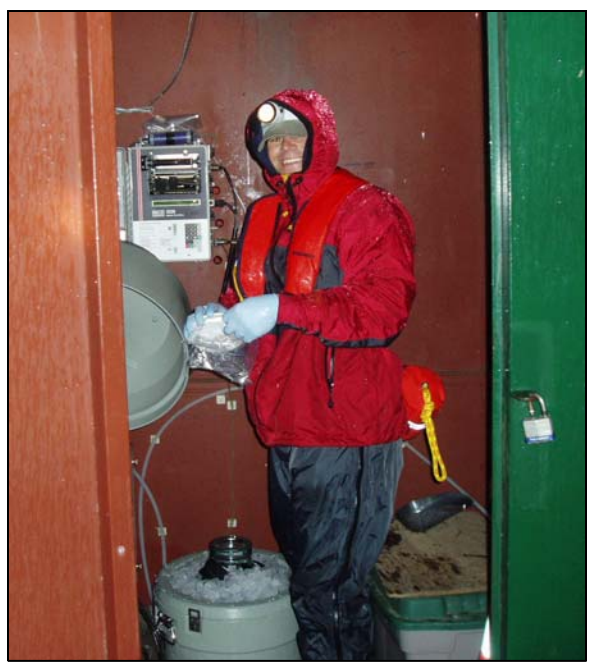
Ventura Countywide Stormwater Quality Management Program

Ventura Countywide Stormwater Monitoring Program
2005/06 Annual Monitoring Report
October 2006



Ventura Countywide Stormwater Quality Annual Monitoring Report Executive Summary

Pursuant to NPDES Permit No. CAS004002, the Ventura Countywide Stormwater Quality Management Program (Management Program) must submit a Stormwater Monitoring Report annually by October 1st summarizing results of water quality monitoring conducted during the monitoring year. Consistent with this requirement the Ventura Countywide Stormwater Quality Management Program has prepared this Report to satisfy the permit requirements as well as to assess the effectiveness of the overall Stormwater Monitoring Program.

This report provides an investigation of stormwater program effectiveness, characterizes the surface water quality of Ventura County, and summarizes water quality data for monitoring conducted during the 2005/06 season. Analysis of samples collected at various monitoring sites throughout the watershed provides information to assess the impact of stormwater runoff and helps characterize the status of surface water quality for watersheds in Ventura County. The monitoring aids in the identification of pollutant sources as well as the evaluation of the Stormwater Monitoring Program's effectiveness. Evaluating the Stormwater Monitoring Program's effectiveness allows for changes to be made and continual improvement of the overall Program. This adaptive management strategy improves the quality and effectiveness of the Stormwater Monitoring Program and minimizes the impact of stormwater pollutant discharges throughout the watersheds.

For the 2005/06 monitoring season, several key points have been identified and are highlighted below.

- **This report presents and discusses the water quality monitoring data collected during four wet weather and two dry weather events monitored by the Ventura Countywide Stormwater Monitoring Program (Stormwater Monitoring Program).** The four wet weather events included monitoring at the Stormwater Monitoring Program's Land Use (Event 1), Receiving Water (Event 1), and Mass Emission (all events) sites, collectively representing all three watersheds (Calleguas Creek, Santa Clara River, and Ventura River) in which the Stormwater Monitoring Program conducts its water quality monitoring activities. The two dry weather events included monitoring only at the Mass Emission stations. The Stormwater Monitoring Program conducted a thorough QA/QC evaluation of the environmental and QA/QC results generated from its analysis of water quality samples and found the resultant data set to have achieved a 94.2% success rate in meeting program data quality objectives. Overall, the 2005/06 monitoring season produced a high quality data set in terms of the low percentage of qualified data, as well as the low reporting levels achieved by all laboratories analyzing the Stormwater Monitoring Program's water quality samples.

