



Rain Year 2002/2003
Water Quality Analysis Report
County of Santa Barbara, California
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Public Health Department

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1.0 INTRODUCTION

Project Clean Water, initiated in the fall of 1998, is Santa Barbara County's programmatic effort to improve the water quality in local creeks and in the ocean. Staff from the Public Works Department and the Public Health Department primarily implements the program. Project Clean Water is driven by public concern over numerous beach advisories and historic closures due to elevated levels of bacteria, as well as community interest to improve the "health" of local creeks. Bacteria levels at local beaches are measured using weekly ocean-water sampling near the creek outfalls at 20 popular local beaches. Creeks and storm-drain outfalls appear to be the major source of bacteria in the nearshore environment. The Ocean Water Monitoring Program of the County Public Health Department conducts the sampling year-round.

As an initial investigation, the South Coast Watershed Characterization Study was conducted in 1998 by Project Clean Water staff to characterize the water quality of four South Coast streams (URS Greiner Woodward Clyde 1999). This study marked the first major local effort at evaluating baseline water quality conditions and water quality impacts from storm water runoff and wet weather conditions. Both dry and wet weather sampling occurred within the watersheds of Arroyo Burro, Mission, Carpinteria, and Rincon Creeks. The most significant water quality parameter that was consistently high was the indicator bacteria (total coliform, fecal coliform, and enterococcus groups).

In order to gain a better understanding of the types and extent of pollutants contributed by storm water and low flow runoff, as well as to address future regulatory requirements (see Section 2.0, Regulatory Setting), Project Clean Water staff designed an expanded program of dry and wet weather sampling for the 1999-2000 season. The sampling program significantly broadened the previous year's study by adding many more creek sites and water quality parameter measurements, such as volatile organic compounds (VOCs) and various pesticides. In addition, the 1999-2000 storm water sampling program focused heavily on collecting samples during the "first flush" of each storm event (i.e., during increasing flow due to initial runoff). The purpose of this sampling effort was to conduct a broad screening of water quality in local creeks in order to ascertain which contaminants are present at significant levels, and which watersheds exhibit consistently higher levels of contaminants.

The 2000-01 and 2001-02 water quality sampling programs were a continuation of the effort begun during the 1999-2000 season.

Due to funding issues in the 2002-2003 rain year, the program was scaled back and attention turned to selected watersheds. On the South Coast, time-series, longitudinal sampling was conducted on San Jose creek. That this creek provided flow to a 303(d)-listed waterbody (the Goleta Slough), had established sampling locations, and was the subject of an in-progress watershed plan were all critical in the selection of this watershed. Special studies were also performed at the South Turnpike BMP site and at the discharge point of the Glen Annie Golf Course. In the North County, sampling sites were selected to ascertain the inputs to the Santa Ynez River from the communities of Santa Ynez, Vandenberg Village and Mission Hills. Also in the North County, sampling was continued at sites on Orcutt Solomon creek.

2.0 REGULATORY SETTING

There are two main regulatory programs under which the County must address the quality of surface water. These are the National Pollutant Discharge Elimination System (NPDES), and Total Maximum Daily Loads (TMDLs). Under the Federal Clean Water Act both of these programs are enforced through regulations promulgated by the U.S. Environmental Protection Agency (EPA), and both programs have been delegated to the California State Water Resources Control Board and Regional Water Quality Control Boards.

2.1 National Pollutant Discharge Elimination System (NPDES)

One of the programs under the federal NPDES regulations addresses storm water “non-point source” discharges (Clean Water Act §402(p)). The storm water program is divided into two phases. The first phase was promulgated in 1987 and regulated certain industry and municipalities with populations greater than 100,000 people. Storm water permits for these medium to large municipalities, such as the counties of Ventura, Los Angeles, and San Diego, were submitted to their respective Regional Water Quality Control Boards in the early 1990s.

Those portions of Santa Barbara County with an urban population of at least 10,000 and a population density of at least 1,000 per square mile fall under the definition of small municipality. Under Phase II of the NPDES regulations, owners and operators of small Municipal Separate Storm Sewer Systems (“MS4s”) must obtain a permit for discharges into surface waters and must develop a program to reduce pollutant runoff to the maximum extent practicable. The application for this permit, which had to include Best Management Practices to reduce pollutant runoff into the storm sewer system, were due to the Regional Water Quality Control Board on March 10, 2003. Additional requirements may, at the discretion of the State Board, be applied to those areas with at least 10,000 and a population density of at least 1,000 per square mile.

There are some differences between the EPA regulations for Phase I and the Phase II programs, notably the requirement for storm water monitoring. Phase I communities are required to conduct storm water monitoring; Phase II communities (at least in the first five years) currently are not. Although storm water monitoring is not a requirement under NPDES Phase II regulations, the information presented in this report and from previous sampling years is used to develop the County’s Storm Water Management Program by generally defining storm water pollution types and sources, guiding development of Best Management Practices, and establishing baseline conditions to possibly gage the long-term success of Project Clean Water.

