**). However, the causal factors may have been unrelated.

Conductivity. Conductivity was low in the 1998 lagoon. It remained less than 650 umhos, except in low spots measured on 7 August (**Appendix B**). But even then, levels were far below the 10-12,000 umhos level that may cause steelhead stress.



Stream In-Flow to the Lagoon. On 17 June and 29 June 1998, streamflow was measured at Nob Hill to be 31.2 and 22.6 cubic feet per second (cfs), respectively. On 12 July 1998, we visually estimated 12-15 cfs entering the lagoon at Nob Hill (**Table 3**) compared to the 2.5-5 cfs estimated in June, 1997. On 19 September 1998, the Coastal Watershed Council measured streamflow with a flowmeter at Nob Hill to be 6.91 cfs (**Table 3; Appendix B**). Water quality worsens at the end of the dry season when stream inflow is at a minimum. The lowest visually estimated summer baseflows in 1995, 1996 and 1997 had been 2.5 cfs, 2.25 cfs and 1 cfs, respectively. In 1994, in-flow declined below 1 cfs by late July and to an estimated 0.05 cfs by late September.

The lagoon water quality is better when more summer baseflow occurs. With more summer baseflow, when tidal overwash occurs or saltwater backflushes into the lagoon, the saltwater is flushed out of the lagoon more quickly to reduce lagoon heating (**Figure 3; 1994 and 1997 were the driest years**). With proper flume management, it should be easier to maintain lagoon depth and prevent fluctuations with more baseflow. However, this potential has not been fully realized (**Figure 2; 1994 and 1997 were the driest years**). To maximize summer baseflow, water percolation into the aquifer must be maximized and surface runoff must be minimized during the rainy season. Summer water diversion and pumping from the underflow of the creek reduce summer baseflow and should be curtailed quickly if surface flow becomes discontinuous in lower Soquel Creek.

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

Discussion of Options to Improve Water Quality

All storm drains leading to the lagoon should ideally 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; 1997; 1998**). In 1998, gray water plumes were observed on 3 of the 7 monitorings (**Appendix B**). 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. 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 to 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 re-directed into the sewer system during the summer.

The gulls are a primary source of pollution, both for bio-stimulating nutrients and bacteria. They forage through the human refuge left on the beach. They bathe in the lagoon. They roost on the buildings surrounding the lagoon. Reducing the gull population at Soquel Creek Lagoon would be a major step in reducing pollution. It is likely that the gull population is artificially high because of the artificial food source and artificial roosting areas. If these were be reduced, then the gull population would probably decline and pollution would be reduced at Soquel Lagoon. Better refuge disposal is needed. The refuge cans currently on the beach have no lids. The gulls have excellent access and commonly drag refuge out of the cans. Refuse cans with lids that were gull-proof and that were usable by the public may reduce gull numbers. Regarding roosting, there are methods available to make buildings' roofs inhospitable to gulls.

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

Regarding pollution from urban runoff, maintenance of existing silt and grease traps on storm drains is critical to reducing pollution by petro-chemicals. All new drainage systems from new development and parking lots should be installed with effective traps and percolation basins to encourage winter percolation of storm runoff.

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

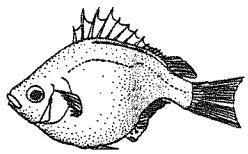
1. Replace the open, lid-less refuse cans on the beach with those with gull-proof lids and convenience in use. Use enough refuse cans to satisfy the demand for refuse disposal.

2. Look into screening the railroad trestle in order to discourage roosting and nesting by rock doves.

3. Re-install the 12-inch high wooden baffle inside the flume prior to directing water through the flume.

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

5. Maximize lagoon depth throughout the dry season, while maintaining passage through the flume for adult steelhead until June 1 and steelhead smolts until July 1. If the lagoon level begins to drop below the notch for steelhead smolts on one side of the flume because of the hole for adult steelhead on the other side after June 1, close the 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.



6. 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.

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

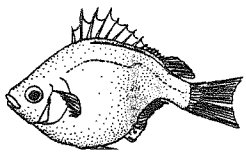
8. If the lagoon bottom becomes invisible due to turbidity for more than one day after the rains that do not breach the sandbar, immediately lower the lagoon level to the point where the bottom is visible. This will allow algal growth despite the high turbidity. Plant photosynthesis will produce oxygen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

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

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

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

12. 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 filled with flashboards as before, if secured against vandals. In this way, vandalism would be prevented, and flooding may be more easily prevented before the sandbar breaches. Also, with this louver system the early, small stormflows of fall would be less likely require premature sandbar breaching to prevent flooding. With the louver design,



the lagoon level may be easily maintained in summer, thus preventing the lagoon level from fluctuating into the "poor" range as occurs with the old flashboard system when boards are not been added quickly as streamflow declines in summer.

13. We recommend that "Gull Sweeps" sold by West Marine Products ($32.00 each and 6 feet across) be installed on Esplanade roofs to test their effectiveness in deterring gulls. According to the catalogue, "Powered by the slightest breeze, the Gull Sweep's motion will deter the most determined bird."

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

15. 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.

16. 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

Steelhead Plantings in Soquel Creek with Discussion

In 1998, no steelhead were planted in Soquel Creek because the hatchery facility at Scott Creek was damaged by winter storms.

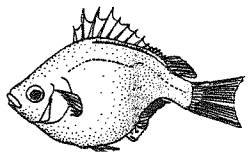
It should be noted that thousands of fingerling steelhead were planted in the upper Soquel Creek watershed in 1997. The planting of fingerling steelhead into the upper watershed results in competition for food and cover between hatchery fish from a genetically different stock and the native, stream-spawned 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 the planting of 1,500-2,500 fingerlings in short stretches of both Branches decreased 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 (**Alley 1998**) and Soquel Creek (**Alley 1998**), 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 with 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

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.

On 11 October 1998, 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 11 October 1998.

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. In fall, 1997, one tidewater goby was captured. The low number captured in 1992-98 probably indicated a lack of backwater areas to be used as refuges during high winter stormflows.

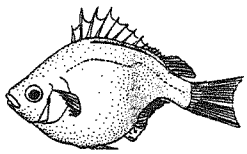
Fall sampling for steelhead was undertaken on 4 and 11 October, 1998, in the same vicinity as the tidewater goby sampling. The bag-seine with dimensions 106-foot long by 6-feet high by 5/16-inch mesh was used. The seine was set perpendicular to shore, parallel to the Stockton Avenue Bridge and just upstream of the Bridge. Juvenile steelhead congregate in the shade under the Bridge. It was pulled into the beach in front of Venetian Court. With this larger, coarser-meshed seine, no tidewater gobies were captured. On 4 October, a total of 164 juvenile steelhead ranging from 90 to 230 mm Standard Length (SL) were measured and marked from three good seine hauls and one snagged haul. There were two steelhead mortalities that day. On 11 October, 184 juvenile steelhead ranging from 95 to 310 mm SL were captured from 4 seine hauls, with 45 being clipped recaptures from the previous week. The 139 unclipped juveniles were measured. No hatchery steelhead were detected in 1998. There was one steelhead mortality on 11 October. Our steelhead population estimate for fall 1998 was 671 juveniles +/- 74. Other species captured by number with the 106-foot seine were 95 juvenile Sacramento

suckers, one prickly sculpin and low numbers of 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 1992-98.

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.
1998-	671 +/- 74 (95% confidence interval). 164 fish were marked from 3 effective and one snagged seine haul.

There may have been few juvenile steelhead moving into the lagoon from the lower Creek in 1995-98 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 and 1998, indicated very low densities of juvenile steelhead in the lower 2 miles of stream habitat leading into the lagoon.

