Santa Ana Regional Water Quality Control Board
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Final Report
September 1, 2002 to September 1, 2003

Project Title: Monitoring of Total and Fecal Coliform in Surface Runoff from Agricultural Operations in the Newport Bay/San Diego Creek Watershed

SWRCB Agreement Number: 0-081-258-0

Project Leaders:

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Task Activities:

Task 1: Project Management and Administration

Subtask 1.1

The following final report covers project activities performed during the project period from September 1, 2002 to September 1, 2003. Agricultural production in the San Diego Creek/Newport Bay Watershed during the project period consisted of container nursery, avocado, tomatoes, beans and strawberries, in various stages of production. Crops under production during this time at specified sampling locations (continuous flow monitoring in place) are detailed in Task 4.

Day to day activities were managed by Dr. Darren L. Haver; fecal coliform sampling was conducted by field technicians Mitch Poole, Sherry Schliskey, or Chris Martinez; laboratory analysis by Debbi Clark; with project oversight by John Kabashima, Kathy Nakase, Stephanie Gasca, and Wanda Smith. The final scope of work submitted to the RWQCB in July 2002 was followed closely including collection, submission of samples, analysis of samples, and reporting of data. The lack of available samples was expected in the scope of work and its impact on analysis is described in this report.

Task 2: Monitoring Program

Subtask 2.1

Table 1 provides the details of the sampling program modified from the agricultural nutrient monitoring program initiated in 2000. The coliform sampling protocol includes two additional nursery sites (F & G). Two monitoring locations are present at sites A through E and one monitoring location at sites F and G.

Table 1. Description of Coliform Sampling Sites

Site	Monitoring ID	Crop	Irrigation System
A	R1	Strawberry	Drip, some overhead
	R2	Strawberry	Drip, some overhead
B	R3	Strawberry	Drip, some overhead
	R4	Strawberry	Drip, some overhead
C	R5	Strawberry	Drip, some overhead
	R6	Strawberry	Drip, some overhead
D	R7	Strawberry	Drip, some overhead
	R8	Strawberry	Drip, some overhead
E	N1	Nursery	Drip and overhead
	N2	Nursery	Drip and overhead
F	N3	Nursery	Drip and overhead
G	N4	Nursery	Drip and overhead

As described in the previous report it has been difficult to collect surface runoff samples from the four row crop sites for multiple reasons: 1) laboratory and method analysis limitations provide us with only a narrow sampling opportunity on Monday and Tuesday morning before 10 a.m., 2) surface runoff from overhead irrigation is extremely random and from drip irrigation is nearly nonexistent, 3) container nursery facilities have or will be under a complete recycling system eliminating dry weather discharges. Because of these limitations and constraints, we have a very limited pool of samples from row crop

monitoring sites and eventually from nursery sites resulting in the inability to calculate geometric means (Table 2). Data presented in Table 2 includes all previous reported data in addition to total and fecal coliform data collected since the March 03 progress report.

Table 2. Individual Coliform Samples for Row Crop Sites A, B, C, and D

Site	Month	Monitoring ID	Fecal Coliform (MPN/100mL)	Total Coliform (MPN/100 mL)
C	8-5-02	R5	700,000	50,000,000
D	9-30-02	R7	11,000	30,000
A	10-7-02	R2	300	13,000
B	11-25-02	R4	17	80
A	12-2-02	R2	90	3,000
B	12-17-2002	R3	130	35,000
B	12-17-2002	R4	230	80,000
A	2-25-03	R1	1600	5,000,000
A	2-25-03	R2	500	1,100,000
B	2-25-03	R3	1600	1,700,000
B	2-25-03	R4	900	1,300,000
D	2-25-03	R7	300	24,000,000
D	2-25-03	R8	700	230,000
A	3-4-03	R1	500	800,000
A	3-11-03	R1	300	300,000
C	3-18-03	R5	<2	11
A	4-21-03	R1	1100	16000
A	4-29-03	R2	300	230000
C	5-5-03	R5	2300	130000
C	5-5-03	R6	5000	230000

At a May 8th meeting at the IRWD Michelson Treatment Plant, the project manager, collaborators, and RWQCB staff met to discuss these results and the direction of the agricultural fecal coliform sampling program. The group came to the consensus that due to the constraints placed on sampling by fecal coliform analysis requirements, the reduction in agricultural acreage that is expected by 2012, the infrequency of significant dry weather flows from agricultural production, and the transition of the container nurseries to complete recycling systems, that the agricultural fecal coliform sampling program would consist of visual flow inspections by field technicians and continuous flow measurements at established nutrient monitoring stations. The continuous flow measurements were terminated in mid-June when strawberry production was completed.