Initially, the unincorporated areas of the Carpinteria Valley, Montecito, Goleta and Orcutt were believed to comprise the area subject to NPDES Phase II regulations, based on 1990 and 2000 census data. In early 2003, Vandenberg Village, Santa Ynez and Los Olivos were added to the list of communities subject to the Phase II regulations because each discharges to the 303(d)-listed Santa Ynez River and is an urban cluster.¹

¹ Likewise, the cities of Solvang and Buellton were added to the list of other areas subject to Phase II regulations, which includes the cities of Santa Maria, Lompoc, Goleta, Santa Barbara and Carpinteria, as well as the Vandenberg Air Force Base. Each of these areas is required to submit their own Storm Water Management Plan.

2.2 Total Maximum Daily Loads (TMDLs)

TMDL regulations are contained in Section 303(d) of the Clean Water Act. TMDLs are designated for water bodies of the state that show signs of being impaired or impacted for beneficial uses. The State Water Resources Control Board (SWRCB) with concurrence of the EPA and the Regional Water Quality Control Boards established a list of all 303(d) impaired water bodies. This listing is prioritized based upon known and/or perceived adverse impacts to the beneficial uses of these waterbodies.

Only eight waterbodies within Santa Barbara County were on previous 303(d) lists. However, the most recent 303(d) list, approved in July 2003, has 25 waterbodies listed for specific pollutants of concern, which are listed in Table 2-1 below.

Table 2-1. Santa Barbara County Section 303(d) Impaired Watersheds

| Watershed | Beneficial Use Impairment |
|---|--|
| Arroyo Burro Creek | Pathogens ² |
| Blosser Channel* | Fecal coliform |
| Bradley Canyon Creek* | Fecal coliform |
| Bradley Channel* | Fecal coliform |
| Carpinteria Creek | Pathogens |
| Carpinteria Marsh | Nutrients, organic enrichment/low dissolved oxygen, priority organics, sedimentation/siltation |
| Goleta Slough | Metals, pathogens, priority organics, sedimentation/siltation |
| Main Street Canal* | Nitrate |
| Mission Creek | Pathogens, unknown toxicity |
| Orcutt Solomon Creek* | Boron, fecal coliform, nitrate |
| Pacific Ocean at Arroyo Burro Beach* | Total coliform |
| Pacific Ocean at Carpinteria State Beach* | Fecal coliform, total coliform |
| Pacific Ocean at East Beach (Mission Creek)* | Fecal coliform, total coliform |
| Pacific Ocean at East Beach (Sycamore Creek)* | Total coliform |
| Pacific Ocean at Gaviota Beach* | Total coliform |
| Pacific Ocean at Hammonds Beach* | Fecal coliform |
| Pacific Ocean at Hope Ranch Beach* | Fecal coliform |
| Pacific Ocean at Jalama Beach* | Fecal coliform, total coliform |
| Pacific Ocean at Ocean Beach* | Fecal coliform, total coliform |
| Pacific Ocean at Point Rincon | Fecal coliform, total coliform |
| Pacific Ocean at Refugio Beach* | Total coliform |
| San Antonio Creek (North County)* | Boron |
| San Antonio Creek (South Coast) | Sedimentation/siltation |
| Santa Maria River* | Fecal coliform, nitrate |
| Santa Ynez River | Nutrients, salinity/TDS/chlorides, sedimentation/siltation |

* Waterbodies that were added to the 2002 list. More information available at <http://www.swrcb.ca.gov/tmdl/docs/2002reg3303dlist.pdf>

² See Section 3.4.1 for explanation of relationship between pathogens and indicator bacteria

The TMDL process has gained more attention in recent years due to lawsuit judgments that have forced local jurisdictions such as Ventura and Los Angeles to establish TMDLs more rapidly.

TMDLs are often created for individual watersheds with cross-jurisdictional boundaries and which may be outside of the NPDES permit area. As such, they offer a unique challenge and opportunity to cooperatively work with all entities that discharge to the local watersheds. Because TMDLs have not yet been established in Santa Barbara County, it is difficult to estimate actual costs associated with specific projects or system components. Nor is it possible to judge their effect on the scope of Project Clean Water.

2.3 Basin Plan Objectives and State Ocean Water Quality Standards

In addition to NPDES and TMDLs, the Regional Water Quality Control Board sets water quality objectives to provide the highest quality water reasonably possible (RWQCB 1994). These are presented in the Water Quality Control Plan, or Basin Plan. The objectives are implemented and enforced through waste discharge permits or NPDES permits. Table A-3 (in Appendix A) lists those objectives, and Table A-4 shows the applicable designated uses assigned to each watershed. The Basin Plan is also implemented by the Board's support of local programs that help achieve the goals of the Basin Plan. Numeric and narrative objectives are established in the Basin Plan and these objectives are used in this report to compare with the results of the 2002-03 water quality monitoring data.

The Basin Plan establishes freshwater objectives for fecal coliform for inland surface waters. However, the standards require a minimum number of sampling events within a given time period. Due to the limited number of sampling events spread out over a significant period of time (several months) comparison to these standards was not possible. Therefore, another set of standards is used to determine creek water quality.

The State Ocean Water Quality Standards for body contact and recreation have been established as follows:

Total Coliform – 10,000 MPN
Fecal Coliform – 400 MPN
Enterococcus – 104 MPN

where MPN is the most probable number, the statistical concentration of bacteria in 100 ml of water. (The fourth standard that is applied is the ratio of total coliform to fecal coliform levels, which was not calculated or utilized, since comparison to individual indicator bacteria standards sufficed for the purposes of this study.) Exceedance of these standards requires the local Health Officer to post warning signs at the beach area where recreational water contact may occur. This same mandate does not currently apply to freshwater areas such as creeks, streams and/or freshwater lakes.

