CLEAN STREAMS PROGRAM

CORRALITOS CREEK WATERSHED
FINAL
ANNUAL REPORT
JULY-DECEMBER 2003

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COASTAL WATERSHED COUNCIL

CORRALITOS CREEK WATERSHED
Annual Report
July-December 2003

EXECUTIVE SUMMARY

The Coastal Watershed Council established a volunteer monitoring program in Corralitos Creek in May 2003 through funding from the State Water Resources Control Board (SWRCB).

The 2003 Corralitos Creek Clean Streams monitoring program focuses on weekly water quality data collection and biannual water sampling for laboratory chemical analysis (once in the dry season and once in the wet season).

Water quality parameters measured include:

In Field:
- Air and water temperature
- Conductivity
- Dissolved oxygen
- pH
- Turbidity

Lab Analysis:

- Bacteria
- Nutrient

A total of 16 data collection events were completed between August-December 2003. Water quality measurements were taken once per week, on average. A water sampling collection for laboratory chemical analysis occurred on November 5, 2003.

Data results for the year indicate the need for further monitoring on Corralitos Creek and its tributaries (Browns Creek and especially Salsipuedes Creek). Low dissolved oxygen levels and higher than average water temperatures, accompanied with agricultural influence in Salsipuedes Creek indicate the need for more in depth study.

A water diversion plant in the town of Corralitos diverts water from Corralitos Creek to the City of Watsonville, running the creek dry in the later part of the summer. Further study is needed to determine the effects on the watershed and to locate where water is re-entering the creek downstream of Varni Road and upstream of Pista Lane.

Other recommendations for 2004 include adding Nitrate field testing, increasing lab anaylsis and adding streamflow monitoring and benthic macroinvertebrate sampling to the program. Stream-flow measurement just below the Browns Valley Road Bridge in the town of Corralitos would be beneficial (for as long as water is present), as this area is just below the City of Watsonville's water diversion plant.

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I. COASTAL WATERSHED COUNCIL'S MONITORING PROGRAM

The Coastal Watershed Council (CWC) is a nonprofit organization committed to the preservation and protection of coastal watersheds through citizen-based conservation, education and community outreach. Serving as watershed advocates, CWC promotes the health of these ecosystems through stewardship, advocacy and proper management practices. Founded in 1994, the Coastal Watershed Council was formed in response to the declining health of the watersheds of the Monterey Bay region.

The mission of the Coastal Watershed Council is to restore the watersheds of the Monterey Bay region and teach area residents how to become stewards of their local creeks and streams. CWC's program areas focus on:

- Watershed stewardship, research and restoration
- Watershed education and outreach through citizen monitoring programs
- Organizational support and training for other grassroots watershed groups

Clean Streams

The Clean Streams Program is managed by the CWC and provides water quality monitoring in 4 watersheds on the Central Coast. The goals of the monitoring are:

- To provide baseline data where data are lacking or absent.
- To support and inform ongoing assessments and enhancement plan development and ultimately provide effective monitoring for projects resulting from the assessment and enhancement plans.
- To support and inform ongoing watershed restoration action strategies.
- To develop and support stakeholder involvement in watershed initiatives and foster long-term watershed stewardship.

The four Central Coast streams in the 2003-4 program include: Aptos, Branciforte, Corralitos and Gazos Creeks. The Clean Streams Citizen Monitoring Program included recruitment, all aspects of training, scheduling and supervision of volunteers, data entry, and draft and final data report completion. Watershed Coordinators work under the supervision and direction of the CWC's Watershed Program Managers.

Figure 1. General location of Corralitos Creek Watershed.

Description of Corralitos Creek Watershed Monitoring Program

Corralitos Creek, located in Santa Cruz County, is a tributary of the Pajaro River and drains a watershed of approximately 23 square miles. It flows approximately 17 miles from its headwaters in the Santa Cruz Mountains to its confluence with Salsipuedes Creek in Watsonville. Land uses in the upper watershed consist mostly of low density residential and timber operations, while the lower watershed consists of increased residential, agriculture and some commercial. The City of Watsonville diverts Corralitos Creek water just below the town of Corralitos for its municipal water needs. This water diversion causes the creek to usually run dry during the summer months from Browns Valley Road to an undetermined point downstream of Varni Road and from Green Valley Road to the confluence with Salispuedes Creek. (Clean Streams Monitoring Plan, 2003, page 3, 4)

The Clean Streams Watershed Monitoring Program for Corralitos Creek began in May 2003. Volunteer outreach methods included flyers and posters, community outreach notices, press releases and public service announcements. A two-hour informational public meeting was held on July 2, 2003 to provide information about the Coastal Watershed Council and the Clean Streams program, its goals and the volunteer time commitment required. A Volunteer Monitoring Training Session followed the public meeting on July 26, 2003 near the Corralitos Meat Market and on Corralitos Creek at Las Colinas Road.

The training provided creekside hands-on training conducting field water quality tests paying particular attention to Standard Operating Procedures (SOP'S) and protocols for each parameter to be tested. Program Manager Tamara Doan and Watershed Coordinator Debie Chirco-Macdonald conducted the training. Field monitoring teams were created at the training session and a schedule formed based on volunteer availability. Team leaders were chosen based on performance during field training, leadership, and willingness to commit to the additional volunteer time required for the position. Team leaders were responsible for kit pickup and checkout before monitoring events and for communication between the Watershed Coordinator and members of the teams. Leaders ensured that team members were aware of the monitoring schedule and communicated any needs and irregularities to the Coordinator.

Ten volunteers in 3 teams collected weekly water quality data at four monitoring stations between August 8 and November 29, 2003 for a total of 65 sampling events. Two stations were located on Corralitos Creek, and one station was located on Salsipuedes Creek, a main tributary to Corralitos Creek. The fourth station, 733 Browns Valley Road, added on September 7, 2003, was located on Browns Creek, another tributary to Corralitos Creek.

Figure 2 shows monitoring stations on Corralitos Creek:

(1) East Lake Avenue Bridge	Site ID: CASSE-21
(2) Pista Lane/7226 Freedom Blvd.	Site ID: CORRA-23
(3) 727 Eureka Canyon Road	Site ID: CORRA-24
(4) 733 Browns Valley Road	Site ID: BROWN-21

Weekly monitoring was generally conducted between 9:00 a.m. –1:00 p.m. on weekends by 2-4 volunteers; three site visits occurred in the late afternoon between 3:00 p.m. – 6:30 p.m. One team (Team A) collected data during the week; twice on Wednesday's, Thursday's and Friday's, during the monitoring period, for a total of 6 site visits. Staff and volunteers conducted an initial water sampling for laboratory chemical analysis on November 5, 2003 at the 4 stations.