Consistent flow at nursery sites E and G during the sampling window has allowed for a greater number of samples to be collected at these sites than at the row crop sites. Due to the lack of consistent runoff, however, five samples were only available during one month and therefore the calculation of a geometric mean was only possible utilizing fewer samples. Monthly geometric means were calculated when two or more values were available in order to provide a greater set of mean MPNs to investigate possible trends (Table 3). The monitoring and reporting program requires a geometric mean calculated on a minimum of five samples per month and therefore we do not feel that geometric means calculated with fewer values is useful data. Regardless, the data is included in this report to assist the RWQCB in assessing the potential impact or lack of impact that agriculture has on coliform levels within the watershed. As detailed in the

scope of work, difficulty in collecting a minimum of five samples per month was anticipated. If runoff was absent at a sampling site, it was documented by the field technician.

Nursery site F continues to recycle at close to 100% and therefore surface runoff rarely occurs. No runoff was detected at site F during the sampling periods. A less efficient water recycling system is operational at site G results in more frequent discharges. Currently the nursery is reconfiguring the recycling system to recapture 100% of irrigation runoff.

In general, the fecal coliform count was lower at N2 than the other nursery sampling sites, as shown in Table 3. The vegetative filter installed at Site E may prove to be a successful BMP to reduce coliform levels; however, further research would need to be completed due to the variability in this data. Additional management practices may further reduce coliform levels. N2 samples after January 2003 were collected on-site prior to it entering a recycling pond. Dry weather runoff from this nursery sites has been eliminated or severely curbed. Currently runoff collected in the recycling pond is used for dust control on roads throughout the nursery.

All geometric means that could be calculated for nursery surface runoff samples analyzed for fecal and total coliform exceeded the allowable limits of less than 200 organisms/100 mL. In fact, only one sample collected during the study period did not exceed 400 organisms/100 mL. Additional coliform sampling has been proposed at several of the nursery sites as well as upstream of the nursery sites to assist in determining specific sources.

Table 3. Monthly Geometric Means or Individual Samples (# of actual samples follows mean in parentheses) for Sampling Sites E and G.

Site	Month	Monitoring ID	Fecal Coliform (MPN/100mL)	Total Coliform (MPN/100 mL)
E	August	N1	50149 (4)	644462 (4)
E		N2	3644 (4)	80931 (4)
G		N4	22186 (3)	183808 (3)
E	September	N1	28480 (3)	227213 (3)
E		N2	211 (4)	3054 (4)
G		N4	15243 (3)	176731 (3)
E	October	N1	419524 (2)	714143 (2)
E		N2	1183 (3)	6503 (3)
G		N4	23000 (1)	130000 (1)
E	November	N1	8000 (1)	5000000 (1)
E		N2	700 (1)	50000 (1)
G		N4	3000 (1)	70000 (1)
E	December	N1	2915 (2)	83066 (2)
E		N2	1574 (3)	218976 (3)
G		N4	1995 (4)	63792 (4)
E	January 03	N1	130000 (1)	2400000 (1)
E		N2	12247 (2)	1581139 (2)
G		N4	50000 (1)	500000 (1)
E	February 03	N1	110 (1)	13000 (1)
E		N2	1700 (1)	800000 (1)
G		N4	N/A[1]	N/A
E	March 03	N1	3612 (5)	558624 (5)
E		N2	N/A	N/A
G		N4	7141 (2)	74833 (2)
E	April 03	N1	9487 (2)	3224903 (2)

E		N2	1871 (2)	122474 (2)
G		N4	7000 (1)	700000 (1)
E	May 03	N1	N/A	N/A
E		N2	N/A	N/A
G		N4	N/A	N/A

[1]N/A refers to the absence of runoff for sampling and subsequent mean calculation.

Conclusions

With the limited number of samples collected during this study it is difficult to determine with any degree of certainty the contribution of agriculture to the loading of fecal and total coliform into San Diego Creek and the Newport Bay. However, it is apparent that fecal and total coliform levels are detectable at extremely high levels in surface runoff leaving both row crops and nurseries. Debbi Clark joined UCCE staff during a sampling period early in the project to check sampling protocol and observe field conditions. No obvious sources of mammalian waste were observed that could result in the levels being detected in the samples. Fecal and total coliform were not detected in samples taken from irrigation pipes, hose bibs, and hand-washing facilities. The overall significance of these findings is unclear. Under certain conditions fecal coliform can be found in the absence of fecal pollution and in the case of agricultural, elevated levels in runoff have been found in the absence of significant fecal inputs from mammals and birds. Dr. Trevor Suslow, Associate Extension Specialist Postharvest Pathology Transportation and Distribution, has been conducting research on the presence of pathogens on the surfaces of vegetable crops. He has found that many naturally occurring bacteria found in the soil and on vegetation may be detected as fecal coliforms. He has suggested by direct communication with us that the high levels we have seen in surface runoff samples may be attributed to this occurrence (Personal Communication with Darren Haver; September 4, 2002) The limited data collected during this project does not provide useful information for the development of source controls and in fact does little more than bring into question again the validity of fecal and total coliform testing.

The debate continues on the role of fecal and total coliform as a useful indicator of human health risk and it is evident that science has yet to provide us with the tools necessary to detect and identify the sources of pathogens of concern.