3.0 METHODS

3.1 Sampling Overview

The goals of the 2002-03 water quality monitoring program were to: (1) continue time-series, longitudinal sampling on San Jose Creek to determine the effects of land-use on water quality, (2) continue sampling on Orcutt Creek to determine the effects of land-use on water quality, and (3) ascertain inputs to the Santa Ynez River from the communities of Santa Ynez, Vandenberg Village and Mission Hills. In addition, two special studies were undertaken to determine the effectiveness of a recently installed treatment control project at the south end of Turnpike Road and measure effluent from the Glen Annie Golf Course.

3.2 Sample Sites

While some sampling sites remained the same as in previous years, there were several additions and even more deletions of sites. In the North County, the sampling program remained the same; as in previous years, two full suite sites were located in Orcutt creek at the upstream and downstream end of the urbanized area.

Similarly, Project Clean Water staff sampled the same five sites along San Jose creek that had been sampled last year. These sites were chosen based upon access to the creek and breaks in land-use. The following table, organized from lower to upper sites, shows upstream use of each of the sites.

Table 3-1. San Jose Creek Sampling Locations

| Sampling Location | Predominant Upstream Use(s) |
|-------------------|-----------------------------|
| SJ 023 | Industrial |
| SJ 062 | Commercial |
| SJ 110 | Residential |
| SJ 166 | Agricultural |
| FRM 010 | Residential/Agricultural |

All other regular sampling sites on the South Coast were deleted.

This year, the sampling program shifted a large number of samples to the Santa Ynez River watershed, in an effort to ascertain inputs to the river from nearby communities. Previously, two samples were taken in Vandenberg Village from just downstream the of golf course. This year, sampling was performed at only one sample point further downstream. One sample site was also chosen below the Mission Hills area. These sample points were chosen by Project Clean Water staff to obtain the most data, that is, capture the largest area of urban inputs, for a given sample location. It is important to note that a rather large portion of the runoff from both of these areas enters the Santa Ynez River through smaller tributaries or by sheetflow, both of which are technically and economically unfeasible to sample.

Further upstream in the Santa Ynez River watershed, sample locations were added at Zanja de Cota creek and Alamo Pintado creek. Project Clean Water staff also attempted several late season samples

of creeks in Solvang and Buellton, but sufficient flows in those small, sandy-bottomed creeks never materialized.

Finally, two special studies were performed. The first was to assess the effectiveness of the recently installed bioswale at the southern terminus of Turnpike Road. Samples were taken at the upstream and downstream headwalls of the bioswale. The second special study was to assess both dry- and wet-weather flow from the Glen Annie Golf Course. Samples were taken as water exited the golf course beneath Cathedral Oaks Road in Goleta.

See Table A-1 (in Appendix A) for a list of creeks sampled and Figures A-1a-d for maps of the sample locations. Table A-1 (in Appendix A) also describes the type of sampling that occurred at each site.

3.3 Sample Collection

Grab samples were determined to be the most cost-effective use of resources for this year's program. The advantage of grab samples is they can be collected over a large area with a minimum of field crew. The disadvantage is that they represent a single snapshot of water quality at one instant during a storm. In contrast, composite samples combine smaller samples throughout the storm into one single, more representative sample. However, composite samples still only provide a snapshot of the tremendous amount of water that passes through a creek during a storm, *and* require additional manpower by repeated sampling of the same site or automatic samplers.

Samplers attempted to collect data representing the maximum concentrations or the maximum range of pollutants within the creeks, except on San Jose creek where multiple samples were taken. It was assumed that the most pollutants would be observed in the creeks during the rising limb of the creek hydrograph (i.e., during the period when the water levels in the creek are rising or at their peak). Every effort was made to capture samples during peak runoff in the creek, although many factors affect the timing of peak runoff. Variability due to permeable surfaces (e.g., pavement), orographic effects, saturation of soils, limitations in predicting peak flow and mobilizing personnel over a wide area to collect the samples are some of the factors.

Unlike previous years, no volunteers were used to perform water quality sampling. In most instances, one two-person team gathered all necessary samples. This was possible due to the way rain falls across the County. In only a couple of instances were additional samplers required at the North County sites.

3.4 Analysis Performed

In previous years, up to 128 water quality analytes were chosen based upon previous storm water quality assessments in the southern California area (SCWCS 1998, SCCWRP 1996), analytes required to be monitored by Phase 1 communities under their NPDES permit conditions, and pollutants that may be present in the Santa Barbara South Coast area. General categories of constituents include bacteria, pesticides, VOCs, metals, nutrients and other constituents (such as total suspended sediments and oil and grease).