- **Sampling equipment was permanently installed at the new Ventura River NPDES Mass Emission Monitoring Station (ME-VR2) located at the Ojai Valley Sanitation District's Treatment Plant above the POTW outfall.** The extremely heavy rainfalls and correspondingly high flows observed in the Ventura River Watershed during January and February 2005 resulted in the need to relocate the original ME-VR Mass Emission station (located on Casitas Vista Road at Foster Park) to a new downstream location due to landslide activity and associated safety concerns at the ME-VR site. The new ME-VR2 Mass Emission site – located approximately one mile downstream of the historical ME-VR site – was first monitored using portable sampling equipment in May 2005. In September 2005, Ventura County Watershed Protection District (VCWPD) staff permanently installed a refrigerated sampler, flow meter, and tipping bucket rain gauge at the new ME-VR2 monitoring site. A digital cellular modem providing remote access to information compiled by all monitoring equipment was installed in June 2006. Due to the unique physical characteristics of the Ventura River at the ME-VR2 monitoring site, a new flow-rating table for this site was developed with assistance from the VCWPD Hydrology Section.

- **VCWPD employed the services of CRG Marine Laboratories, Inc., in order to achieve low detection limits for the majority of the water quality parameters evaluated by the Stormwater Monitoring Program.** As a means of improving the detection capability of various constituents found in the water quality samples collected by the VCWPD, the Stormwater Monitoring Program has again employed the services of CRG Marine Laboratories, Inc (CRG). CRG began analyzing the majority of the water quality parameters evaluated by the Stormwater Monitoring Program at the beginning of the 2003/04 monitoring season. CRG is known for their ability to measure analytes at concentrations much lower than most water quality laboratories. During the current monitoring year, CRG was able to achieve detection limits for trace organic compounds (i.e., organics, PCBs, and pesticides) that are 100 – 1000 times lower than laboratories used in the past. This translates into a current achievable detection limit of 0.01 µg/L for an organic compound such as 1,4-Dichlorobenzene, whereas in years past the detection limit for this constituent was 10 µg/L. Additionally, CRG typically achieved detection limits for metals that are 10 times lower than historic levels for this class of constituent. Additional laboratories used by VCWPD also possess the ability to measure target analytes at very low levels.

- **VCWPD staff evaluated environmental and QA/QC water chemistry data using new *2005/2006 Data Quality Evaluation Plan* and *Data Quality Evaluation Standard Operating Procedures* guidance documents.** The Stormwater Monitoring Program drafted two new guidance documents to help VCWPD staff accurately and consistently evaluate the water chemistry data collected by the Stormwater Monitoring Program. The new *2005/2006 Data Quality Evaluation Plan* (DQEP) describes the multiple step process used by VCWPD staff to identify errors, inconsistencies, or other problems potentially associated with Stormwater Monitoring Program data. Furthermore, the DQEP describes the various data quality objectives (DQOs) to which environmental and QA/QC data are compared as part of the Stormwater Monitoring Program's quality assurance/quality control program. The new *Data Quality Evaluation Standard Operating Procedures* document is a set of written instructions that describes both technical and administrative operational elements undertaken by the Stormwater Monitoring Program in carrying out its DQEP.

- **VCWPD used its water quality database to store and analyze stormwater quality data.** The Stormwater Monitoring Program has invested approximately $150,000 in the past three years to develop a water quality database to further expedite, standardize, and enhance the Stormwater Monitoring Program's data management and data analysis activities. This monitoring season marks the first time that water quality data were received by the Stormwater Monitoring Program as electronic data deliverables (EDDs) due to a recent upgrade of the database that allows it to automatically import electronic data formatted in either Microsoft Excel® or Microsoft Access®. Key database attributes include automatic importation and cursory evaluation of electronically formatted data, semi-automated QA/QC evaluation, automated comparison of the Stormwater Monitoring Program's data to water quality objectives, and a wide array of hard copy and electronic data reporting features. The database has allowed the Stormwater Monitoring Program to improve its overall data management effort by providing staff with a robust data management tool for the storage, analysis, and reporting of stormwater monitoring data.

- **Acute toxicity of *Ceriodaphnia dubia* (water flea) was observed during one wet weather event at Receiving Water site W-3.** Acute toxicity tests using water flea were performed at all Land Use (A-1, I-2, R-1) and Receiving Water (W-3 and W-4) monitoring sites during the first October 2005 monitoring event (Event 1). A TUa > 1 (which demonstrates acute toxicity) was observed at the W-3 Receiving Water site. Although toxicity was detected a subsequent Toxicity Identification Evaluation (TIE) test was unable to identify the toxicant(s) because the toxicity had dissipated in the Receiving Water sample at the time the TIE was performed.