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 potentially easier to maintain good water quality and water depth with higher streamflow into the the lagoon in summer (known as summer baseflow), Public Works had room for improvement after the 1998 summer. 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 minimized.

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

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

4. Look into better ways of sealing the cracks between the

flashboards in the flume inlet. Tacking visquine to 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.

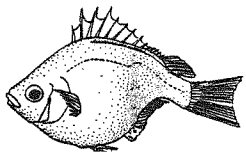
7. Remove flume boards as the first small storms begin in fall and replace the boards after the stormflow has subsided. The effort should be to minimize lagoon fluctuation until the sandbar actually breaches. Many forecasts for rain and storm intensities are incorrect in the early fall. It is harmful 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 to lagoon-inhabiting steelhead. If necessary, install a perimeter fence with 2"x 4" mesh with 6-foot panels around the flume entrance by October to prevent plugging of the flume's screen with aquatic vegetation during the first minor storms. The goal should be to maintain the lagoon until approximately Thanksgiving in late November, before allowing stormflow to breach the sandbar.

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 boards, as is presently the case. In this way, the lagoon level may be easily maintained and vandalism may be prevented. Furthermore, sustaining 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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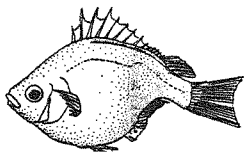

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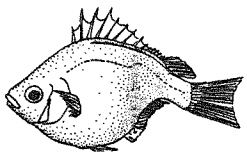