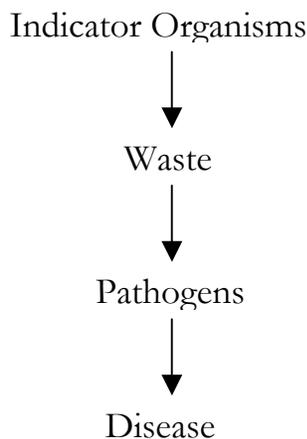
However, due to budget constraints, a smaller subset of these constituents was chosen this year. Glyphosate, organophosphorus pesticides, dissolved metals, nutrients and bacteria were sampled for at most sites by gathering water in appropriate containers and performing lab analyses. In addition, several field parameters were measured with a YSI85 field probe. This was the first year that a field probe was used to gather water quality parameters. All constituents are shown in Table A-2 (in Appendix A), which also shows the EPA method used in processing the constituents, and their associated lab cost.

Each category of analytes is briefly discussed below.

3.4.1 Bacteria

Several watersheds in the county have had TMDLs assigned to them for impairment due to pathogens (see Section 2.2). Pathogens are, by definition, disease-causing organisms. This concern is based upon historic measurements of indicator organisms. Current water quality testing

Figure 3-1 Chain of inference for indicator organisms

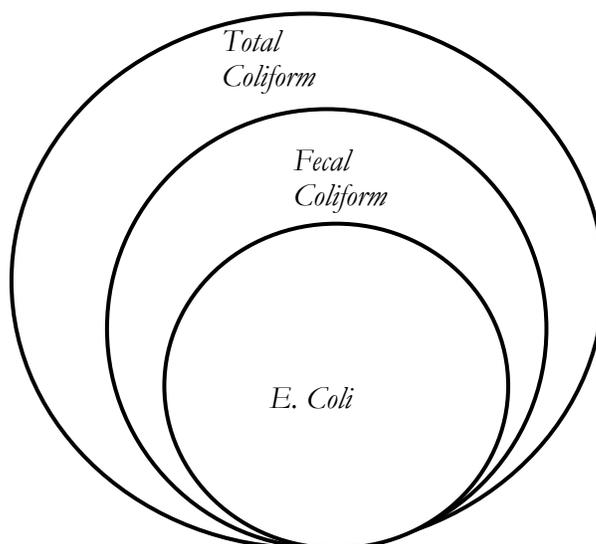


methodology relies on the usage of indicator organisms- total coliform, fecal coliform and enterococcus- as a measure of the potential for human pathogens to be present in the sampled waters. Indicator organisms are more readily detected and quantified than many human pathogens. As shown in Figure 3-1, indicator organisms are used to reveal the presence of waste in a water sample. Waste may be of plant, animal or human origin and may or may not contain human pathogens.

For fecal coliform and enterococcus species, these organisms exist in the intestines of both human and animal populations. Their presence in the water has a relationship to public health risk (e.g. skin rashes, respiratory infections, gastro-intestinal illness and other diseases).

Water samples were collected and sent to the County Public Health Laboratory for analysis of the concentrations of three indicator organisms: total coliform, enterococcus and *Escherichia coli* (*E. coli*) bacteria. Figure 3-2 below displays the relationship between total coliform, fecal coliform, and *E. coli*. *E. coli* bacteria is the most prevalent form of fecal coliform bacteria. This species normally comprises approximately 85-95% of the fecal coliform that may be present in water sample. Once again, the vast majority of *E. coli* bacteria are not human pathogens and in most cases are beneficial to humans by aiding in digestion of food. One subspecies of *E. coli* (0157:H7) is pathogenic. This pathogenic *E. coli* has been involved in several foodborne illness outbreaks.

Figure 3-2. Relationship Among Bacteriologic Indicators (not to scale)



3.4.2 Pesticides

Pesticides include all chemicals used to control “pests” of any sort, including herbicides, insecticides, algacides, fungicides, and rodenticides. Homeowners and commercial operations use these chemicals to control weeds, ants, termites, undesirable garden organisms, etc.

Chlorpyrifos, an organophosphate pesticide, is sold under several trade names, but the most common is Dursban. Chlorpyrifos made headlines several years ago as the EPA and the manufacturer reached an agreement to cease manufacturer’s retail distribution prior to December 2000 and all product sales by December 2001 due to increasing evidence of aquatic toxicity at very low concentrations. Dursban is used for professional as well as non-professional applications, for the control of ants, fleas, and termites.

Homeowners to combat ant infestations often use diazinon, another organophosphate pesticide. Diazinon has been shown to be toxic to aquatic life at very low levels, often below the normal detection limits of testing laboratories. Discussions with pesticide regulators are ongoing regarding the licensing of Diazinon. On December 5, 2000, EPA released its revised risk assessment and announced an agreement with registrants to phase out and eliminate certain uses of Diazinon. It is possible that Diazinon will, like Chlorpyrifos, be removed from the retail shelving in the near future, although we may not see any water quality benefits from these restrictions for years to come.

Glyphosate is a non-selective systemic herbicide that is applied to and absorbed by the leaves of plants. It is available to the general public at most lawn and garden stores under the trade name of

Roundup or Rodeo, which is the form used for aquatic applications. The prevalence and frequency of Glyphosate in the data suggests its common usage and over-application or inappropriate use. There are no known aquatic standards for environmental exposure of Glyphosate; only drinking water standards exist. Environmental toxicity tests show a slight to moderate toxicity (LC50) based upon exposures ranging from 3.9 mg/L for fish (carp) to greater than 1,000 mg/L for crayfish (Pesticide Management Education Program).