- **No chronic toxicity of *Strongylocentrotus purpuratus* (Purple Sea Urchin) was observed during wet or dry weather events at Mass Emission stations during the 2005/06 monitoring season.** Chronic toxicity tests using purple sea urchin were conducted during two wet weather events (October and November 2005) and one dry weather event (May 2006) at the three Mass Emission stations. Chronic toxicity (as determined by a TUc > 1.0) was not detected at any Mass Emission site.

- **Elevated pollutant concentrations were observed at all monitoring sites during one or more monitored wet weather storm events, as well as at Mass Emission sites ME-CC and ME-SCR during one or more dry weather events.** Constituent concentrations above Los Angeles Region Basin Plan and California Toxics Rule water quality objectives were measured at the following monitoring sites:

Mass Emission Sites

ME-CC	**Anion:** Chloride (dry) **Bacteriological:** E. coli (wet and dry), Fecal Coliform (wet and dry) **Conventional:** Total Dissolved Solids (dry) **Metal:** Aluminum (wet and dry), Mercury **Organic:** Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Bis(2-ethylhexyl)phthalate, Chrysene **Pesticide:** 4,4'-DDD (wet and dry), 4,4'-DDE (wet and dry), 4,4'-DDT (dry)
ME-VR2	**Anion:** Chloride **Bacteriological:** E. coli, Fecal Coliform **Conventional:** Total Dissolved Solids **Metal:** Aluminum, Mercury **Organic:** Bis(2-ethylhexyl)phthalate
ME-SCR	**Bacteriological:** E. coli, Fecal Coliform (wet and dry) **Metal:** Aluminum (wet and dry), Cadmium, Mercury, Nickel, Selenium (dry) **Organic:** Bis(2-ethylhexyl)phthalate, Chrysene

Receiving Water Sites

W-3	**Bacteriological:** E. coli, Fecal Coliform **Conventional:** Total Dissolved Solids **Metal:** Aluminum, Mercury **Pesticide:** 4,4'-DDD, 4,4'-DDE
W-4	**Bacteriological:** E. coli, Fecal Coliform **Conventional:** Total Dissolved Solids **Metal:** Aluminum **Nutrient:** Nitrate as N **Organic:** Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Chrysene, Indeno(1,2,3-cd)pyrene **Pesticide:** 4,4'-DDD, 4,4'-DDE

Even though receiving water objectives are not directly applicable to constituent concentrations measured at Land Use monitoring stations, the Stormwater Monitoring Program performed comparisons between Land Use water quality data and Los Angeles Region Basin Plan and California Toxics Rule objectives as a means of identifying potential pollutants of concern.

Land Use Sites

A-1	**Bacteriological:** E. coli, Fecal Coliform **Conventional:** Total Dissolved Solids **Nutrient:** Nitrate as N **Pesticide:** 4,4'-DDD, 4,4'-DDE

Bioassessment Monitoring

The following were the main findings for the 2005 benthic macroinvertebrate (BMI) survey of the Ventura River Watershed:

- **The September 2005 BMI survey was preceded by winter storms in December 2004, and January and February 2005 that dropped a combined total of 44.5 inches of rain** (23.3 inches above normal) and represented the greatest amount of rain measured during the last five years since BMI sampling began. These storms produced widespread flooding, erosion, and sedimentation throughout the Ventura River Watershed.

- **Physical habitat conditions at the 14 sampling sites ranged from marginal to optimal.** The best habitat scores were at the locations on the upper main stem of the Ventura River, upper San Antonio Creek, and Matilija Creek. The lowest scores were at locations on the lower Ventura River and Canada Larga Creek.

- **Based on the Southern California Index of Biological Integrity (So CA IBI), the aquatic health of the Ventura River Watershed during 2005 ranged from poor to fair.** One site each on the Ventura River and San Antonio Creek ranked in the poor range and the other twelve sites in the watershed ranked in the fair range. The sites that ranked in the poor range were located in areas of the watershed that were impacted by either a large human transient population on the Ventura River or were located downstream of an erosion control project in the vicinity of grazing and stables.