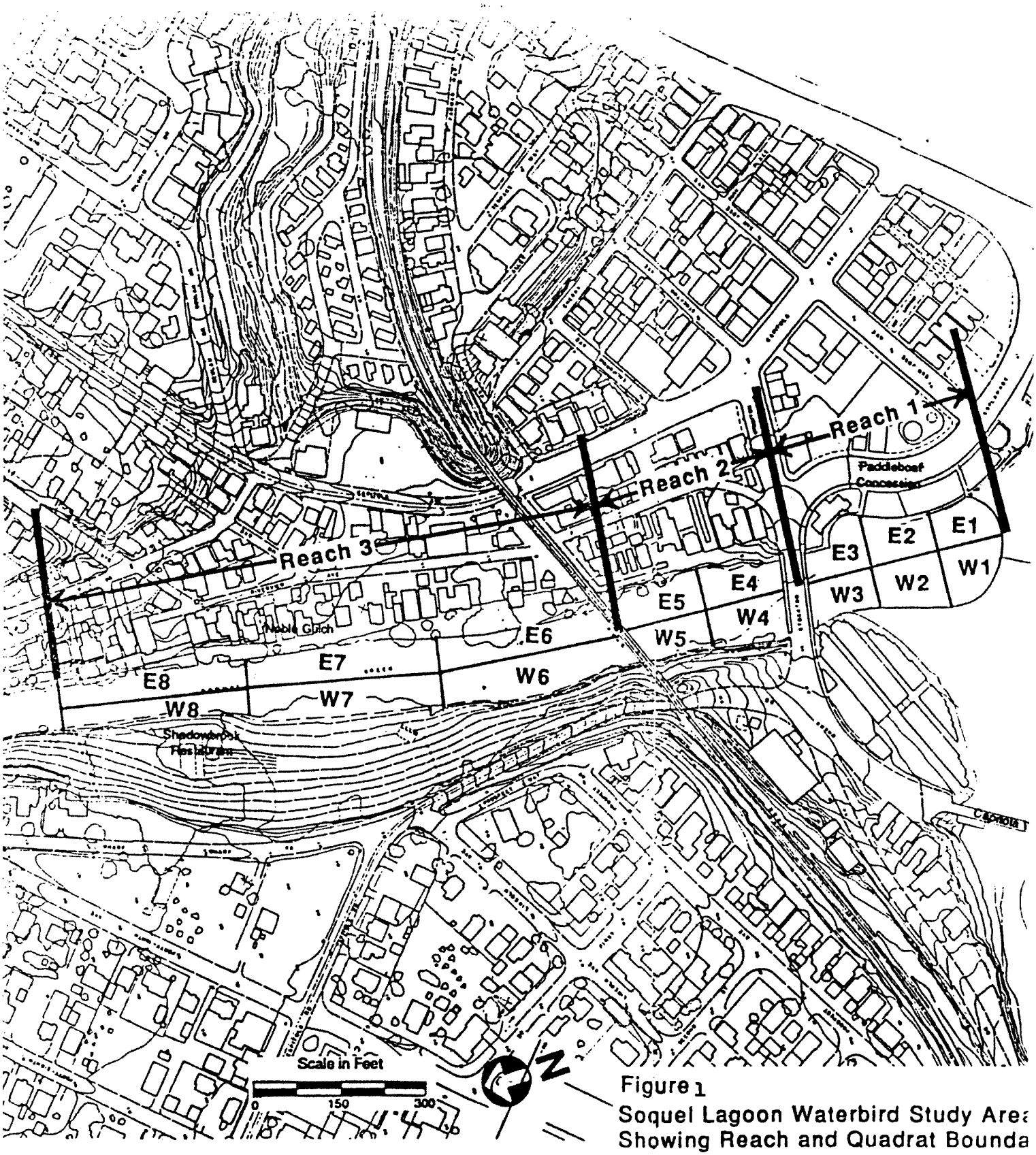


Figure 1
Soquel Lagoon Waterbird Study Area
Showing Reach and Quadrat Bounda

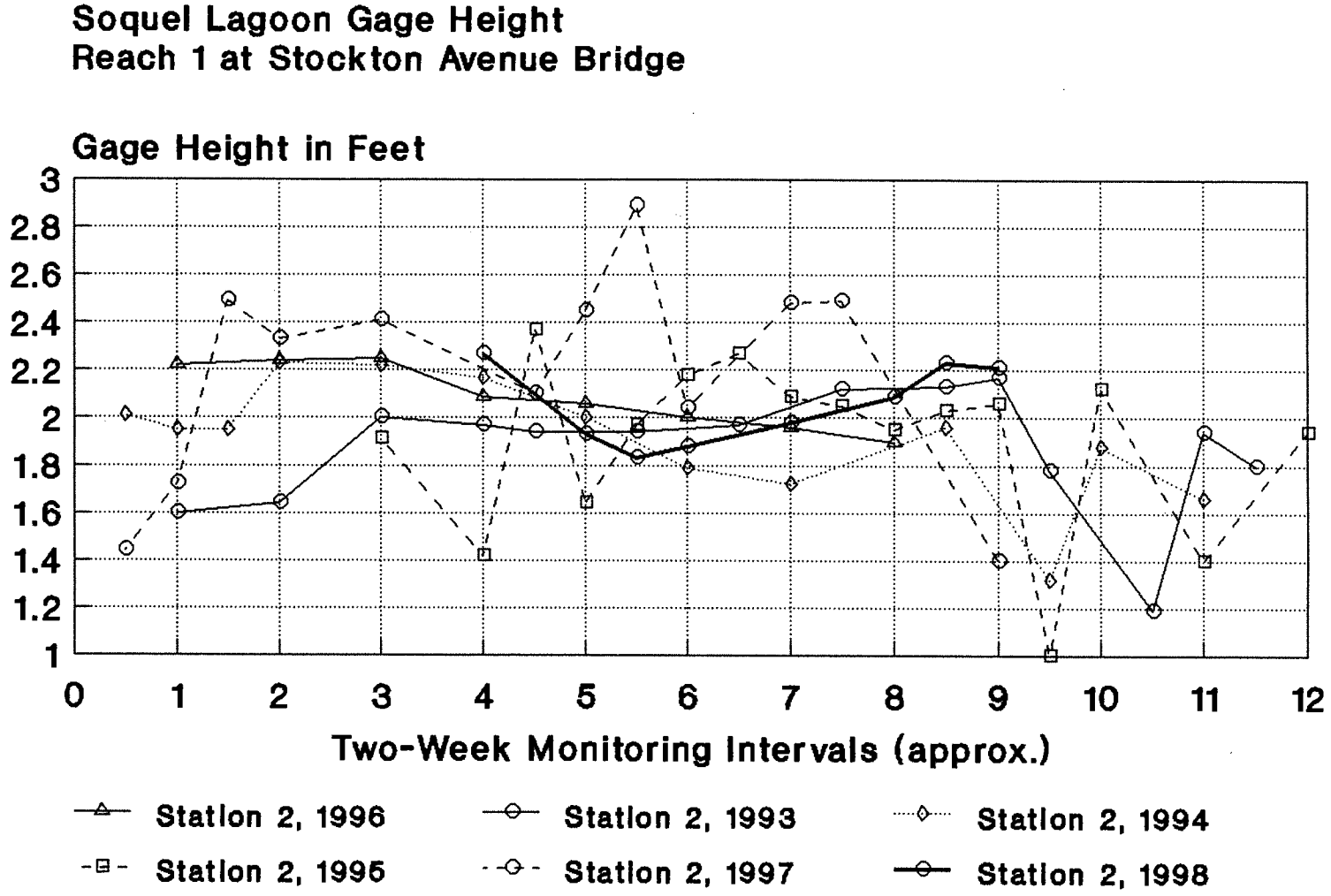


Figure 2. Soquel Lagoon Gage Height Near Stockton Avenue Bridge Mid-May to Mid-November, 1993-98.

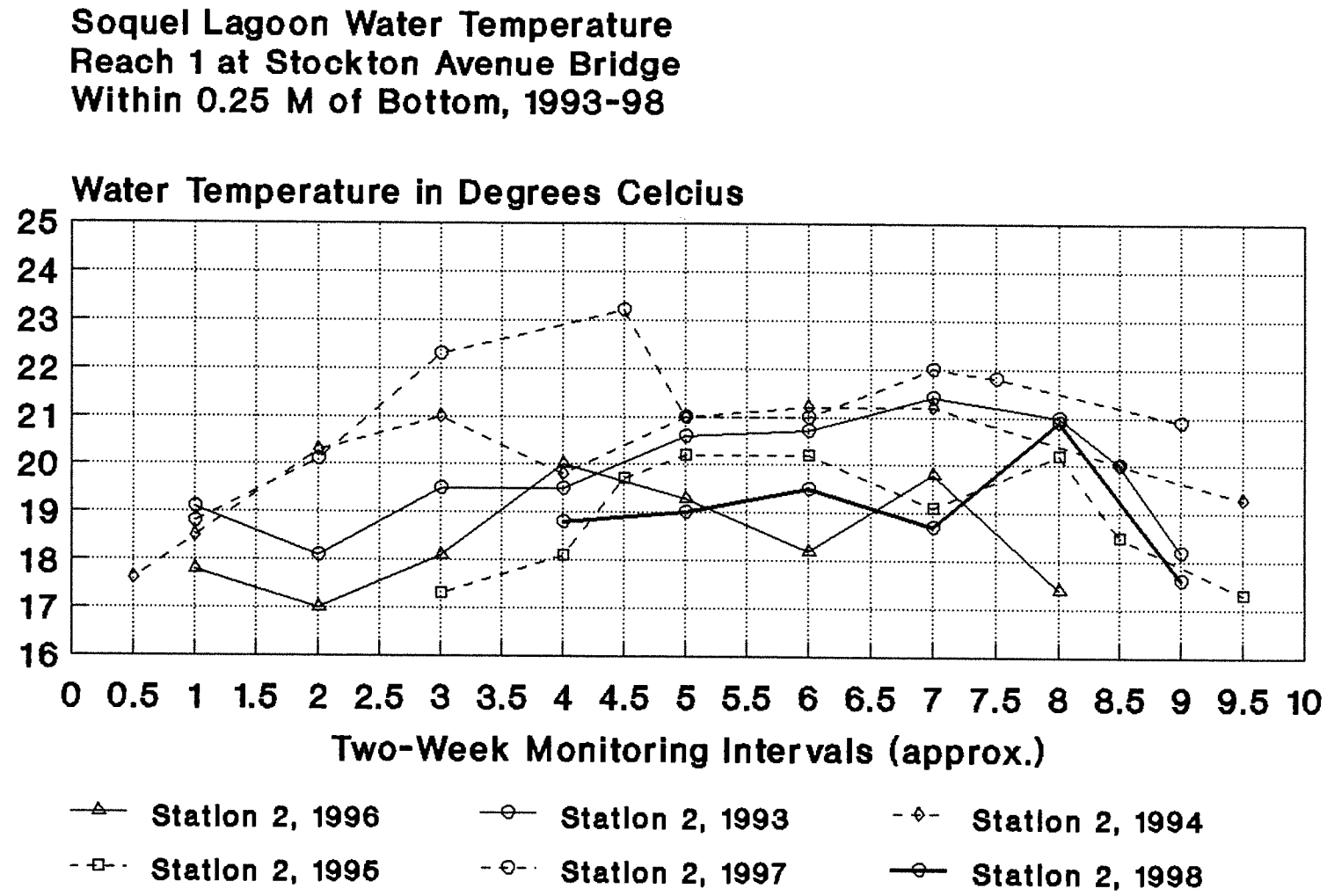
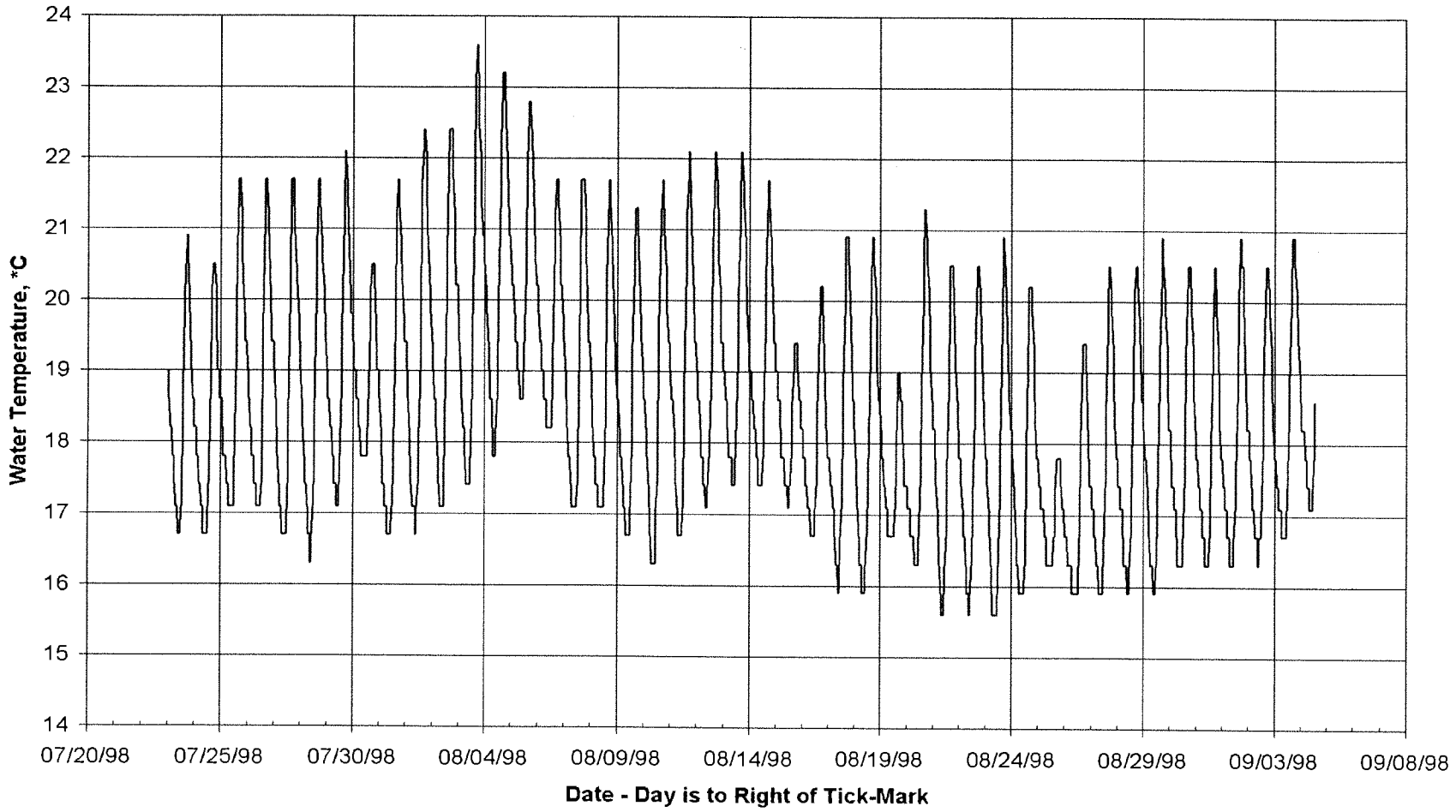