3.4.3 Dissolved Metals

Metals are ubiquitous in the environment. Anthropogenic sources of metals include: brake pads, industrial activities, tire wear (steel belted tires), air deposition, and some types of pesticides (copper algicides, etc.). Metals can be toxic and bioaccumulate in both solid and dissolved form. Research has shown that aquatic plants and bivalves are particularly vulnerable to exposure. Thus, bivalves tend to suffer from metal accumulation in polluted environments.

3.4.4 Nutrients

Nutrients are vital to the health of an aquatic environment. However, they can be detrimental to aquatic life in high concentrations. Nitrogen and phosphorus tend to be the most common problematic nutrients because homeowners and agricultural operations add these nutrients to their lawns and gardens in vast quantities to increase productivity. The presence of nutrients can accelerate growth and the preponderance of water plants such as algae. When water becomes stagnant and temperatures increase, algal growth greatly increases, leading to the formation of large patches of thick green algal mats. These mats are not harmful to humans, but reduce light and oxygen availability in the water and may lead to anaerobic conditions, odors, and severe impacts to other aquatic life.

The nitrogen cycle is normally driven by nitrogen fixing bacteria in the soil. Ammonia, often deposited as animal waste, is oxygenated to nitrites and further to nitrates. In an oxygenated environment, nitrites are short-lived.

3.4.5 Other Constituents

Other constituents sampled for include dissolved oxygen specific conductance, salinity, oil and grease, and total recoverable petroleum hydrocarbons, among others. While many of these physical parameters are expected to be present and may not be toxic in the aquatic environment, their concentrations may be indicative of other problems, or useful for general characterization of the creek.

3.4.6 Benthic Macroinvertebrate Sampling

This year, Project Clean Water and the City of Santa Barbara have collaborated in the fourth consecutive year of rapid bioassessment monitoring in streams of the south coast from Gaviota to Carpinteria. Bioassessment, or biomonitoring as it is also called, is the science of using biological assemblages including benthic macroinvertebrates (BMIs), fish, amphibians, and diatoms to assess

and monitor the integrity or “health” of aquatic ecosystems. The Bioassessment Program involves annual collection and analyses of physiochemical and biological data from local streams using standardized methods adapted from the U.S. Environmental Protection Agency’s (USEPA’s) Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers (Barbour et. al., 1999). Annual rapid bioassessment field surveys include assessment and measurement of physiochemical parameters (e.g., water quality, stream flow, stream width and depth, etc.), and the collection of BMI samples, which are the main focus of the Program with respect to biological monitoring. Our goal is to continue the Bioassessment Program over several years to evaluate the ecological health of south-county streams through time. Study and comparison of local streams will provide a better understanding of their physiochemical and biological conditions, and how they are influenced by natural factors and human development.

This year’s Bioassessment Program effort involves the study of 20 individual stream reaches along the south coast, including reaches in Carpinteria Creek (2), Montecito Creek (1), Sycamore Creek (2), Mission Creek (3), Arroyo Burro/San Roque Creek (3), San Antonio Creek (1), Atascadero Creek (2), San Jose Creek (3), Arroyo Hondo (1), San Onofre Creek (1), and Gaviota Creek (1). Field surveys were completed between the dates of May 6th and June 10th by staff from PCW, the City, and the consultant (Ecology Consultants, Inc.). Currently, the consultant is conducting the laboratory analyses of BMI samples collected at the study stream reaches. The laboratory work involves randomly selecting 100 BMIs from each sample (three samples collected per stream reach), and completing taxonomic identifications of the selected BMIs to the family level. Most BMIs were identified to genus (i.e., a finer taxonomic level) in previous years. The decision to identify BMIs to family this year was made in response to (1) overwhelming statistical test results indicating that identifying BMIs beyond the family-level (i.e., to genus) did not provide greater ability/power to detect influences of human disturbance and physiochemical parameters on BMI community structure during the first three years of the Program, and (2) Identifying BMIs to family rather than genus results in a cost savings of 30-40 percent for laboratory work (10-15 percent overall).

After the laboratory work is complete, the consultant, PCW, and City staff will develop a BMI-based Index of Biotic Integrity (IBI) for south coast streams. The IBI will be a multi-metric index that provides a standardized, integrative method for measuring the biological integrity of local streams. Using the IBI, one will be able to take values for several pre-selected BMI metrics (e.g., abundance, diversity, richness, etc.) obtained from a given stream reach, and add them together to produce an overall “score” of biological integrity for the stream reach. BMI metrics pre-selected for use in the IBI will all show distinct separation (i.e., differences) between relatively pristine “reference” streams and human-impacted “test” streams studied from 2000-2003. In other words, the selected BMI metrics will be those that are most sensitive to human disturbance. Statistical analyses of the four years of local stream data including analysis of variance (ANOVA) will be used to determine which BMI parameters are most appropriate for incorporation into the IBI. Once functional, the IBI will translate complex biological data collected at local streams of interest into easily understood scores of biological integrity. In doing so, the IBI will serve as a powerful tool for communicating the biological integrity of local streams to a wide audience, and can be used as an important basis of local watershed management decisions.

The collected data, statistical analyses results, and IBI will be provided in the 2003 Annual Report. The Annual Report is tentatively scheduled for public release next January.