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1. Background

Pursuant to NPDES Permit No. CAS004002[1], the Ventura Countywide Stormwater Quality Management Program must submit a Stormwater Monitoring Report, annually by October 1st, and include the following:

- Status of implementation of the Stormwater Monitoring Program
- Results of the Stormwater Monitoring Program
- General interpretation of the results
- Tabular and graphical summaries of the monitoring data obtained during the previous years.

Consistent with this requirement, the Ventura Countywide Stormwater Quality Management Program (Management Program) has prepared this Report to address the permit requirements as well as to assess the effectiveness of the overall Management Program. The Ventura Countywide Stormwater Monitoring Program (Stormwater Monitoring Program), as originally proposed, is described in Chapter 9 of the Report of Waste Discharge submitted in February 1999. To facilitate the incorporation of information learned during implementation of the Management Program, increase the effectiveness of the Management Program, and streamline stormwater monitoring procedures, modifications to the Stormwater Monitoring Program have been implemented since 1999. As part of this adaptive management strategy, improvements to the *Mass Emission Stations Water Quality Monitoring Standard Operating Procedures (SOP) 2000-2005* were implemented in April 2003 to make them consistent with NPDES No. CAS004002, Order No. 00-108. The Stormwater Monitoring Program includes both stormwater management and scientific elements. The collection and analysis of stormwater samples across Ventura County and the analysis and interpretation of the resulting data are the central activities of the Stormwater Monitoring Program. The Stormwater Monitoring Program is currently conducted with the following four major objectives at its focus:

- Characterizing stormwater discharges from monitoring sites representative of different land uses: industrial, agricultural, and residential
- Establishing the impact of stormwater discharges on receiving waters by conducting receiving water quality, mass emission, and bioassessment monitoring
- Identifying pollutant sources based on analysis of monitoring data, inspection of businesses, and investigation of illicit discharges
- Defining stormwater program effectiveness using data collected before and after implementation of pollution prevention programs

This report provides an overview of stormwater program effectiveness and characterizes the surface water quality of Ventura County. Analysis of samples collected at various sites throughout the watershed gives an overall representation of the impact of stormwater discharges. The monitoring also aids in the identification of pollutant sources as well as the assessment of stormwater program effectiveness. Evaluating program effectiveness allows for changes to be made in the Stormwater Monitoring Program in order to resolve any problems that may exist. This adaptive management strategy improves stormwater monitoring program effectiveness and minimizes the impact of stormwater pollutant discharges on the watershed.

[1] This Order expired July 27, 2005. However, in the absence of a State-issued new permit, the Ventura Countywide Stormwater Quality Management Program has elected to carry out the requirements of the Ventura County Storm Water Quality Management Plan under the expired Order pursuant to 40 CFR 122.6(d).

The pertinent parts of the Stormwater Monitoring Program include the following:

Land Use Site (Discharge Characterization) Monitoring

Land use monitoring is designed to capture stormwater discharge from a specific type of land use. In the Stormwater Management Plan sites are chosen to represent three land use types: agricultural, industrial, and residential.

Land use monitoring began during the 1992-93 monitoring season and is designed to characterize stormwater discharges from the three specific land uses noted above. During the 2005/06 monitoring season, samples from an October 2005 wet weather event were collected for water chemistry and aquatic toxicity at the agricultural (Wood Road, A-1) monitoring site. During the same wet weather event, only aquatic toxicity grab samples were collected at the Ortega Street (I-2) and Swan Street (R-1) Land Use sites because the Stormwater Monitoring Program had already satisfied its NPDES permit condition stating that these two Land Use sites must be monitored a minimum of three times per permit term with respect to the collection of water chemistry samples. However, the Stormwater Monitoring Program is still under a regulatory obligation to collect aquatic toxicity grab samples at these sites in order to amass baseline toxicity information related to land use discharges.