Not all stations and parameters were sampled during the monitoring period. Due to schedule confilcts for the November 15 and November 20 dates, two teams were combined for a sampling date on November 19. An extra training date was conducted at one station (727 Eureka Canyon Road) on 10/2/03 for a new volunteer, thus adding an extra collection date to that station only. Due to a broken water temperature bulb, water temperature was not taken at the 727 Eureka Canyon Road station on 11/8/03. The Watershed Coordinator supplied a replacement instrument at the next site, thereby allowing the last three stations to be sampled for water temperature.

Volunteer Participation

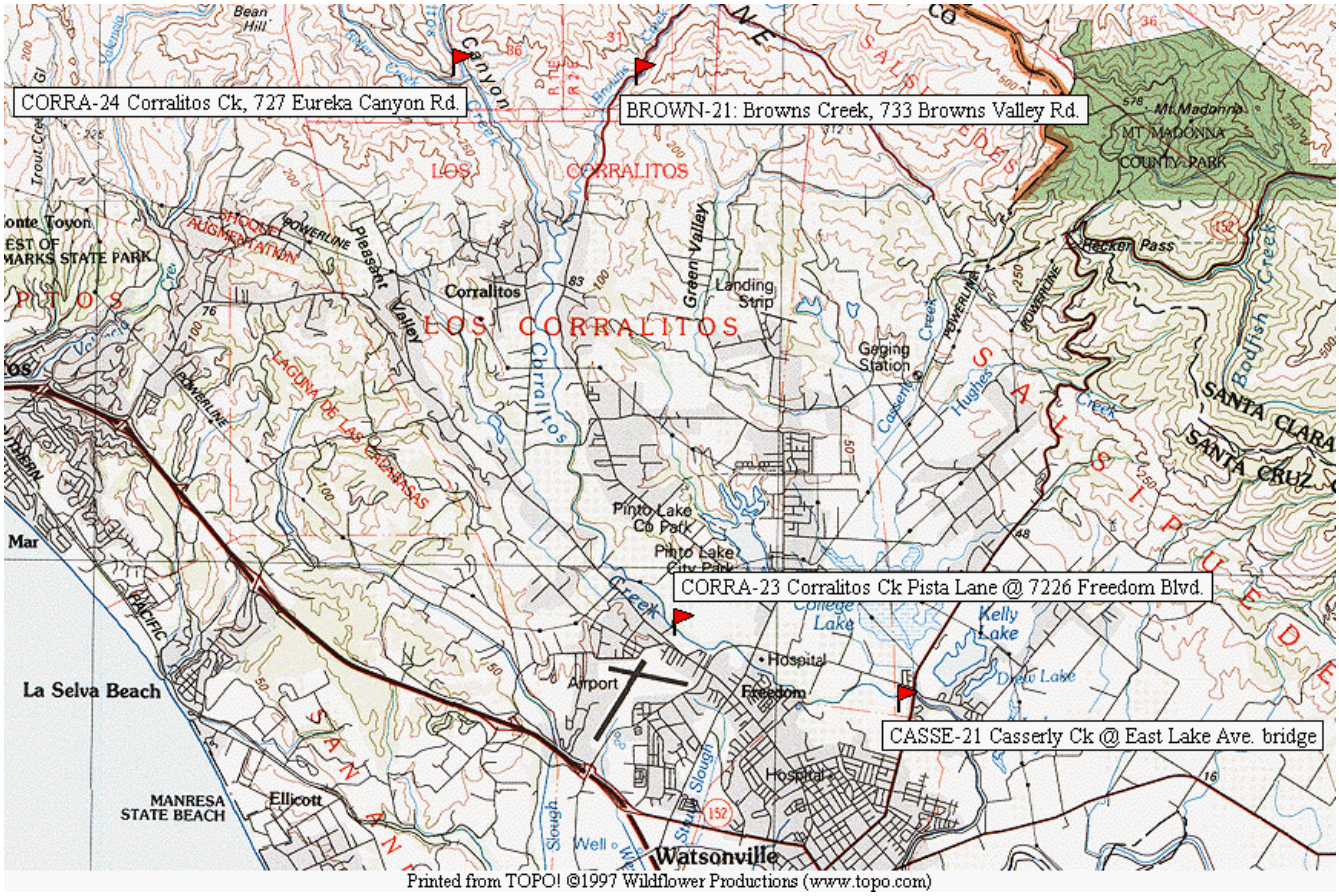
Hours spent by Corralitos Creek volunteers in the field, at the community meeting and in-field training came to a total of 178 hours between July 2 -November 29 2003, with most of the hours spent in the field.

A volunteer recognition party was held at Petroglyphs in Santa Cruz on December 3, 2003 for volunteers from all current CWC programs. Five of 9 Corralitos volunteers joined in the celebration that evening.

Participating volunteers during the 2003 season included:

Mr. Tom Deetz
Ms. Laurie Hannon
Ms. S'rai Helmbrecht
Ms. Liz Hightower
Miss Annie Hightower
Mr. Wilbur Hoff
Ms. Kris Muller
Ms. Gail Olson
Mr. Gary Smith
Mr. Alejendro Valencia

Figure 2. Monitoring locations of Corralitos Creek Watershed stations.



II. DATA QUALITY, METHODS AND EQUIPMENT

Coordinator Training
Watershed Coordinators received two days of classroom and in field training. The training session was conducted by Program Managers Tamara Doan and Kaitilin Gaffney and assisted by Bridget Hoover (Monterey Bay Sanctuary Citizen Watershed Monitoring Network). Training topics covered: administration, quality assurance, the Monitoring Plan, parameters, volunteers, data and reporting.

Volunteer training
Volunteers received a half-day of classroom and in field training prior to monitoring and the Watershed Coordinator accompanied each team on the first 2 visits in the field. Program Manager Tamara Doan and Watershed Coordinator Debie Chirco-Macdonald conducted the training session. Training topics included: program purpose, safety, equipment orientation, in field training on Standard Operating Procedures (SOP's) and quality assurance. The Coordinator continued to supervise each team during the monitoring season as necessary. Volunteer teams were provided with a program manual, which included descriptions of parameters to be tested, parameter fact sheets, general watershed ecology, SOP's, data sheets, volunteer schedule, maps and directions to stations and a list of contact information for the Coordinator and program volunteers.

Volunteer's conducted water quality monitoring 3-4 times per month at the selected monitoring stations within the watershed. The specific parameters sampled and station locations for monitoring were developed as part of the community outreach portion of this program and added to the monitoring plan prior to commencement of volunteer monitoring. At each station, volunteers were trained to collect water samples according to the appropriate protocol and to measure air/water temperature, conductivity, dissolved oxygen, pH, and turbidity.