3.5 Precipitation and Storm Tracking

Based upon local experience, samples were collected following a minimum rainfall of at least 0.25 inches within a period of several hours. Amounts less than this or distributed over a longer duration were not expected to generate sufficient runoff to mobilize pollutants. Also, storm water runoff was not sampled if more than 0.25 inches of rain occurred within the previous three days. Antecedent dry conditions of at least three days prior to storm water monitoring is common practice among the Phase I regulated communities, such as Ventura County (Ventura County 1999). Allowing sufficient antecedent dry conditions is thought to maximize the build-up of pollutants and subsequent flux measured in the runoff.

Each storm is unique in the quantity and intensity of rain, so weather data was closely tracked to determine the best time to initiate sampling. Due to the variation in rainfall within the watersheds sampled, sampling was occasionally initiated at a point when some areas received more than 0.25 inches while other areas did not. Every attempt was made to collect data from a storm that delivered at least 0.25 inches to the entire South Coast and/or north county area.

Historical average annual rainfall for the South Coast area is approximately 18 inches per year (based on period from September 1 to August 31, and an average of data since 1868). Rainfall varies greatly from year to year, with a standard deviation of 8.17 inches. (SB County Flood Control 1999). During the 2002-03 storm sampling season, over 24.88 inches of rainfall fell in downtown Santa Barbara.

Weather data available on the Internet from various sources including satellite imagery, radar, and modeling was used to forecast storm events. For real-time data, the County maintains a comprehensive flood warning system, the Automated Local Evaluation in Real Time (ALERT) network, that provides rainfall and stream flow gage data. This network is used to determine when, where, and how much rainfall has occurred. Figure B-1 shows the location of rainfall and stream gauges throughout the county. Hourly precipitation during the sampled storms is shown in Figures B-2 through B-6.

3.6 Sampling QA/QC

Early in the project, Project Clean Water staff developed an extensive quality assurance/quality control plan for field sampling. A sampling protocol document was created (Appendix E) and a preliminary training session was held for the County staff members that would be participating in the sampling. The individuals were composed of Project Clean Water staff and Environmental Health Services staff.

All sample bottles were labeled, handled and transported following the developed protocols. Chain of custody forms identified sample locations, date and time of collection, samplers and time of delivery to testing laboratory and/or transfer to laboratory technicians for transport to testing laboratories. Bacteria analyses were conducted at the Santa Barbara County Public Health

Laboratory, while all other analyses were sent to Zymax Envirotechnology laboratory in San Luis Obispo. The Public Health Laboratory is certified by the State of California's Environmental Laboratory Accreditation Program and Zymax is certified by the State of California's Department of Health Services.

Field duplicates were not taken due to the higher lab cost of processing and previously demonstrated reliability of analysis in the South Coast Watershed Characterization Study (1998). Blanks were not included in the shipment of samples to the labs, again due to the high lab cost of processing the constituents. Each laboratory performed QA/QC procedures according to certification criteria.

4.0 RESULTS & DISCUSSION

Table A-3 shows the Practical Quantitation Limit (PQL) and any known standard or objective for each constituent. The PQL is the lowest level that the lab is confident of reporting. Therefore, a null result means that the constituent was not detected or the lab was not confident of the value because it was at or below the PQL.

4.1 Storm Sampling Results

Samples were taken during five storms. The following table shows the dates of the sampling and the types of samples gathered on those dates.

Table 4-1. Sampling Locations and Dates

| Location | Nov. 7-8 | Dec. 14-16 | Feb. 11-12 | Feb. 24 | Mar. 15 |
|----------|---------------------|----------------------------------|------------|---------|---------|
| OR 1 | Z ¹ FB | ZFB | ZFB | | |
| OR 5 | Z ¹ FB | ZFB | ZFB | | |
| MH | ZFB | ZFB | ZFB | | |
| VV | ZFB | ZFB | ZFB | | |
| SYZ 1 | | ZFB | ZFB | ZFB | |
| SYZ 2 | | | ZFB | ZFB | ZFB |
| SJ 023 | ZFB | ZF ⁴ B ⁵ | ZFB | | |
| SJ 062 | ZFB | ZF ⁴ B ^{5,6} | ZFB | | |
| SJ 110 | Z ^{2,3} FB | ZF ⁴ B ⁵ | ZFB | | |
| SJ 166 | Z ^{2,3} FB | ZF ⁴ B ⁵ | ZFB | | |
| FRM 010 | Z ^{2,3} FB | ZF ⁴ B ⁵ | ZFB | | |

Z=samples sent to Zymax (pesticides, nutrients, metals, oil and grease, TRPH)

F=field measurements taken with YSI85 (specific conductance, conductivity, DO, temperature, salinity)

B=samples sent to Public Health Lab (bacteria)

¹ No organophosphorus pesticides

² No organophosphorus pesticides, second sample

³ No organophosphorus pesticides, third sample

⁴ No field measurements, second sample

⁵ No bacteria, first sample

⁶ No bacteria, third sample

The timing of each storm, precipitation data, and time of sample collection is shown in Appendix B. Except for the time series sampling along San Jose creek, samples were collected during the first few hours of the storm runoff when expected pollutant loads would be at their highest. Sampling during this period is sometimes referred to as the "first flush", a time when pollutants are initially mobilized, especially from impervious areas, and runoff is most concentrated. This is the common thinking, although previous sampling has not always shown this to be true (see Section 4.2.2).