Receiving Water (Tributaries) Monitoring

Receiving water monitoring is designed to characterize the quality of receiving waters rather than discharges to the receiving waters. This type of monitoring evaluates the water quality of smaller waterbodies tributary to main river systems. Monitoring smaller tributaries allows the Stormwater Monitoring Program to focus on smaller sub-basins of the watershed that are not impacted by discharges from wastewater treatment facilities. Monitoring a localized section of the watershed allows the Stormwater Monitoring Program to better examine the impact of stormwater on the watershed than mass emission monitoring (see discussion below). During the 2005/06 monitoring season, the Receiving Water sites La Vista (W-3) and Revolon Slough (W-4) were monitored once in October 2005 under wet weather conditions. Water chemistry and aquatic toxicity samples were collected at both sites. Receiving water monitoring at these sites was first implemented during the 1997-98 season and captures stormwater runoff from the Revolon Slough sub-basin.

Mass Emission Monitoring

The purpose of mass emission monitoring is to identify pollutant loads to the ocean and identify long-term trends in pollutant concentrations. Mass Emission sites are located in the lower reaches of major watersheds. Through water quality monitoring at these sites, the Stormwater Monitoring Program can evaluate the cumulative effects of stormwater and other surface water discharges on beneficial uses in the watershed prior to discharge to the ocean. Both Mass Emission and Receiving Water stations allow for the measurement of water quality conditions in a surface water body, whereas Land Use monitoring stations permit the water quality characterization of discharges to surface waterbodies. Mass Emission monitoring stations allow for the measurement of water quality parameter concentrations resulting from discharges throughout an entire watershed. The Mass Emission drainage areas are much larger than the drainage areas associated with Receiving Water sites, and include other sources of discharge, such as wastewater treatment plants, non-point sources, and groundwater discharges.

Mass Emission stations are located in the three major Ventura County watersheds: Calleguas Creek (ME-CC), Ventura River (ME-VR2), and Santa Clara River (ME-SCR). Each Mass Emission station was monitored this season. During the 2005/06 monitoring season, water quality samples from four wet weather events and two dry weather events were collected for water chemistry at the Mass Emission sites, while aquatic toxicity samples were collected at each site during Events 1 (October 2005), Event 2 (November 2005), and Event 5 (May 2006). Monitoring at the ME-CC station was initiated during the 2000/01 monitoring season, monitoring at the ME-SCR station was initiated during the 2001/02 monitoring season, and monitoring at the newly installed ME-VR2 station was initiated during the 2004/05 monitoring season after landslide activity at the original Ventura River Mass Emission station, ME-VR, precluded further sampling at that location.

Bioassessment Monitoring

The Ventura County Stormwater Monitoring Program also includes the Bioassessment Monitoring Program. Biological assessments (bioassessments) of water resources integrate the effects of water quality over time and are capable of simultaneously evaluating multiple aspects of water and habitat quality. When integrated with physical and chemical assessments, bioassessments help to further define the effects of point and non-point source discharges of pollutants and provide a more appropriate means for evaluating impacts of non-chemical substances, such as sedimentation and habitat alteration. A work plan for in-stream bioassessment monitoring in the Ventura River Watershed was developed and submitted in January 2001 to the Regional Water Quality Control Board (RWQCB) as part of the revised Stormwater Management Plan. For five years, starting in 2001, bioassessment monitoring has been conducted once a year in the fall to compile a baseline data set. The bioassessment monitoring for this reporting period occurred in September 2005, and included samples collected at 14 BMI sampling locations representing main streams and tributaries. This year staff participated in the multiple collection method evaluation for low gradient streams conducted through the Southern California Coastal Water Research Program (SCCWRP) Stormwater Management Coalition (SMC) Bioassessment Workgroup and the California Department of Fish and Game. Bioassessment monitoring is conducted during the fall because it is the time period during which flows are most consistent and macroinvertebrates are most productive and diverse. The fall season provides a consistent, stable environment for sampling that allows for macroinvertebrate comparability from year to year. The results and discussion of the fall 2005 bioassessment monitoring are summarized in Section 2 and presented in their entirety in Appendix O.