The Clean Streams water quality monitoring kit included the testing equipment, paper towels, water collection cups, trash bags, first aid kit, clipboard with laminated protocol sheets for each parameter, and a water quality monitoring manual. The Coordinator maintained the kit.

Standard Operating Procedure
A Standard Operating Procedure (SOP) is an approved methodology for conductivity, dissolved oxygen, pH, turbidity and water temperature provided by State Water Resources Control Board (SWRCB) Clean Water Team (Table 1). Volunteer monitoring was conducted following the Standard SOP's.

Table 1. SWRCB Clean Water Team Compendium Standard Operating Procedures

Parameter	Equipment	SWRCB SOP
Conductivity	ECTestr Oakton ISO 9001	3.1.3.1
Dissolved Oxygen	Winkler Model EDO Code: 7414	3.1.1.2
pH	Non-bleeding pH strips Macherey-Nagel D-52348	3.1.4.2
Turbidity	Dual Cylinder turbidity kit Model TTM Code 7519	3.1.5.3
Water Temperature	Bulb Thermometer LaMotte Code 1066	3.1.2.1

Data Quality Objectives (DQO)
This section identifies how sensitive and representative, precise, accurate, and complete measurements will be (Table 2). These Data Quality Objectives were derived by reviewing the QAPP and performance of other citizen monitoring organizations, by considering the specifications of the instruments and methods planned for use, and by considering how the data will be used. These criteria are reflected in the Clean Streams QAPP. See Appendix A for all QA documentation forms.

Detection Limit and Sensitivity
The Method Detection Limit is the lowest possible concentration an instrument or equipment can detect. Sensitivity is the ability of the instrument to detect one concentration from the next.

Precision
The precision objectives apply to replicate samples taken as part of a QC session or as part of periodic in-field QC checks. Precision describes how well repeated measurements agree. The evaluation of precision described here relates to repeated measurements taken by either different volunteers on the same sample (at quality control sessions) or the same volunteer analyzing replicate samples in the field. Sampling variability will not be covered in this section.

Accuracy
Accuracy describes how close a measurement is to its true value. Using standard solutions, accuracy measurements compare the results of a sample of known value to its measured value. Accuracy checks are conducted twice per year on conductivity, pH, and temperature.

Completeness
Completeness is the fraction of planned data that must be collected in order to fulfill the statistical criteria of the project. Volunteer data will not be used for legal or compliance uses. There are no statistical criteria that require a certain percentage of data. However, it is expected that 80% of all measurements could be taken when anticipated. This accounts for adverse weather conditions, safety concerns, and equipment problems.

Table 2 - Data Quality Objectives for Conventional Water Quality Parameters

Parameter	Method/range	Units	Detection Limit	Sensitivity	Precision	Accuracy	Complete-ness
Conductivity	Conductivity Meter	µS/cm	10	10 µS/cm	± 10%	± 10%	80%
Dissolved oxygen	Micro-Winkler Titration	mg/L	0.2 mg/L	0.2 mg/L	± 10%	± 10%	80%
pH	Non-bleeding Strips (range 4.5-10.0)	pH units	4.5	0.5 unit	±0.5 units	± 0.5 units	80%
Temperature	Thermometer (-5 to 50)	^{o} C	-5	0.5 ^{o} C	± 0.5 ^{o} C	± 0.5 ^{o} C	80%
Turbidity	Dual Tube Optical	JTUs	5	5 JTUs	± 5 JTUs	NA	80%

NA: not applicable

- Note: Some test kits vary in sensitivity over the range of detection. The specific range of readings is noted in parentheses.
- DQO's are based on the manufacturer's enclosed accuracy information.

Quality Assurance
The following field measurement quality objectives were adopted to validate the quality of the data collected for the Clean Streams volunteer monitoring program:

1) Assure that each instrument had a unique identifying code (referred to as "Instrument ID") that was tracked with each measurement taken.
2) Assure that adjustable and non-adjustable-reading equipment provided was calibrated every 6 months using a certified state Standard to assess accuracy.
3) Assure accurate labeling of chemical reagents with expiration dates provided by LaMotte Chemical Company and that expired reagents were not used in the testing (dissolved oxygen and turbidity).
4) Assure that each instrument had at least one "replicate" measurement on each field day for the purpose of calculating 'precision'.

5) Assure that in-field measurements were taken appropriately by providing adequate instruction and written procedures for volunteers.

Laboratory

Samples were sent to Santa Cruz County Environmental Health Department, under the supervision of Steve Peters for bacteria and nutrient analyses. It is assumed that each laboratory will act under the guidelines of its own QAPP and authorization to operate as a professional water quality laboratory in the State of California.

The laboratory quality assurance samples taken for this project were as follows:

- Field "Duplicates" (a second container filled at the same time in the same location) for both bacteria and nutrient samples were collected for laboratory analysis in one of the four station locations in the watershed.
- One "Field blank" (a sample container filled with distilled water while in the field) was collected for conducting bacteria analysis.
- A temperature blank was kept in each sample cooler. This was used to record the temperature of the samples until they were turned over to the lab.

Water Quality Objectives

A Water Quality Objective (WQO) is the acceptable range of values for a particular parameter, what constitutes *healthy* water quality. The Regional Water Quality Control Board (RWQCB) has created a Basin Plan to show how the quality of the surface and ground waters in the Central Coast Region should be managed to provide the highest water quality reasonably possible (Basin Plan).

The Central Coast RWQCB has established The Central Coast Ambient Monitoring Program (CCAMP), a regionally scaled water quality monitoring and assessment program whose purpose is to provide scientific information to Regional Board staff and the public, to protect, restore, and enhance the quality of the waters of central California (CCAMP, 2004). The CCAMP program has set "action levels" for the water quality parameters, which are specific to this geographic area. An action level is an indicator or flag assigned to the data indicating that it is above or below an acceptable range. The parameter may or may not have a regulatory limit set for it. The Clean Streams program has adopted these action levels as our WQO for dissolved oxygen, pH and water temperature, as well as for bacteria (E. coli, total coliform) and nutrient (ortho-phosphate, nitrate-nitrogen and ammonia) analysis.

After the monitoring was completed, and the data verified, WQOs were then applied to the results. If a result at a particular station did not meet its WQO, it was identified as having 'exceeded' its criteria. The phrase "exceedence" was adopted to discuss the values that were out of the acceptable range for "good" water quality as defined by the WQO. Based on the WQO for an individual parameter, exceedence values can be either higher or lower than the WQO.

All of the parameters with WQO have a significant impact on water quality and habitat value for wildlife and fishes in coastal California, as well as indicate concerns for human health (Table 3).