Figure 3. Soquel Lagoon Water Temp. Near Bottom at Dawn; Stockton Avenue Bridge, Mid-May to Mid-October 1993-98.

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



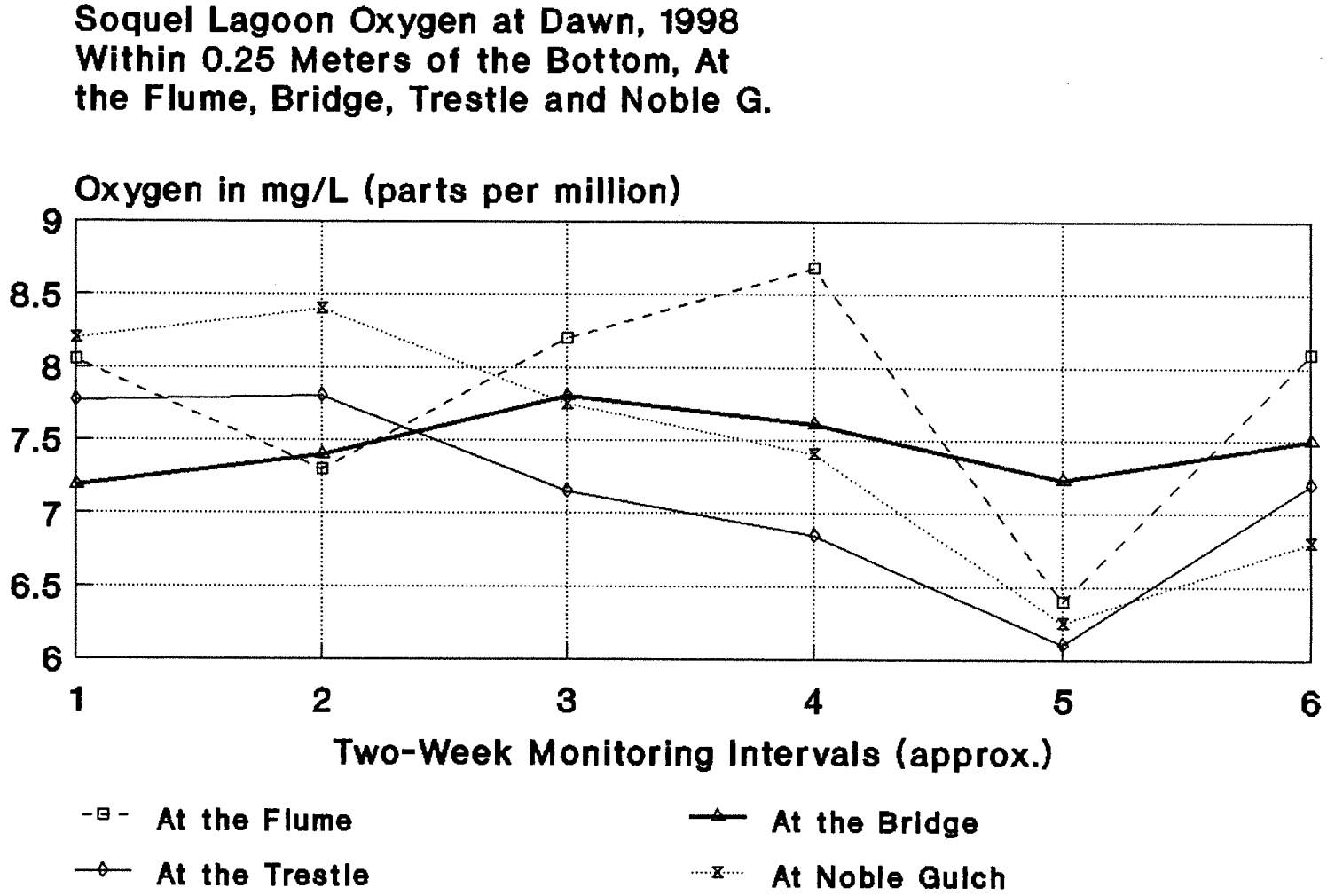
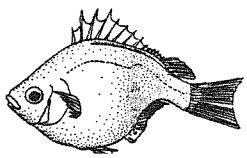


Figure 5. Oxygen Level at Four Stations,
Soquel Lagoon Near the Bottom at Dawn;
12 July - 20 September, 1998.

APPENDIX A.

FISH AND GAME AGREEMENT REGARDING PROPOSED STREAM OR LAKE ALTERATION, 1998.

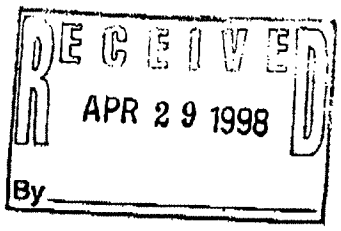


PETE WILSON, Governor

STATE OF CALIFORNIA - THE RESOURCES AGENCY

DEPARTMENT OF FISH AND GAME

POST OFFICE BOX 47
YOUNTVILLE, CALIFORNIA 94599
(707) 944-5500



* ED MORRISON
CITY OF CAPITOLA
420 CAPITOLA AVE
CAPITOLA CA 95010

Notification No.: 0347-98

Date Received: 4-27-98

THP Number:

Work Order No.:

We have received your Notification of proposed operations on SOQUEL CREEK, SANTA CRUZ COUNTY.

Your proposed operation has been assigned to a Department representative who will contact you within 30 days from the above date.

Under provisions of the Fish and Game Code, you may not begin work on your proposed project until the Department has conducted an inspection and its recommendations (or if an agreement cannot be reached, the decision of an arbitration panel) have been incorporated into your project.

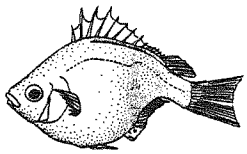
These provisions of the Fish and Game Code are intended to protect and conserve California's fish and wildlife resources.