Table C-1 summarizes all results from 2002-03, while Table C-2 summarizes first flush results.

Graphs showing data for all storms and constituents that were detected are shown in Appendix C.

4.2 Summary of Findings

Described below are the findings observed from this year's storm water sampling. Although some geographic and temporal trends were observed and some constituents were found in relatively higher concentrations compared to regional and national criteria and objectives, the data discussed below represent only a handful of samples. Therefore, the data may not necessarily be statistically significant or representative. It is not apparent from these results that any watershed stands out dramatically from the rest as having unusually high concentrations of pollutants during a majority of the storms.

4.2.1 First Flush Sampling

Depending on the constituent, between 31 and 33 first flush samples were taken this year. Trends in data are noted below.

- Every sample exceeded the standards for indicator bacteria, which was similar to previous years.
- In most cases, bacteria results were dramatically lower during the last storm of the season, sometimes by one to two orders of magnitude. This shows how important it is, when presenting the "worst-case scenario," to sample the first storm of the year.
- Diazinon was detected in each of the three samples taken at the middle San Jose sites (SJ 062 and SJ 110), the Fremont site (FRM 010), and the Mission Hills site (MH).
- Average Glyphosate results for San Jose creek were consistently above the overall average.
- Glyphosate was detected in all three samples at lower San Jose creek (SJ 0223) and at Zanja de Cota (SYZ 2).
- Dissolved chromium was detected in each of the three samples taken at the Vandenberg Village site (VV).
- Dissolved zinc was detected predominantly in the first storm of the season.
- At the downstream Orcutt site (OR 1), conductivity, specific conductance (temperature-corrected conductivity) and salinity were consistently higher than at all other first flush sites, especially the upstream Orcutt site (OR 5). A review of the United States Geological Survey's total dissolved solids data reveals similar trends. Informal discussions with other County staff have revealed that further studies are needed to determine the source of these readings. One hypothesis is that the source is now-abandoned oil and gas projects in the Pine Canyon watershed.

4.2.2 San Jose Creek Time-Series, Longitudinal Sampling

Depending on the constituent, between 37 and 45 samples were taken this year. Trends in data are noted below.

- As was shown for a wide range of constituents during 2000-01 at the Atascadero "loading site," sampling during the rising limb of the creek hydrograph may not provide a full representation of the "worst-case scenario." Last year (2001-02), *E. coli* bacteria in the "first flush" samples were about 3-13 times less than the maximum *E. coli* bacteria found in later samples. Similarly, "first

flush” enterococcus samples underestimated the maximum number of bacteria by approximately 2-10 times. This year (2002-03), the same trend was true for total coliform, while higher *E. coli* levels were generally found in the “first flush” samples and no trend was obvious for enterococcus.

- Glyphosate was detected more frequently and at higher levels in later samples, especially the last sample of the last storm.
- Contrarily, Diazinon was detected more frequently and at higher levels in earlier samples, especially the first sample of the first storm.

4.2.3 Special Studies

At the South Turnpike BMP site, samples were taken during a late-season storm. This was done to allow the plants, which had just been placed in the bioswale, to grow and achieve maximum pollutant removal. The results are not very conclusive, due to the limited number and type of samples taken (see Section 3.3 for a discussion of grab samples). Section 5.0 describes staff’s recommendation to continue sampling at the upstream and downstream ends of the bioswale to determine how effective the bioswale is and will become at removing pollutants.

Table 4-2. South Turnpike BMP Site Sampling Results (mg/L)

| Site | S. Turn. BMP-Run-on | S. Turn. BMP-Run-off |
|--|---------------------|----------------------|
| Date | 3/15/2003 | 3/15/2003 |
| Glyphosate | 0.056 | 0.034 |
| Total Recoverable Petroleum Hydrocarbons | ND | ND |
| Chlorpyrifos | ND | ND |
| Demeton | ND | ND |
| Diazinon | ND | ND |
| Malathion | ND | ND |
| Parathion | ND | ND |
| Oil and Grease | ND | ND |
| Dissolved Arsenic | ND | ND |
| Dissolved Cadmium | ND | ND |
| Dissolved Chromium | ND | ND |
| Dissolved Copper | ND | ND |
| Dissolved Lead | ND | ND |
| Dissolved Mercury | ND | ND |
| Dissolved Nickel | ND | ND |
| Dissolved Zinc | 0.02 | ND |
| Ammonical Nitrogen | 0.6 | 0.3 |
| Nitrate as Nitrogen (NO3-N) | ND | ND |
| Nitrite as Nitrogen (NO2-N) | ND | ND |
| Phosphate as Phosphorus (PO4-P) | ND | ND |
| Total Phosphorus | 0.83 | 0.27 |
| Total Kjeldahl Nitrogen | 2.3 | 0.9 |
| pH | 7.0 | 7.7 |
| DO (%) | 92.2 | 96.8 |
| DO (mg/L) | 9.28 | 9.92 |

| Site | S. Turn. BMP-Run-on | S. Turn. BMP-Run-off |
|----------------------|---------------------|----------------------|
| Conductivity | 89.6 | 195.1 |
| Specific Conductance | 110.5 | 245.7 |
| Salinity | 0.1 | 0.1 |
| Temperature | 15.1 | 14.2 |
| Total coliform (MPN) | 120,330 | 173,290 |
| E. coli (MPN) | 1,054 | 7,270 |
| Enterococcus (MPN) | 1,354 | 7,270 |