Table 3. Water Quality Objectives

Parameter	Water Quality Objectives (WQO)	Source of Objective
Dissolved Oxygen (mg/l)	Not lower than 7	CCAMP Action Level
pH	Not <7.0 or > 8.5	CCAMP Action Level
Temperature (°C)	Not > 22 °C	CCAMP Action Level
Turbidity	Not >20 JTU	NA
Bacteria		
Nutrients/Orthophosphates		

III. DESCRIPTION OF PARAMETERS AND RELEVANCE TO WATER QUALITY AND HABITAT

Conductivity

Conductivity is a general measure of water's ability to conduct an electrical current. There are no water quality objectives for conductivity for water bodies in the Central Coast Region. Generally, the conductivity of rivers in the United States ranges from 50-1500 uS/cm and inland fresh water studies indicate a range between 150 to 500 uS/cm for supporting good mixed fisheries (EPA, 2003). Industrial waters can range as high as 10,000 uS/cm (EPA, 2003). Volunteers measure conductivity with a temperature-adjusted meter in the field.

Testing for conductivity provides ways to:

- identify different water sources (for example, rain water, agricultural runoff, municipal waste water)
- identify potential sources of pollution
- monitor seasonal changes in the water table
- monitor effects of salt water intrusion (salt water typically has higher conductivity than fresh water because of the presence of salts in the water)
- infer the local geology of the area (baseline conductivity varies depending upon which minerals are present as surface water flows over the local substrate)

Dissolved Oxygen

Dissolved oxygen (DO) refers to the amount of oxygen captured within the water column. Factors that affect the concentration of dissolved oxygen include temperature, DO sources (such as photosynthesis that adds oxygen to the water), DO sinks (such as respiration that consume oxygen), breakdown of organic material, sewage, yard waste, oil and grease, and salinity. Low dissolved oxygen levels usually result from water temperature increases, algal blooms, or the presence of human and animal waste.

Aquatic organisms, such as fish and amphibians, require adequate amounts of dissolved oxygen for their continued health and survival. Reduced dissolved oxygen levels in freshwater systems can cause problems with reproduction and incubation, egg or larval failure, retarded growth, and, in extreme cases, death in salmonids.

Anadromous fish require high DO levels (>9.0 mg/l) during their reproductive phases (San Francisco Estuary Institute 1997). During the juvenile growth period (in the summer and fall), DO levels must remain at 8.0 mg/l or higher to prevent impairment. When DO levels fall to 6.5-7.0 mg/l, sharp decreases in performance have been observed. Embryos and larvae require even higher DO levels (State Water Resources Control Board 1996). The Water Quality Objective minimum for DO for supporting coldwater fish has been set at not less than 7.0 mg/l (Basin Plan).

pH

pH is a measure of how acidic or basic (alkaline) the water is. On a scale of 0-14, a pH value of 7 is said to be neutral, (neither acidic or basic). As the pH decreases, water becomes more acidic; as the pH increases, water becomes more basic. Changes in pH may also alter the concentrations of other substances in the water to a more toxic form. In freshwater systems, pH usually ranges between 6.5 and 8.5 (San Francisco Estuary Institute 1997). In fresh water, increasing temperature decreases pH. In the Central Coast Region for waters that are designated municipal and domestic water supply, water contact recreation, and non-contact water recreation, it is recommended that pH not fall below 6.5 or rise above 8.5 (Basin Plan).

Most fish species can tolerate pH values between 6.0 to 9.0. However, on the Central Coast, in streams that support salmon and steelhead, the pH values must fall between 7.0 and 8.5. Extreme pH values (<5 or >9) can be detrimental to fish survival and may cause physical damage to their gills, exoskeleton, and fins, and, in some cases, death (Basin Plan).

Temperature

Water temperature is one of the most important water quality parameters that has direct affects on water chemistry and the functions of aquatic organisms. Temperature influences the dissolved oxygen content of the water; conductivity and pH levels; the rate of photosynthesis by algae and other aquatic plants; the metabolic rates of

organisms; the sensitivity of organisms to toxic wastes, parasites and diseases; and the timing of reproduction, migration and aestivation of aquatic organisms.

Factors that can affect water temperature include sunlight energy, seasonal and daily changes, shade, air temperature, streamflow, water depth, inflow of groundwater or surface water, and the color and turbidity (cloudiness) of the water. Other factors that can affect temperature include soil erosion, stormwater runoff, removal of riparian vegetation, water diversions, cooling water discharges from power plants, and alterations to stream morphology, substrate and flow. Water temperature is reported in degrees Celsius (°C).

Upstream migration of salmon and steelhead can occur when stream temperatures are between 3 °C and 20 °C; higher temperatures can inhibit migration, inducing salmonids to remain at sea until temperatures decrease (Reiser and Bjornn 1979). Water temperatures of 11.8-14.6 °C are optimal for coho salmon rearing; temperatures over 20 °C stop growth; and temperatures over 26 °C are lethal to coho salmon. Steelhead prefer lower temperatures of 7.3-14.6 °C for rearing; temperatures over 20 °C stops growth; and temperatures above 24 °C can result in mortality. Low water temperatures are imperative for successful salmonid reproduction and rearing (citation).

Turbidity

Turbidity is a measure of the amount of suspended particles in the water. Watersheds have a natural turbidity level given the effects of natural erosion, organic decay and algae. There has been no determination of the natural turbidity level in most of the local watersheds within the Central California Coast. Turbidity can be an indicator of erosion, excessive nutrient loading and algal growth. Because of the number of suspended plants and animals (plankton) found within stream systems, turbid water can also be considered natural. The baseline level of turbidity will vary from stream to stream depending on the nutrient loading, geology and stream dynamics. Turbidity increases caused by discharge of sediment or nutrients should not exceed 10% of natural levels. In the absence of a numeric data quality objective, a turbidity level of >20 JTU (Jackson Turbidity Units) was adopted for this program.

Salmon and steelhead need clear-running streams with minimal sediment. High turbidity levels can indicate high sedimentation within the system. If a creek or river is heavily sedimented, spawning gravels and deep-water rearing habitat can become silted in. Also, highly turbid waters can increase the chance for redds (nests with egg sacks) to be washed away during storm events. Excessively turbid waters can also impair feeding. Coho salmon redds are highly susceptible to destruction caused by early storms (Smith 1998).

Tam: description for nutrient and bacteria?

IV. DATA RESULTS

During the July-December 2003 period, water quality data were collected each week for a total of 65 sampling efforts for all four stations.

Table 4 provides a summary of water quality data by parameters for all 4 stations in the Corralitos Watershed. The table provides parameters tested, WQO, total number of samples collected, including exccedences and minimum, maximum and mean of parameter results. Raw data results are presented in Appendix B of this report.