If you have any questions regarding this Notification, please feel free to give me a call at (707) 944-5520.

Sincerely,

Sandy

Sandy Brunson
Office Technician
Region 3



Notification no. 0347-98—

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, 420 CAPITOLA AVE. State of California 95010, hereinafter called the operator, is as follows:

WHEREAS, pursuant to Division 2, Chapter 6 of California Fish and Game Code, the operator, on the -27TH day of APRIL ,1998, 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.

WHEREAS, the Department (represented by N. BOWSER-- has made an inspection of subject area and) has determined that such operations may substantially adversely affect existing fish and wildlife resources including: STEELHEAD, NON GAME FISH, RIPARIAN HABITAT AND ITS RELATED SPECIES.

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 NEAR OR IN THE STREAM SHALL BE CONFINED TO THE PERIOD OF 5-15-98 - 10-15-98.
B. THIS AGREEMENT IS LIMITED TO THE DAMMING OF SOQUEL CREEK AT THE MOUTH AS PER SUBMITTED APPLICATION.
C. A NEW STRAIGHT 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 IF ANY HOLES ALONG THE EDGE OF THE LAGOON, THESE AREAS SHALL BE SEINED AND NETTED 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 7-1-98. AFTER FINAL DAMMING, NO DRAW DOWN WILL BE ALLOWED WITHOUT PRIOR DEPARTMENT APPROVAL. THE OPERATOR SHALL CONTACT THE 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 does not authorize 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.

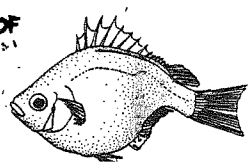
This agreement becomes effective when signed by both parties. GOOD FOR ONE YEAR.

Operator _____
Title Asst. Director of Public Works
Organization City of Capitola
Date 5-29-98

Department Representative N. BOWSER
Title Fish and Game Warden
Department of Fish and Game, State of CA
Date _____

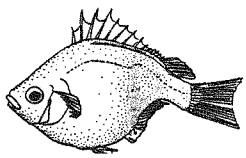
RECOMMENDATIONS

1. DISTURBANCE OR REMOVAL OF VEGETATION SHALL NOT EXCEED THE MINIMUM NECESSARY TO COMPLETE OPERATIONS. THE DISTURBED PORTIONS OF ANY STREAM CHANNEL OR LAKE MARGIN WITHIN THE HIGH WATER MARK OF THE STREAM OR LAKE SHALL BE RESTORED TO AS NEAR THEIR ORIGINAL CONDITION AS POSSIBLE.
2. RESTORATION SHALL INCLUDE THE REVEGETATION OF STRIPPED OR EXPOSED AREAS.
3. ROCK RIP-RAP, OR OTHER EROSION PROTECTION SHALL BE PLACED IN AREAS WHERE VEGETATION CANNOT REASONABLY BE EXPECTED TO BECOME ESTABLISHED.
4. INSTALLATION OF BRIDGES, CULVERTS, OR OTHER STRUCTURES SHALL BE SUCH THAT WATER FLOW IS NOT IMPAIRED AND UPSTREAM OR DOWNSTREAM PASSAGE OF FISH IS ASSURED AT ALL TIMES. BOTTOMS OF TEMPORARY CULVERTS SHALL BE PLACED AT OR BELOW STREAM CHANNEL GRADE. BOTTOMS OF PERMANENT CULVERTS SHALL BE PLACED BELOW STREAM CHANNEL GRADE.
5. PLANS FOR DESIGN OF CONCRETE SILLS AND OTHER FEATURES THAT COULD POTENTIALLY IMPEDE FISH MIGRATIONS MUST BE APPROVED BY DEPARTMENT ENGINEERS.
6. WHEN ANY DAM (ANY ARTIFICIAL OBSTRUCTION) IS BEING CONSTRUCTED, MAINTAINED, OR PLACED IN OPERATION, SUFFICIENT WATER SHALL AT ALL TIMES BE ALLOWED TO PASS DOWN STREAM TO MAINTAIN FISH LIFE BELOW THE DAM.
7. AN ADEQUATE FISH PASSAGE FACILITY MUST BE INCORPORATED INTO ANY BARRIER THAT OBSTRUCTS FISH PASSAGE. NO TREES WILL BE REMOVED FROM THIS PROJECT. ALL BARE SOILS SHALL BE RESEEDED AND
8. ANY TEMPORARY DAM (ANY ARTIFICIAL OBSTRUCTION) CONSTRUCTED SHALL BE BUILT FROM MATERIAL SUCH AS CLEAN GRAVEL WHICH WILL CAUSE UTTLE OR NO SILTATION.
9. NO EQUIPMENT WILL BE OPERATED IN LIVE STREAM CHANNELS.
10. EQUIPMENT SHALL NOT BE OPERATED IN THE STREAM CHANNELS OF FLOWING LIVE STREAMS EXCEPT AS MAY BE NECESSARY TO CONSTRUCT CROSSINGS OR BARRIERS AND FILLS AT CHANNEL CHANGES.
11. WHEN WORK IN A FLOWING STREAM IS UNAVOIDABLE, THE ENTIRE STREAMFLOW SHALL BE DIVERTED AROUND THE WORK AREA BY A BARRIER, TEMPORARY CULVERT, AND/ OR A NEW CHANNEL CAPABLE OF PERMITTING UPSTREAM AND DOWNSTREAM FISH MOVEMENT. CONSTRUCTION OF THE BARRIER AND/ OR THE NEW CHANNEL SHALL NORMALLY BEGIN IN THE DOWNSTREAM AREA AND CONTINUE IN AN UPSTREAM DIRECTION, AND THE FLOW SHALL BE DIVERTED ONLY WHEN CONSTRUCTION OF THE DIVERSION IS COMPLETED. CHANNEL BANK OR BARRIER CONSTRUCTION SHALL BE ADEQUATE TO PREVENT SEEPAGE INTO OR FROM THE WORK AREA. CHANNEL BANKS OR BARRIERS SHALL NOT BE MADE OF EARTH OF OTHER SUBSTANCES SUBJECT TO EROSION UNLESS FIRST ENCLOSED BY SHEET PILING, ROCK RIP-RAP, OR OTHER PROTECTIVE MATERIAL. THE ENCLOSURE AND SUPPORTIVE MATERIAL SHALL BE REMOVED WHEN THE WORK IS COMPLETED AND THE REMOVAL SHALL NORMALLY PROCEED FROM DOWNSTREAM IN AN UPSTREAM DIRECTION.
12. EQUIPMENT SHALL NOT BE OPERATED IN THE LAKE OR ITS MARGIN EXCEPT DURING EXCAVATION AND AS MAY BE NECESSARY TO CONSTRUCT BARRIERS OF FILLS. IF WORK IN THE LAKE IS UNAVOIDABLE, A CURTAIN ENCLOSURE TO PREVENT SILTATION OF THE LAKE BEYOND THE IMMEDIATE WORK AREA SHALL BE INSTALLED. THE ENCLOSURE AND ANY SUPPORTIVE MATERIAL SHALL BE REMOVED WHEN THE WORK IS COMPLETED.
13. SILT SETTLING BASINS SHALL BE LOCATED AWAY FROM THE STREAM OF LAKE TO PREVENT DISCOLORED, SILT-BEARING WATER FROM REACHING THE STREAM OR LAKE.
14. PREPARATION SHALL BE MADE SO THAT RUNOFF FROM STEEP, ERODIBLE SURFACES WILL BE DIVERTED INTO STABLE AREAS WITH LITTLE EROSION POTENTIAL. FREQUENT WATER CHECKS SHALL BE PLACED ON DIRT ROADS, CAT TRACKS, OR OTHER WORK TRAILS TO CONTROL EROSION.
15. WASH WATER CONTAINING MUD OR SILT FROM AGGREGATE WASHING OR OTHER OPERATIONS SHALL NOT BE ALLOWED TO ENTER A LAKE OR FLOWING STREAMS.
16. a) A SILT CATCHMENT BASIN SHALL BE CONSTRUCTED ACROSS THE STREAM IMMEDIATELY BELOW THE PROJECT SITE. THIS CATCHMENT BASIN SHALL BE CONSTRUCTED OF GRAVEL WHICH IS FREE FROM MUD AND SILT.
    b) UPON COMPLETION OF THE PROJECT AND AFTER ALL FLOWING WATER IN THE AREA IS CLEAR OF TURBIDITY, THE GRAVEL ALONG WITH THE TRAPPED SEDIMENT SHALL BE REMOVED FROM THE STREAM.
18. IF OPERATIONS REQUIRE MOVING EQUIPMENT ACROSS A FLOWING STREAM, SUCH OPERATIONS SHALL BE CONDUCTED WITHOUT SUBSTANTIALLY INCREASING STREAM TURBIDITY. FOR REPEATED CROSSINGS, THE OPERATOR SHALL INSTALL A BRIDGE, CULVERT, OR ROCK-FILL CROSSING AS SPECIFIED IN COMMENTS BELOW.
19. IF A STREAM CHANNEL HAS BEEN ALTERED DURING THE OPERATIONS, ITS LOW FLOW CHANNEL SHALL BE RETURNED AS NEARLY AS POSSIBLE TO ITS NATURAL STATE WITHOUT CREATING A POSSIBLE FUTURE BANK EROSION PROBLEM, OR A FLAT WIDE CHANNEL OF SLUICE-LIKE AREA. IF A LAKE MARGIN HAS BEEN ALTERED, IT SHALL BE RETURNED AS NEARLY AS POSSIBLE TO ITS NATURAL STATE WITHOUT CREATING A FUTURE BANK EROSION PROBLEM. THE GRADIENT OF THE STREAMBED OR LAKE MARGIN SHALL BE AS NEARLY AS POSSIBLE THE SAME GRADIENT AS EXISTED PRIOR TO DISTURBANCE.
20. STRUCTURES AND ASSOCIATED MATERIALS NOT DESIGNED TO WITHSTAND HIGH SEASONAL FLOWS SHALL BE REMOVED TO AREAS ABOVE THE HIGH WATER MARK BEFORE SUCH FLOWS OCCUR.
21. NO DEBRIS, SOIL, SILT, SAND, BARK, SLASH, SAWDUST, RUBBISH, CEMENT OR CONCRETE OR WASHINGS THEREOF, OIL OR PETROLEUM PRODUCTS OF OTHER ORGANIC OF EARTHEN MATERIAL FROM ANY LOGGING, CONSTRUCTION, OR ASSOCIATED ACTIVITY OF WHATEVER NATURE SHALL BE ALLOWED TO ENTER INTO OR PLACED WHERE IT MAY BE WASHED BY RAINFALL OR RUNOFF INTO, WATERS OF THE STATE. WHEN OPERATIONS ARE COMPLETED, ANY EXCESS MATERIALS OR DEBRIS SHALL BE REMOVED FROM THE WORK AREA. NO RUBBISH SHALL BE DEPOSITED WITHIN 150 FEET OF THE HIGH WATER MARK OF ANY STREAM OR LAKE.
22. THE OPERATOR WILL NOTIFY THE DEPARTMENT OF FISH AND GAME OF THE DATE OF COMMENCEMENT OF OPERATIONS AND THE DATE OF COMPLETION OF OPERATIONS AT LEAST FIVE DAYS PRIOR TO SUCH COMPLETION'S.