At the Glen Annie Golf Course site, runoff was sampled during both low-flow conditions and during storm conditions. This study was performed because of previous reports that water leaving the golf course was not in accordance with the course's permits. Indeed, low-flow sampling taken this year was similar to that from previous years, in that nitrate, commonly found in reclaimed water (which the golf course uses for irrigation), was quite high. As such, the Regional Water Quality Control Board, who has jurisdiction in these matters, should approach the golf course owners for an explanation.

Table 4-3. Glen Annie Golf Course Sampling Results (mg/L)

| Site | Glen Annie G.C. (Low Flow) | Glen Annie G.C. (Storm) |
|--|----------------------------|-------------------------|
| Date | 3/12/2003 | 3/15/2003 |
| Glyphosate | 0.036 | ND |
| Chlorpyrifos | ND | 0.00016 |
| Demeton | ND | ND |
| Diazinon | ND | ND |
| Malathion | ND | ND |
| Parathion | ND | ND |
| Ammonical Nitrogen | 0.4 | 0.1 |
| Nitrate as Nitrogen (NO ₃ -N) | 24 | 1.1 |
| Nitrite as Nitrogen (NO ₂ -N) | 1.0 | ND |
| Phosphate as Phosphorus (PO ₄ -P) | ND | 0.7 |
| Total Phosphorus | 0.35 | 3.1 |
| Total Kjeldahl Nitrogen | 2.7 | 2.7 |
| Total coliform (MPN) | | 2,419,200 |
| E. coli (MPN) | | 598 |
| Enterococcus (MPN) | | 6,867 |

4.2.4 Benthic Macroinvertebrate Sampling

A total of 85 rapid bioassessment surveys have been conducted in 44 different stream reaches during the four years of the Program. The locations of the study reaches are shown in Appendix F. The 2002 Annual Report summarizes the findings of the first three years of the Bioassessment Program (2000-2002). The work conducted thus far provides a great deal of insight on relationships between local stream biota, human disturbance, and natural physiochemical parameters, and which biological parameters are the best indicators of stream ecosystem integrity. Key findings of the study thus far are as follows:

- About half of the biological parameters evaluated had significant or marginally significant natural relationships with physiochemical variables. Of the seven physiochemical variables considered, stream temperature and elevation appeared to have the greatest influence on the stream biota.
- Nearly all of the biological community parameters (17 of 18) and many individual BMI taxa were significantly or marginally significantly related to human disturbance. Human-disturbed study reaches were degraded in terms of ecosystem integrity as evidenced by:
 - Impaired water quality in the form of higher stream temperature, specific conductance, and nutrient levels;
 - Lower diversity of BMIs and aquatic vertebrates;
 - Lower composition of disturbance-sensitive BMIs, and;
 - Higher composition of disturbance-tolerant BMIs.
- Urban-impacted sites were typically more degraded in terms of water quality and biology compared to agriculture-impacted sites.
- Differences in water quality and biology between undisturbed and lightly disturbed sites were in most cases minor and not statistically significant.
- The study identified more than 50 biological parameters showing significant or marginally significant relationships with human disturbance. These biological parameters are all potential indicators of stream ecosystem integrity.

The 2002 Annual Report provides a full discussion of the study findings thus far. To view or download the 2002 Annual Report, visit:

http://www.countyofsb.org/project_cleanwater/Documents.htm#BMI_Report_2002

5.0 RECOMMENDATIONS

The storm-water quality data obtained in 1999-2000, 2000-01, 2001-02 and 2002-03 was developed, in part, to be the basis for both efforts to improve water quality and more limited sampling in subsequent years. Since very little was previously known about the characteristics of the County's urban runoff prior to the first year's sampling effort, results from these first four full seasons of water quality testing have established general characteristics of storm water quality and provided a screening-level evaluation of pollution problems in local creeks.

Given the current budget, staff can only recommend continuation of two portions of the current sampling program. As a result, this report will be discontinued in future years and all results and discussions of the benthic macroinvertebrate sampling will be discussed in that program's annual report.

- Continue sampling at the South Turnpike BMP site to determine the pollutant removal efficacy of the bioswale.
- Continue benthic macroinvertebrate sampling.

Below are suggestions that should be considered for future programs, or as suggestions for academic studies.

- Continue sampling San Jose creek in greater detail.
- Continue sampling on selected individual catchments or storm water outfalls within urban areas before the runoff mixes with creek water, particularly at treatment control pilot project sites.
- Conduct a pilot study to determine a spatial distribution of pollutants as measured across a cross section of flow. (This would help establish the variability of water quality in flowing streams, thus providing a basis of estimating sampling error.)
- Consider adding bioassay tests for toxicity, while keeping all other potentially toxic compounds such as metals and pesticides. (This would help establish the relationship of measured pollutants and environmental effects.)

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