Report Contents

This report discusses work conducted from July 2005 to August 2006 and includes precipitation and flow information and associated water quality data from four wet weather events monitored at the Stormwater Monitoring Program's Land Use (Event 1), Receiving Water (Event 1), and Mass Emission (all events) sites, as well as two dry weather events monitored at each of the Mass Emission stations.

This monitoring report is organized into nine sections. The first section provides the background and purpose of the Stormwater Monitoring Program. Section 2 provides a summary of the fall 2005 bioassessment monitoring. Section 3 includes a description of the monitoring sites. Section 4 discusses precipitation and flow conditions at the monitoring sites. Section 5 gives an overview of sample collection procedures and Section 6 provides tabular results of the sample analyses. Section 7 describes the quality assurance and control procedures employed by the Stormwater Monitoring Program. Section 8 discusses the water quality results and Section 9 summarizes mass loadings and comparisons to water quality objectives.

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2. Ventura River Watershed 2005 Bioassessment Monitoring

BMI Survey

The Ventura County Stormwater Monitoring Program also includes the Bioassessment Monitoring Program. Biological assessments (bioassessments) of water resources integrate the effects of water quality over time and are capable of simultaneously evaluating multiple aspects of water and habitat quality. When integrated with physical and chemical assessments, bioassessments help to further define the effects of point and non-point source discharges of pollutants and provide a more appropriate means for evaluating impacts of non-chemical substances, such as sedimentation and habitat alteration. A work plan for in-stream bioassessment monitoring in the Ventura River Watershed was developed and submitted in January 2001 to the Regional Water Quality Control Board (RWQCB) as part of the revised Stormwater Management Plan. For five years, starting in 2001, bioassessment monitoring has been conducted once a year in the fall to compile a baseline data set.

Fifteen benthic macroinvertebrate (BMI) sampling locations were visited during the 2005 bioassessment survey. The survey was conducted by staff members from the Ventura County Watershed Protection District, the Ojai Valley Sanitation District, and Aquatic Bioassay and Consulting Laboratories. Samples were collected on September 13th, 14th, and 15th of 2005 for BMI organisms, physical and habitat observations, flow, and water quality at each location. All of the quality control guidelines for collection, sorting, and identification of BMI organisms specified in the California Bioassessment Protocol (2003) were met. Staff members from the California Department of Fish and Game (CDFG) and /or the Sustainable Land Stewardship Institute (SLSI) audited sample collection activities during each of the four survey years and provided data analysis and reporting services.

The September 2005 BMI survey was preceded by winter storms in December, January and February that dropped a combined total of 44.5 inches of rain (23.3 inches above normal) and represented the greatest amount of rain measured during the last five years since BMI sampling began. These storms produced widespread flooding, erosion, and sedimentation throughout the watershed. As a result of the unusually large amount of rain, 14 of the 15 BMI sampling locations had sufficient flow for sample collection (as compared to nine sites during the 2004 BMI survey possessing sufficient flow to allow sample collection). The 15 locations are described in Table 1. Station 6 was not sampled in 2005 due to lack of flow.

Table 1: BMI Monitoring Stations and Locations

Station	Waterbody	Location
0	Ventura River	1st above estuary
4	Ventura River	Main stem, closest to San Antonio Creek
6	Ventura River	Main stem
12	Ventura River	1st above urban influence
2	Canada Larga Creek	Downstream of grazing
3	Canada Larga Creek	Above grazing impact
5	San Antonio Creek	1st above Ventura River confluence
7	Lion Canyon Creek	1st above San Antonio Creek confluence
15	San Antonio Creek	Above Lion Canyon Creek
8	Stewart Canyon Creek	1st above San Antonio Creek confluence
9	San Antonio Creek	Close to City of Ojai
10	North Fork Matilija Creek	Above influence of Matilija Dam, below quarry
11	North Fork Matilija Creek	Above influence of Matilija Dam, above quarry
13	Matilija Creek	Above dam, below community
14	Matilija Creek	Above dam, above community

2005 Results

Physical habitat conditions at the 14 sampling sites ranged from marginal to optimal, as shown in Figure 1. The best (highest) habitat scores were at locations on the upper main stem of the Ventura River, upper San Antonio Creek and Matilija Creek. The worst (lowest) scores were at locations on the lower Ventura River and Canada Larga Creek. Habitat conditions were scored out of a total possible score of 200.