Table 4

Corralitos Watershed

Parameter	WQO	Number of Samples in 2003	Number of Exceedences	Percent of Exceedences	Minimum	Maximum	Mean
Air Temp °C	None	65			9.0	23.5	16.0
Conductivity (uS)	None	65			450	930	
D.O. (mg/l)	Not <7.0	65	17	26%	2.6	11.0	7.9
pH	Not <7.0 or >8.5	65	0	0%	7.0	8.0	7.4
Turbidity (JTU)	Not >20	65	12	18%	0	45	
Water Temp °C	Not >22°C	64	0	0%	8.0	19.4	14.0

Table 5 summarizes water quality data by individual stations in the Corralitos Watershed. The table reflects results by station and includes parameters tested, WQO, total number of samples collected, including exccedences and minimum, maximum and mean of parameter results.

Temperature

Air temperature. The overall mean for all 4 stations was 16.0 °C. The air temperature range for all four stations was 9.0 °C (East Lake Avenue Bridge, 11/5/03 at 8:35 and Browns Valley Road, 10/30/03 at 10:25 am and 11/05/03 at 10:32 am) to 23.5 °C (Eureka Canyon Road, 8/23/03 at 12:30 pm). The mean temperatures at each station were 16.3 °C (East Lake Avenue Bridge), 16.4 °C (Pista Lane), 16.6 °C (727 Eureka Canyon Road), and 14.2 °C (733 Browns Valley Road).

Water temperature. The overall mean for all 4 stations was 14.0 °C. The water temperature range for all four stations was 8.0 °C (Pista Lane, 11/5/03 at 9:23 am and 733 Browns Valley Road, 11/5/03 at 10:32am) to 19.4 °C (East Lake Avenue Bridge, 8/27/03 at 9:30 am). The mean temperatures at each station were as follows: 15.3°C (East Lake Avenue Bridge), 14.3°C (Pista Lane), 13.8°C (727 Eureka Canyon Road), and 12.0°C (733 Browns Valley Road).

Conductivity

Conductivity values for all four stations ranged from 450 uS to 930 uS. The most common Conductivity values fell between 600-690 uS and 700-790 uS, which were both recorded 20 of 65 times (31% each), while the least common values were between 450-490 uS, recorded 2 of 65 times (3%). The remaining Conductivity values were as follows: 500-590 uS (3 of 65 times, 4%), 800-890 uS (16 of 65 times, 25%), and 900-930 uS (4 of 65 times, 6%). Conductivity values within the monitoring stations vary primarily due to seasonal changes in the water table. The Conductivity values recorded during the monitoring period are within the acceptable range of potable water as determined by the US Environmental Protection Agency (San Francisco Estuary Institute 1997).

Dissolved Oxygen

The overall mean for all four stations was 7.9mg/l. Dissolved oxygen values for the four stations ranged from 2.6mg/l (East Lake Avenue Bridge, 11/19/03 at 8:40 am) to 11.0mg/l (Pista Lane, 11/29/03 at 11:45 am). The mean values at each station were as follows: 5.0mg/l (East Lake Avenue Bridge), 8.5mg/l (Pista Lane), 9.2mg/l (733 Eureka Canyon Road), and 9.0mg/l (733 Browns Valley Road).

The East Lake Avenue Bridge station recorded a total of 15 of 17 exceedences (88%) for dissolved oxygen during the monitoring period, while the Pista Lane station recorded 2 of 17 exceedences (12%). Dissolved oxygen levels at the East Lake Avenue Bridge station ranged between 2.6 mg/l to 9.6 mg/l and between 6.6 mg/l to 11.0 mg/l at the Pista Lane station.

pH

Mean pH values at all four stations ranged from 7.4 (East Lake Avenue Bridge, Pista Lane and 727 Eureka Canyon Road) to 7.5 (733 Browns Valley Road). pH values throughout the entire program exhibited a range of 7.0 to 8.0 pH, with the mean value being 7.4 overall. The highest measurement was 8.0, which was recorded 1 of 65 times (1%) and the most common pH measurement was 7.5, which was recorded 53 of 65 times (82%). The remaining pH measurements of 7.0 were recorded 11 of 65 times (17%).

Turbidity

Turbidity levels were consistently low throughout the July-December monitoring period at 3 of four stations. Almost all turbidity readings at Pista Lane, 727 Eureka Canyon Road and 733 Browns Valley Road were not detectable and therefore no graph was created for this parameter.

In contrast, The East Lake Avenue Bridge station (on Salsipuedes Creek, a tributary of Corralitos Creek) recorded 11 of 17 turbidity levels between 15 to 45 JTU's during the entire monitoring period. The Pista Lane station recorded one turbidity level at 25 JTU's otherwise it had consistently low readings.

Table 5

East Lake Avenue Bridge

Parameter	WQO	Number of Samples	Number of Exceedences	Percent of Exceedences	Minimum	Maximum	Mean
Air Temp °C	None	17			9.0	21.5	16.3
Conductivity (uS)	None	17			450	930	
D.O. (mg/l)	Not <7.0	17	15	88%	2.6	9.6	5.0
pH	Not <7.0 or >8.5	17	0	0%	7.0	7.5	7.4
Turbidity (JTU)	Not >20	17	11	65%	15	45	
Water Temp °C	Not >22°C	17	0	0%	9.5	19.4	15.3

Pista Lane

Parameter	WQO	Number of Samples	Number of Exceedences	Percent of Exceedences	Minimum	Maximum	Mean
Air Temp °C	None	17			10.0	22.0	16.4
Conductivity (uS)	None	17			590	840	
D.O. (mg/l)	Not <7.0	17	2	12%	6.6	11.0	8.5
pH	Not <7.0 or >8.5	17	0	0%	7.0	7.5	7.4
Turbidity (JTU)	Not >20	17	1	5%	0	25	
Water Temp °C	Not >22°C	17	0	0%	8.0	19.0	14.3

727 Eureka Canyon Road

Parameter	WQO	Number of Samples	Number of Exceedences	Percent of Exceedences	Minimum	Maximum	Mean
Air Temp °C	None	18			10.0	23.5	16.6
Conductivity (uS)	None	18			500	650	
D.O. (mg/l)	Not <7.0	18	0	0%	8.4	10.0	9.2
pH	Not <7.0 or >8.5	18	0	0%	7.0	8.0	7.4
Turbidity (JTU)	Not >20	18			0	5	
Water Temp °C	Not >22°C	17	0	0%	10.0	16.5	13.8

733 Browns Valley Road

Parameter	WQO	Number of Samples	Number of Exceedences	Percent of Exceedences	Minimum	Maximum	Mean
Air Temp °C	None	13			9.0	20.0	14.2
Conductivity (uS)	None	13			650	820	
D.O. (mg/l)	Not <7.0	13	0	0%	8.0	10.0	9.0
pH	Not <7.0 or >8.5	13	0	0%	7.0	7.5	7.5
Turbidity (JTU)	Not >20	13			0	5	
Water Temp °C	Not >22°C	13	0	0%	8.0	15.0	12.0

Table 6 reflects results of initial bacteria and nutrient sampling conducted on November 5, 2003 by staff and volunteers. The table includes parameters, WQO, and the four stations sampled.