APPENDIX B.

WATER QUALITY DATA 12 JULY - 20 SEPTEMBER, 1998.



17 June 1998. Streamflow measured at Nob Hill to be 31.2 cubic feet per second (cfs) with Marsh McBirney Model 2000 flowmeter.

29 June 1998. Streamflow measured at Nob Hill to be 22.6 cfs.

12 July, 1998. This was three days after sandbar construction was completed. Depth at flume exit averaged 1.5 feet. Estimated streamflow was very high, 9-12 cfs, at Nob Hill. At Nob Hill the water temperature was 16.5 C at 0930 hr with conductivity of 500 umhos. Storm drain cap in place. No sheet-metal observed under sidewalk grates.

Station: Flume at 0648 hr, overcast. Gage Height= 2.27. Air temp. 14.0 C. Fog came in at 0845 hr. No surface algae with thin film on bottom.

Depth(m)	Temp.(C)	Salin.(ppt)	Oxygen(ppm)	Cond. (umhos)
surf	19.0	0.0	8.35	530
0.25	19.2	0.0	8.05	550
0.50	19.2	0.0	7.90	550
0.75	19.0	0.0	8.05	550
0.85(bot)	19.0	0.0	7.82	550

Station: Stockton Ave Bridge, center, upstream side in thalweg, 0717 hr. Secchi depth to bottom. No surface algae. Bottom 70% covered with 3 inches thick.

surf	18.0	0.0	7.20	530
0.25	18.8	0.0	7.13	540
0.50	18.8	0.0	7.19	520
0.65(bot)	18.8	0.0	1.80	480

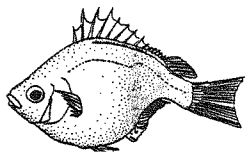
Station: Railroad trestle, 0730 hr. No surface algae. Bottom with 20% algae coverage, 3 inches thick.

surf.	18.0	0.0	7.70	510
0.25	18.0	0.0	7.71	510
0.50	18.0	0.0	7.10	510
0.75	18.0	0.0	7.10	510
1.00	18.0	0.0	7.77	510
1.16(bot)	18.0	0.0	4.80	510

Station: Mouth of Noble Gulch, 0745 hr. No surface algae, thin film on bottom. Saw a kingfisher. Gray plume extending out from Noble Gulch 15 feet by 60 feet size.

surf	17.0	0.00	8.30	505
0.25	17.0	0.00	8.20	505
0.50	17.0	0.00	8.30	510
0.75	17.0	0.00	8.35	510
1.00	17.0	0.00	8.40	510
1.08	17.0	0.00	5.40	510

Conclusion: Water temperature was relatively low. The gray



plume at Noble Gulch was somewhat alarming. No increase in conductivity was noted. Detected no salinity at bridge piers and thalweg. Assumed freshwater lagoon.

21 July 1998. Gage reading = 1.94 at 0930 hr. Morrison said he would replace the 1/2 screens with 1/4 screens.

22 July 1998. Gage reading = 1.91 at 1640 hr.

24 July 1998. Flume entrance and exit were 1.5 feet deep. Water temperature at the lagoon inflow near Nob Hill parking lot was 17.0 C at 0948 hr. Water temperature at Nob Hill 17.0 C t 0948 hr. Flume was leaking, creating 8 sand craters in the beach, mostly on wharf side. Sheetmetal was not under two sidewalk grates on Esplanade. Cap in storm drain was in place.

Station: Flume at 0640 hr, overcast. Gage Height= 1.91. Air temp. 18.9 C. No surface algae. 15% of bottom 3 inches thick.