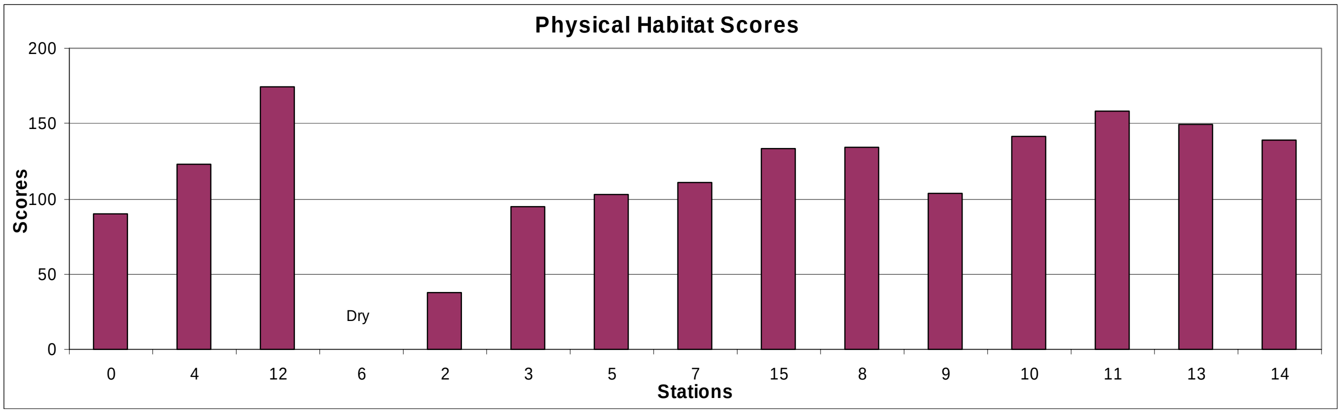

Figure 1: Physical Habitat Scores for Reaches in the Ventura River Watershed, 2005

Based on the Southern California Index of Biological Integrity (So CA IBI), the aquatic health of the Ventura Watershed during 2005 ranged from poor to fair, as shown in Figure 2 (histogram bars are divided by the proportion that each biological metric contributed to the total score). One site each on the Ventura River and San Antonio Creek ranked in the poor range and the other twelve sites in the watershed ranked in the fair range. The sites that ranked in the poor range were located in areas of the watershed that were impacted by either a large transient human population on the Ventura River or was located downstream of an erosion control project in the vicinity of grazing and stables.