Table 6

Corralitos Creek - 5 November 2003

Parameter	WQO	E. Lake Ave. Br.	Pista Lane	727 E.C. Road	733 Browns Valley Rd.
E. coli (MPN/100ml)	≤ 235	662	322	82	10
Total Coliform (MPN/100ml)	≤ 10000	>48,384	22,397	974	618
Ortho-Phosphate (ppm)	≤ 0.10	0.131	n.d.	n.d.	n.d.
Nitrate-N (ppm)	Not >2.25	5.42	3.01	0.176	0.186
Ammonia		n.d.	n.d.	n.d.	n.d.

Shaded numbers indicate exceedences of the Water Quality Objectives set forth by CCAMP.
n.d. indicates a non-detection of bacteria or nutrient in the sample.

V. DISCUSSION

The water quality data collected during the 2003 season on Corralitos Creek set baseline figures for future studies in the Corralitos Watershed. The four stations in various parts of the watershed were chosen to portray an overall view of water quality in this area. Decisions for the 2004 season will be partially based upon findings from this first year of data collection.

Water quality data collected from the two stations in the upper watershed remained within the water quality objective values throughout the season. However, data from 727 Eureka Canyon Road on Corralitos Creek and 733 Browns Valley Road on Browns Creek should continue to be collected so as to gain a more complete view of this portion of the watershed.

Two dissolved oxygen exceedences and one turbidity result of >25 JTU's at the Pista Lane station indicate the need for further study of this area in the mid-watershed range. These numbers alone do not give a complete answer to what is happening in the watershed. However, agricultural influence and yet unknown water sources entering the creek potentially compromise water quality and should be investigated. Additionally, a second year of data collection at this station will be beneficial.

Salsipuedes Creek, a main tributary to Corralitos Creek, joins Corralitos Creek in the lower watershed at the East Lake Avenue station. It had consistently low Dissolved Oxygen readings and slightly higher water temperatures than seen in the upper watershed stations. There were a total of 15 (of 17) exceedences (readings <7.0 mg/l) for Dissolved Oxygen at this station during the monitoring season. Lack of canopy cover could contribute to the elevated water temperatures (9 of 17 recordings >15.5 °C) and air temperatures (10 of 17 recordings >15.5 °C). Water temperatures taken after10/18/03 showed consistent drops in temperature levels. Water temperatures decreased from 15.5 °C to 9.5 °C by the end of the monitoring season. These numbers show the overall cooling temperatures of seasonal change taking effect on the water column.

Turbidity at the East Lake Avenue station was consistently elevated during the monitoring season. Salsipuedes Creek moves through agricultural fields for much of its length. Salsipuedes Creek passes through College Lake and past more agricultural fields before joining Corralitos Creek at the East Lake Avenue station. The elevated turbidity levels could be a strong indicator of several effects such as runoff or bank erosion that also warrant further study of this watershed.

Experimental Nitrate testing was conducted during the program at all 4 stations from 9/14/03 until the end of the monitoring season, for a total of 5 times. Testing was not done on every sampling date, only when the Coordinator was present, as volunteers had not been trained to utilize the Nitrate kit. Preliminary results at 727 Eureka Canyon Road and 733 Browns Valley Road showed levels at 0 ppm or <0.25 ppm in all 5 samples tested. Preliminary results at Pista Lane showed levels ranging from 1.0 ppm to 3.0 ppm. The East Lake Avenue Bridge station showed levels between 2.0-4.0 ppm.

Though nitrogen occurs naturally in streams and is essential for the plants and animals found there, elevated numbers can be an indication of human influence. Elevated nitrate levels have the potential of creating harmful "blooms" of algae and other plants that starve wildlife due to depletion of light and oxygen (Land Use and Water Quality on California's Central Coast, 2003). Whether coincidence or a "bloom", considerable increases in plant growth were noted during the course of the monitoring season at the East Lake Avenue Bridge station.

VI. CLEAN STREAMS RECOMMENDATIONS

As the 2003 monitoring season was a relatively short collection period, it is recommended that all four stations be monitored for a second season and an expansion of the program occur to include Casserly Creek (which joins Salsipuedes Creek near College Lake), more of Browns Creek (which has some logging in its upper watershed) and Salsipuedes Creek (very low in the watershed). With so much agricultural land and housing development surrounding much of this watershed, continued study and further investigation into potential runoff and bank erosion will benefit this watershed and its fisheries. Additionally, public outreach to the general public, schools and farmers to increase awareness about the Corralitos Watershed is highly recommended.

Nitrate testing in the 2004 season is recommended, as the elevated levels at Pista Lane and East Lake Avenue Bridge indicate potential issues in the water column. Creating a more complete baseline may help to answer questions about surrounding agriculture septic systems and potential runoff.

Stream diversion in town of Corralitos by the City of Watsonville causes the creek to run dry in summer (late July) just below the town of Corralitos. Small, possibly unnamed tributaries, or field runoff, add water to the creekbed downstream of this point, but it is not known at what exact point. Visual observations at the Varni Road bridge show no water flowing from early August until enough rains bring the water levels up. Futher study of the water diversion and locating where the creek begins running with water again is recommended. At this time effects to the watershed and possible fish passage is unknown.

Further recommendations for 2004 include increasing lab analysis, adding streamflow monitoring and benthic macroinvertebrate sampling to the program. Stream-flow measurement just below the Browns Valley Road Bridge in the town of Corralitos would be beneficial (for as long as water is present), as this area is just below the City of Watsonville's water diversion plant.

VII. REFERENCES

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APPENDICES

APPENDIX A

Quality Assurance (QA) Documents and Summary Text

Quality Assurance Steps

Accuracy

Percent Accuracy is calculated from the drift (the difference between the post-event reading and the value of the Standard), divided by the "true" value of the Standard, times 100. An acceptable value for percent accuracy is less than 10%.

The percent accuracy was calculated for the conductivity meter used in the Corralitos Watershed and was found to be 5.33%; an acceptable value based on the data quality objectives set forth for water quality parameters.

The pH strips were not calibrated at the end of the monitoring season, as all the pH strips had been used by that time.