Depth(m)	Temp.(C)	Salin.(ppt)	Oxygen(ppm)	Cond. (umhos)
surf	19.0	0.0	8.0	570
0.25	19.0	0.0	7.4	570
0.50	19.0	0.0	7.2	570
0.75	19.0	0.0	7.3	570
0.80(bot)	19.0	0.0	7.3	570

Station: Stockton Avenue Bridge at 0720 hr, Clear.

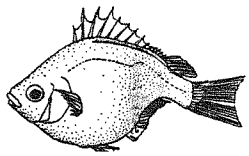
surf.	19.0	0.0	7.6	570
0.25	19.0	0.0	7.4	570
0.50	19.0	0.0	7.4	570
0.55(bot)	19.0	0.0	4.1	520

Station: Railroad trestle, 0740 hr. No surface algae. Bottom with 15% algae coverage, 3 inches thick.

surf.	18.1	0.0	7.8	540
0.25	18.0	0.0	7.7	540
0.50	18.0	0.0	7.8	540
0.75	18.0	0.0	7.8	540
1.00	18.0	0.0	7.8	540
1.05(bot)	18.0	0.0	4.8	540

Station: Mouth of Noble Gulch, 0800 hr. Small patches of surface algae. Gray plume visible.

surf	18.0	0.00	8.15	520
0.25	17.9	0.00	8.20	520
0.50	17.8	0.00	8.4	530
0.75	17.8	0.00	8.4	530
1.00(bot)	17.8	0.00	7.4	540



Conclusions: The gage height had dropped substantially from previous monitoring. Water temperature was increased a degree from the previous monitoring. Water temperature increased 2 C from Nob Hill to the flume.

26 July 1998. Gage reading = 1.97.

3 August 1998. Gage reading = 1.83. Morrison stated that he needed to change the screens and would put in solid boards on one side of the flume this day.

7 August 1998. It was Friday. West side of flume with all boards. East side with half screen. Flume exit 1.5 feet deep. Water temperature at Nob Hill 17.1 C with conductivity of 580 umhos at 1030 hr. A passer-by couple stated that alot of foam covered the lagoon on Monday. Another couple saw foam on Wednesday. Bartender observed tractor building up sandbar after tidal overwash. Pocket of saltwater found at northwest bridge pier at 2.99 ppt (4,800 umhos conductivity), with water temperature of 21 C at the bottom. In thalweg under the bridge at 1.5 meter depth the salinity was 4 ppt (6,200 umhos) with water temperature of 22 C. Southwest and southeast piers also had a saline pockets at the bottom with water temperature between 19.5 and 21.5 C.

Station: Flume at 0630 hr, overcast with light fog. Gage Height = 1.88. Air temp. 15.1 C. 30% of surface with algae clumps. 35% of bottom algae 1 foot thick. Remainder less than 4 inches thick.

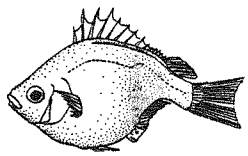
Depth(m)	Temp.(C)	Salin.(ppt)	Oxygen(ppm)	Cond. (umhos)
surf	18.8	0.0	8.2	600
0.25	19.9	0.0	8.2	600
0.50	19.9	0.0	8.2	600
0.75	19.9	0.0	8.2	600
0.80(bot)	19.9	0.0	8.0	600

Station: Stockton Avenue Bridge at 0655 hr. Reach 2- 30% of surface covered with foam, scum and algae. 30% of bottom 4-6 inches thick of algae. 40% less than 1 foot thick.

surf.	19.5	0.0	7.8	600
0.25	19.5	0.0	7.8	600
0.50(bot)	19.5	0.0	5.0	600

Station: Railroad trestle, 0715 hr.

surf.	19.0	0.0	7.2	590
0.25	19.0	0.0	7.15	590
0.50	19.0	0.0	7.15	590
0.75	19.0	0.0	7.15	590
1.00	19.0	0.0	7.15	580
1.03(bot)	19.0	0.0	4.2	580



Depth(m)	Temp.(C)	Salin.(ppt)	Oxygen(ppm)	Cond.
Station: Mouth of Noble Gulch, 0810 hr. Milky green water, no plume.				
surf	19.0	0.00	7.5	580
0.25	18.5	0.00	7.8	580
0.50	18.5	0.00	7.75	580
0.75	18.5	0.00	7.75	580
1.00(bot)	18.4	0.00	5.1	580

Conclusions: The lagoon continues to warm up each monitoring, but was still tolerable for steelhead. There was a 2.8 C increase in water temperature from Nob Hill to the flume. Saltwater had entered the lagoon during the week, with the heavier saltwater settling in pockets under the Stockton Avenue bridge. Water temperature at the bottom there increased. This is a primary holding location for steelhead during the day and had some of the worst water quality measured in the lagoon.

10 August 1998. Gage reading = 2.00.

17 August 1998. Gage reading = 1.98. Patches of surface algae were starting to form. Observations by Morrison.

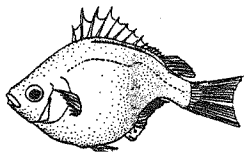
23 August 1998. Weather was overcast and foggy. Gage height was 2.09. The flume boards appeared vandalized with one board dislodged and branches jammed in underneath. I recommended to Morrison that they remove the quarter screen on the east side and put in another flashboard. Gage height decreased to 1.98 after repair. Water temperature at Nob Hill 62.8 F (17.1 C) at 1050 hr, with estimated 4 cfs flow.

Station: Flume at 0700 hr. Air temperature = 13.4 C. Surface with 15% coverage of algae before flume repaired, 10% after. 80% of bottom with algae 0.5-1.0 feet thick. Remainder 0.1 foot thick.

Depth(m)	Temp.(C)	Salin.(ppt)	Oxygen(ppm)	Cond.
surf.	18.2	0.00	8.75	580
0.25	18.4	0.00	8.35	580
0.50	18.4	0.00	8.65	580
0.75	18.4	0.00	8.68	580
0.85(bot)	18.5	0.00	8.30	580

Station: Stockton Ave Bridge, 0730 hr. Secchi depth to bottom. Reach 2- surface with 15% algae coverage. Bottom with 35% algae and pondweed at 0.3-1.5 feet thick, averaging 1 foot. Remainder 0.1 foot thick.

surf	18.2	0.00	7.35	570
0.25	18.4	0.00	7.38	570
0.50	18.5	0.00	7.33	570
0.75	18.6	0.00	6.35	570
1.00	18.7	0.00	6.60	570
1.25	18.7	0.00	7.65	570



Depth(m)	Temp.(C)	Salin.(ppt)	Oxygen(ppm)	Cond.
1.50	18.7	0.00	7.61	580
1.65(bot)	18.7	0.00	3.43	580

Station: Railroad trestle, 0750 hr. Reach 3- surface algae 15% coverage. 30% of bottom algae and pondweed 0.5-3.0 feet thick (all the way to the surface) . Remainder less than 0.1 feet thick.

surf.	17.9	0.0	6.90	560
0.25	18.2	0.0	6.85	560
0.50	18.2	0.0	6.80	560
0.75	18.2	0.0	6.85	560
1.00	18.2	0.0	6.85	560
1.10(bot)	18.2	0.0	5.40	580

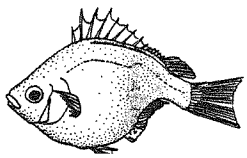
Station: Mouth of Noble Gulch, 0810 hr. Water was milky-green. Surface had 5% algal coverage. 100% of bottom within 20 feet of Noble Gulch had algae 0.2-0.6 feet thick, averaging 0.3 feet.

surf	17.4	0.00	7.10	560
0.25	17.4	0.00	7.32	560
0.50	17.3	0.00	7.42	560
0.75	17.3	0.00	7.41	560
1.00(bot)	17.3	0.00	5.30	560

Conclusion: Water quality conditions were good for steelhead in all reaches except for oxygen below 5 ppm at the bottom at the bridge. However, just above the bottom oxygen levels were good, as were temperatures. No salinity was detected at the bridge, indicating that saltwater had been flushed out, at least in the location of the measurement. However, the water temperature was greatest under the bridge. Water temperature increased approximately 1.5 C between Nob Hill and the Stockton Avenue Bridge. The lagoon had cooled about a degree celcius from the last monitoring with much cooler air temperature (1.7 C less), indicating that lagoon water temperature was sensitive to air temperature. On 31 August, the gage height was up to 2.35. Morrison had discovered a gap in a lower flashboard and eliminated it. They put plywood on one side to reduce leakage between the flashboards.