Three temperature instruments were utilized for the Corralitos watershed, two for water and one for air temperature. The second water temperature instrument was digital and utilized by several volunteers that had difficulty reading the bulb instrument in the water. One of the bulb instruments broke on November 8, 2003; an instrument from another kit was borrowed to finish the monitoring day. It could not be calculated for accuracy because no prior calibration record existed for it. Another instrument was utilized for the remainder of the season (2 sampling dates). That instrument could not be calculated for accuracy either, as it was calibrated at two different temperatures (17 °C and 20°C) at the beginning and end of the monitoring season. The digital instrument broke near the end of the monitoring season as well and could therefore not be calibrated.

Completeness

There were a total of 18 monitoring events scheduled for this season's monitoring program. An overall total of 17 monitoring events were conducted during the period. On a parameter-by-parameter basis 13-18 samples were collected. Water temperature was collected 17 of 18 times (94%) during the monitoring program at East Lake Avenue Bridge, Pista Lane and Eureka Canyon Road and 13 of 13 times (100%) at 733 Browns Valley Road. Dissolved Oxygen, pH and Conductivity values were collected 18 times (100%) during the monitoring program at 727 Eureka Canyon Road, 17 of 18 times (94%) at East Lake Avenue Bridge and Pista Lane and 13 of 13 times (100%) at 733 Browns Valley Road.

Precision

The percent precision was calculated using the formula: the absolute value of A minus B, divided by the average of A and B, time 100, where A equals the parameter result and B equals the replicate results (|A-B|x100/AVG(A+B). For dissolved oxygen samples (n=13), all the values were below the precision objective of 10% (a range of 0-10.0%). One of the conductivity replicates (n=15) exceeded the precision objective (11.8%). For temperature, pH and turbidity, the difference between the parameter result and its replicate were compared to the precision objective for each parameter. All temperature, pH and turbidity replicates were within the objective values for their respective parameters.

Summary Text

Three teams were created for this sampling season, for a total of 10 volunteers (Team A with 3 members, Team B with 3 members and Team C with 4 -and later 3 - members. Team B gained a new volunteer towards the very end of the program and lost another, while Team C lost a volunteer for health reasons mid-way through the program. All volunteers agreed they wanted to go out as often as possible, so a rotating schedule was created that included all weekends from the beginning (August 8) to the end (November 29) of the program. This gave teams a greater number of sampling events for the season – Team A had 7 events, Team B 6 events and Team C 5 events.

Team leaders were very consistent in Team C, maintaining the same team leader throughout the program. Team A & B had a mixture of 'team leaders' due to vacation absenteeism and volunteers uncomfortable with a team leader role. The Watershed Coordinator was present in 11of 17 sampling events; many field visits were follow up field visits to

check on volunteer practices and clarify protocols were being followed and some visits due to absenteeism. I was in the field 5 of 7 times with Team A, and 3 of 6 times with both Teams B and C.

Teams A and C worked very well together. Team A included an elder married couple and a single elder woman. Early in the program she e-mailed with the following comment: "We did fine at our last site and then we had a sandwich at the Meat Market. We all have a lot in common so there was great bonding taking place!! A by-product of volunteering!!!" (Gail Olson, personal communication). Team C included a mother, her daughter and a veteran volunteer from Aptos Creek (who lives in Corralitos).

Team B had some difficulties part way through the season, which required intervention on the Watershed Coordinator and Program Manager's part. Communication between 2 volunteers regarding which day to sample led to a conflict that was eventually remedied. Unfortunately, one volunteer chose not to return to the program.

The enthusiasm and dedication of all volunteers for the Corralitos Creek water quality monitoring helped with the success of the program this first season. Additionally, the offer by area residents Ron Ware, allowing access to Corralitos Creek via his property and Liz Hightower, telling us of easy access to Browns Creek near her home, helped as well (727 Eureka Canyon Road station).

There has been contact by an interested family via one of the current volunteers. She plans to join the monitoring program in the 2004 season.

APPENDIX B

Site ID	Site description	Team	Date	Time	Rain in last 24 hrs?	AIR_TEMP	H2O_TEMP	PH	D.O.	Exceedences (<7.0 mg/l)	COND_US	TURBIDITY	Exceedences (>20 JTU)
CASSE-21	E. Lake Ave. Bridge	A	08/08/03	9:30	no	17.0	18.0	7.5	4.0	yes	800	15	
CASSE-21	E. Lake Ave. Bridge	B	08/17/03	6:30	no	15.5	19.0	7.5	7.6		900	20	
CASSE-21	E. Lake Ave. Bridge	C	08/23/03	9:15	no	19.0	19.0	7.0	4.4	yes	800	35	yes
CASSE-21	E. Lake Ave. Bridge	A	08/27/03	9:30	no	14.0	19.4	7.0	3.2	yes	800	15	
CASSE-21	E. Lake Ave. Bridge	B	09/07/03	12:33	no	21.5	18.0	7.5	6.0	yes	800	30	yes
CASSE-21	E. Lake Ave. Bridge	C	09/14/03	9:20	no	18.0	19.0	7.5	4.0	yes	870	45	yes
CASSE-21	E. Lake Ave. Bridge	A	09/18/03	8:56	no	15.0	17.2	7.5	3.6	yes	890	35	yes
CASSE-21	E. Lake Ave. Bridge	B	09/28/03	6:10	no	18.0	17.0	7.5	5.8	yes	880	15	
CASSE-21	E. Lake Ave. Bridge	C	10/05/03	9:43	no	14.5	15.5	7.5	4.2	yes	890	25	yes
CASSE-21	E. Lake Ave. Bridge	A	10/10/03	9:32	no	12.5	15.0	7.0	4.2	yes	900	35	yes
CASSE-21	E. Lake Ave. Bridge	B	10/18/03	5:00	no	19.0	14.0	7.5	9.6		800	25	yes
CASSE-21	E. Lake Ave. Bridge	C	10/26/03	9:05	no	20.0	13.0	7.5	4.8	yes	930	25	yes
CASSE-21	E. Lake Ave. Bridge	A	10/30/03	11:30	no	15.5	13.0	7.5	5.0	yes	930	30	yes
CASSE-21	E. Lake Ave. Bridge		11/05/03	8:35	no	9.0	10.0	7.5	5.4	yes	690	45	yes
CASSE-21	E. Lake Ave. Bridge	B	11/08/03	12:15	yes	20.5	13.5	7.5	6.4	yes	660	20	
CASSE-21	E. Lake Ave. Bridge	C/A	11/19/03	8:40	no	11.0	10.0	7.5	2.6	yes	450	40	yes
CASSE-21	E. Lake Ave. Bridge	B	11/29/03	10:35	no	17.0	9.5	7.5	3.4	yes	480	15	
CORRA-23	Pista Lane	A	08/08/03	10:55	no	20.0	16.5	7.5	8.6		700	5	
CORRA-23	Pista Lane	B	08/17/03	5:20	no	18.0	18.0	7.0	7.6		700	5	
CORRA-23	Pista Lane	C	08/23/03	11:30	no	22.0	19.0	7.5	8.2		700	0	
CORRA-23	Pista Lane	A	08/27/03	10:55	no	15.2	17.0	7.5	6.8	yes	700	5	
CORRA-23	Pista Lane	B	09/07/03	11:50	no	22.0	18.0	7.5	9.4		700	5	
CORRA-23	Pista Lane	C	09/14/03	10:35	no	17.5	18.0	7.5	8.0		770	5	
CORRA-23	Pista Lane	A	09/18/03	9:42	no	15.0	14.2	7.5	7.2		790	5	
CORRA-23	Pista Lane	B	09/28/03	5:20	no	18.0	16.0	7.5	8.6		810	5	
CORRA-23	Pista Lane	C	10/05/03	10:15	no	15.0	14.5	7.0	8.2		820	0	
CORRA-23	Pista Lane	A	10/10/03	10:50	no	14.5	14.0	7.0	8.8		830	0	
CORRA-23	Pista Lane	B	10/18/03	4:15	no	19.0	14.0	7.5	6.6	yes	790	5	
CORRA-23	Pista Lane	C	10/26/03	10:00	no	17.5	12.5	7.5	8.0		740	0	
CORRA-23	Pista Lane	A	10/30/03	10:25	no	12.0	11.0	7.5	9.3		810	5	
CORRA-23	Pista Lane		11/05/03	9:23	no	10.0	8.0	7.5	9.4		810	10	
CORRA-23	Pista Lane	B	11/08/03	11:15	yes	16.0	12.0	7.0	9.2		720	25	yes
CORRA-23	Pista Lane	A/C	11/19/03	9:20	no	11.5	10.0	7.5	9.2		840	0	
CORRA-23	Pista Lane	B	11/29/03	11:45	no	16.0	10.0	7.5	11.0		590	0	
CORRA-24	727 E.C. Road	A	08/08/03	12:15	no	22.5	16.0	7.5	8.8		500	5	
CORRA-24	727 E.C. Road	B	08/17/03	3:00	no	21.0	16.5	7.5	9.4		600	5	
CORRA-24	727 E.C. Road	C	08/23/03	12:30	no	23.5	16.0	7.5	8.8		600	0	