8 September 1998. Before the Begonia Festival. Air temperature of 15.8 C. Surface algae was reduced from previous monitoring, with apparent algal die-back in Reach 1 below the Stockton Avenue Bridge. Elsewhere, the bottom algae was about the same. Flume entrance depth of 1.8 feet, exit = 1 foot depth. Water temperature at Nob Hill 65 F (18.3 C) as was the air temperature at 0907 hr, with estimated flow of 3 cfs.

Station: Flume at 0712 hr, foggy and windy. Gage Height= 2.09. Air temperature 15.8 C. No surface algae. 40% of bottom with algae and pondweed 0.2-1.0 feet thick, averaging 0.5.



Depth(m)	Temp.(C)	Salin.(ppt)	Oxygen(ppm)	Cond.
surf.	20.7	0.00	7.12	630
0.25	20.8	0.00	7.03	630
0.50	20.8	0.00	7.02	630
0.75	20.8	0.00	6.90	630
0.85(bot)	21.0	0.00	5.70	630

Station: Stockton Ave Bridge, 0729 hr. No surface algae. Reach 2- 35% of bottom with algae and pondweed 0.2-1.0 feet thick, averaging 0.5. White powder deposit under trestle, 3-4 feet in diameter. Less algae in the vicinity of powder.

surf	20.5	0.00	7.50	620
0.25	20.6	0.00	7.40	620
0.50	20.8	0.00	7.35	620
0.75	21.0	0.00	7.30	620
1.00	21.0	0.00	7.30	620
1.25	20.9	0.00	7.23	620
1.35(bot)	20.9	0.00	3.40	620

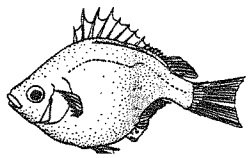
Station: Railroad trestle, 0745 hr. Reach 3- 2% surface algae; 30% of bottom with algae and pondweed 0.2-3.0 feet thick, averaging 0.5 feet.

surf.	20.2	0.00	6.34	610
0.25	20.3	0.00	6.20	610
0.50	20.4	0.00	6.20	610
0.75	20.4	0.00	6.10	610
1.00(bot)	20.4	0.00	3.50	610

Station: Mouth of Noble Gulch, 0800 hr. Floating raft of algae 25 feet in diameter adjacent to the Gulch outflow. 30% of bottom covered with algae 0.1-0.5 feet, averaging 0.3 feet.

surf	19.5	0.00	6.42	580
0.25	19.5	0.00	6.42	580
0.50	19.6	0.00	6.35	580
0.75	19.6	0.00	6.35	580
1.00	19.5	0.00	6.25	580
1.15(bot)	19.4	0.00	3.90	600

Conclusions: Although there appeared to be a die-back in algae and pondweed in the lower Reach 1, its density was similar to the past monitoring in other reaches, and surface algae had increased near Noble Gulch. Water temperature was the highest of the summer, with it increasing approximately 2.5 C from Nob Hill to the flume. Air temperature was 2.4 C warmer than previous monitoring at the flume. Oxygen levels were down from the previous monitoring at 3 of the 4 stations, the exception being the Stockton Avenue Bridge. However, except for the bottom,



oxygen concentrations were above 6 mg/L, which was ample for steelhead. The warm water temperatures of around 21 C (69.8) that early in the morning indicated possible thermal stress later in the afternoon.

20 September 1998. Weather overcast and breezy. Water temperature at Nob Hill 15.2 C (59.4 F) at 0920 hr, with estimated streamflow of 3.5 cfs. In the lagoon the willows remained green, the box elder were yellowing. Algae was bright green in Reach 2. The coots have returned to Soquel Lagoon! It's time for a festival! A great blue heron was seen west side, Reach 3, downstream of Shadowbrook Restaurant.

Station: Flume; 0730 hr. Overcast. Gage height= 2.21. Air temp. 12.2 C. No surface algae. Bottom 60% covered with algae 0.5-1.5 feet thick.

Depth(m)	Temp.(C)	Salin.(ppt)	Oxygen(ppm)	Cond. (umhos)
surf.	16.5	0.00	8.30	600
0.25	16.5	0.00	8.10	600
0.50	16.5	0.00	8.04	600
0.75	16.6	0.00	8.05	600
0.90(bot)	16.8	0.00	7.81	600

Station: Stockton Avenue Bridge, 0745hr. Secchi depth to bottom. Reach 2- no surface algae; bottom 100% covered with algae and pondweed 0.5-2.0 feet thick. Thickest in western thalweg.

surf.	17.3	0.00	7.70	580
0.25	17.4	0.00	7.55	580
0.50	17.5	0.00	7.55	580
0.75	17.5	0.00	7.55	580
1.00	17.5	0.00	7.53	580
1.25	17.6	0.00	7.50	580
1.40(bot)	17.6	0.00	4.50	580

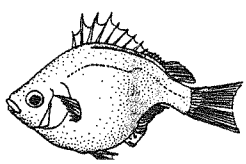
Station: Railroad trestle, 0800 hr. Reach 3- no surface algae; 35% of bottom with algae and pondweed 0.5-1.5 feet thick. Algae very bright green on east side.

surf.	16.9	0.00	7.35	570
0.25	17.2	0.00	7.20	570
0.50	17.2	0.00	7.20	570
0.75	17.2	0.00	7.20	570
1.00	17.2	0.00	7.20	570
1.12(bot)	17.3	0.00	4.78	570

Station: Mouth of Noble Gulch, 0830 hr. Gray water observed. A 30-foot diameter mat of algae and pondweed, 1-2 feet thick, was located just downstream of Noble Gulch. Then another mat 20 feet in diameter just beyond Gulch inflow, 0.5-1.5 feet thick. No surface algae.

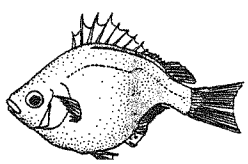
Depth(m)	Temp.(C)	Salin.(ppt)	Oxygen(ppm)	Cond. (umhos)
surf.	17.1	0.00	6.80	560
0.25	17.2	0.00	6.80	560
0.50	17.2	0.00	6.80	560
0.75	17.2	0.00	6.70	560
1.00	17.2	0.00	6.80	560
1.10	17.2	0.00	5.10	560

Conclusions: It was the coolest air temperature of the season, and lagoon water temperatures were definitely cooling. Oxygen levels were up from the previous monitoring, but not as high as earlier in the summer. The summer warm period for the lagoon was apparently finished for 1998.



APPENDIX C.

DRAIN LINE TEST FOR RESTAURANTS CONTIGUOUS WITH SOQUEL CREEK LAGOON, 1998.



Memo

To: Dan Pincetich, City Manager

From: Daniel J. Kostelec, Building Official

Subject: Drain Line Tests - Lagoon

Date: June 15, 1998

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