Site ID	Site description	Team	Date	Time	Rain in last 24 hrs?	AIR_TEMP	H2O_TEMP	PH	D.O.	Exceedences (<7.0 mg/l)	COND_US	TURBIDITY	Exceedences (>20 JTU)
CORRA-24	727 E.C. Road	A	08/27/03	11:50	no	17.5	16.0	8.0	8.6		600	0	
CORRA-24	727 E.C. Road	B	09/07/03	9:35	no	16.0	13.0	7.5	9.0		600	0	
CORRA-24	727 E.C. Road	C	09/14/03	11:37	no	21.0	15.5	7.5	8.4		610	0	
CORRA-24	727 E.C. Road	A	09/18/03	11:02	no	17.5	14.0	7.5	8.4		630	0	
CORRA-24	727 E.C. Road	B	09/28/03	4:00	no	17.0	15.0	7.5	8.8		620	0	
CORRA-24	727 E.C. Road	B	10/02/03	9:15	no	12.5	14.0	7.5	9.0		620	0	
CORRA-24	727 E.C. Road	C	10/05/03	10:46	no	17.5	14.0	7.5	9.4		610	0	
CORRA-24	727 E.C. Road	A	10/10/03	12:11	no	17.0	13.0	7.0	9.6		620	0	
CORRA-24	727 E.C. Road	B	10/18/03	2:30	no	23.0	14.0	7.5	8.6		610	0	
CORRA-24	727 E.C. Road	C	10/26/03	11:00	no	17.5	14.0	7.5	9.4		610	0	
CORRA-24	727 E.C. Road	A	10/30/03	9:40	no	10.0	11.5	7.5	10.0		650	5	
CORRA-24	728 E.C. Road		11/05/03	10:03	no	10.0	10.0	7.5	10.0		630	0	
CORRA-24	727 E.C. Road	B	11/08/03	9:00	yes	12.0		7.5	10.0		620	0	
CORRA-24	727 E.C. Road	A/C	11/19/03	9:46	no	12.0	11.5	7.0	9.2		630	0	
CORRA-24	727 E.C. Road	B	11/29/03	1:06	no	11.5	11.0	7.0	10.0		570	0	
BROWN-21	733 B. V. Road	B	09/07/03	10:55	no	14.5	12.5	7.5	9.2		700	0	
BROWN-21	733 B. V. Road	C	09/14/03	12:15	no	20.0	15.0	7.5	8.0		750	0	
BROWN-21	733 B. V. Road	A	09/18/03	10:28	no	14.0	13.4	7.5	8.2		770	0	
BROWN-21	733 B. V. Road	B	09/28/03	4:47	no	17.0	15.0	7.5	8.8		750	0	
BROWN-21	733 B. V. Road	C	10/05/03	11:25	no	15.0	13.0	7.5	9.0		760	0	
BROWN-21	733 B. V. Road	A	10/10/03	11:31	no	13.0	11.5	7.0	9.6		760	0	
BROWN-21	733 B. V. Road	B	10/18/03	3:30	no	19.0	12.0	7.5	8.8		650	0	
BROWN-21	733 B. V. Road	C	10/26/03	11:25	no	19.0	12.0	7.5	8.8		730	0	
BROWN-21	733 B. V. Road	A	10/30/03	10:25	no	9.0	11.0	7.5	8.6		820	5	
BROWN-21	734 B. V. Road		11/05/03	10:32	no	9.0	8.0	7.5	9.4		780	0	
BROWN-21	733 B. V. Road	B	11/08/03	10:25	yes	12.5	11.5	7.5	9.4		700	0	
BROWN-21	733 B. V. Road	A/C	11/19/03	10:18	no	11.0	11.0	7.5	10.0		750	0	
BROWN-21	733 B. V. Road	B	11/29/03	12:34	no	11.0	9.5	7.5	9.8		650	0	
				count	1	65	64	65	65	17	65	65	12
				min		9.0	8.0	7.0	2.6		450	0	
				max		23.5	19.4	8.0	11.0		930	45	
				average		16.0	14.0	7.4	7.9				

APPENDIX C

Participating Agency, Organization and Donor List

Funding Agency:

State Water Resources Control Board

Participating Agencies:

Monterey Bay National Marine Sanctuary
Ocean Conservancy
Santa Cruz County Environmental Health
State Water Resources Control Board Clean Water Team
Surfrider Foundation

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Safeway, Aptos