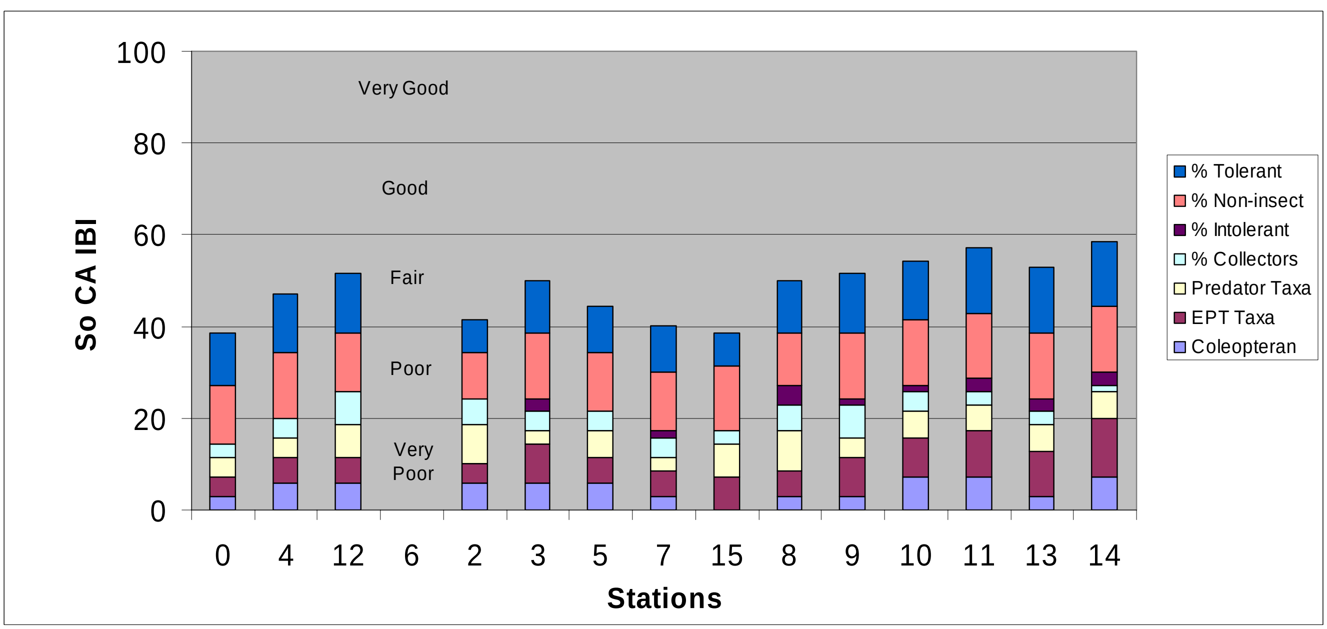

Figure 2: Southern California IBI Scores for sites in the Ventura River Watershed, 2005

The highly invasive New Zealand Mud Snail (*Potamopyrgus antipodarum*) that has infested a number of California waterbodies in recent years was not found in the Ventura River Watershed during the 2005 BMI survey. VCWPD staff takes great precaution to avoid the introduction of the snail into the waterbodies monitored by the Stormwater Monitoring Program.

Figure 3: Benthic Macroinvertebrate Sampling at the North Fork of Matilija Creek (BMI Station 10)

<u>Historical Results (2001-2005)</u>

The best habitat conditions during the five year period from 2001 to 2005 were measured at Station 12 below the Matilija Dam and the worst occurred on Canada Larga Creek above its confluence with the main stem of the Ventura River. Physical habitat scores increased as elevation in the watershed increased, becoming progressively greater on the Ventura River main stem from Station 0 near the ocean to Station 12 below Matilija Dam, and from Canada Larga Creek (Stations 2 and 3) to the North Fork of Matilija Creek (Stations 10 to 14). The greatest variation in physical/habitat scores during the five year period were found at Stations 0 and 2. Station 0 is located just above the confluence of the Ventura River with the ocean and Station 2 is located just above the confluence of Canada Larga Creek with the Ventura River in the lower watershed. The habitats at each of these sites are strongly influenced by the severity of the storm season preceding sampling. During large storms the stream beds are scoured of vegetation and upstream sediments are deposited, which decreases the amount of instream cover present for BMIs. During relatively mild storm seasons, the vegetative and instream cover at these sites remain unchanged. In contrast, the upper watershed (Stations 10, 11, 12 and 13) is characterized as much more stable, owing to a streambed composed mostly of boulder, cobble and gravel, with banks mostly covered with dense stands of vegetation.

During the five year period from 2001 to 2005, the average IBI scores for all sites, except Stations 0 and 1, were in the fair to very good range. The average scores for Stations 0 and 1, each located above the Main Street Bridge, were below the impairment threshold of 39. IBI scores increased with elevation on the Ventura River, Canada Larga Creek (Stations 2 and 3), and San Antonio Creek (Stations 5, 7, 15, 8 and 9). The greatest average IBI score during the five year period was at Station 11 on the North Fork of Matilija Creek. Based on the findings of the 2005 BMI monitoring, it is recommended that the Ventura County Watershed Protection District continue to work with the Southern California Coastal Water Research Project (SCCWRP) to assist in the development of improved BMI sampling design, sampling protocols, taxonomic identification, and analysis techniques.

The complete Ventura County Stormwater Monitoring Program Ventura River Watershed 2005 Bioassessment Monitoring Report prepared by Aquatic Bioassay & Consulting Laboratories is presented in Appendix O.

3. Monitoring Site Locations and Descriptions

The locations of stormwater quality monitoring stations (including current and historical monitoring sites) are shown in Figure 4.

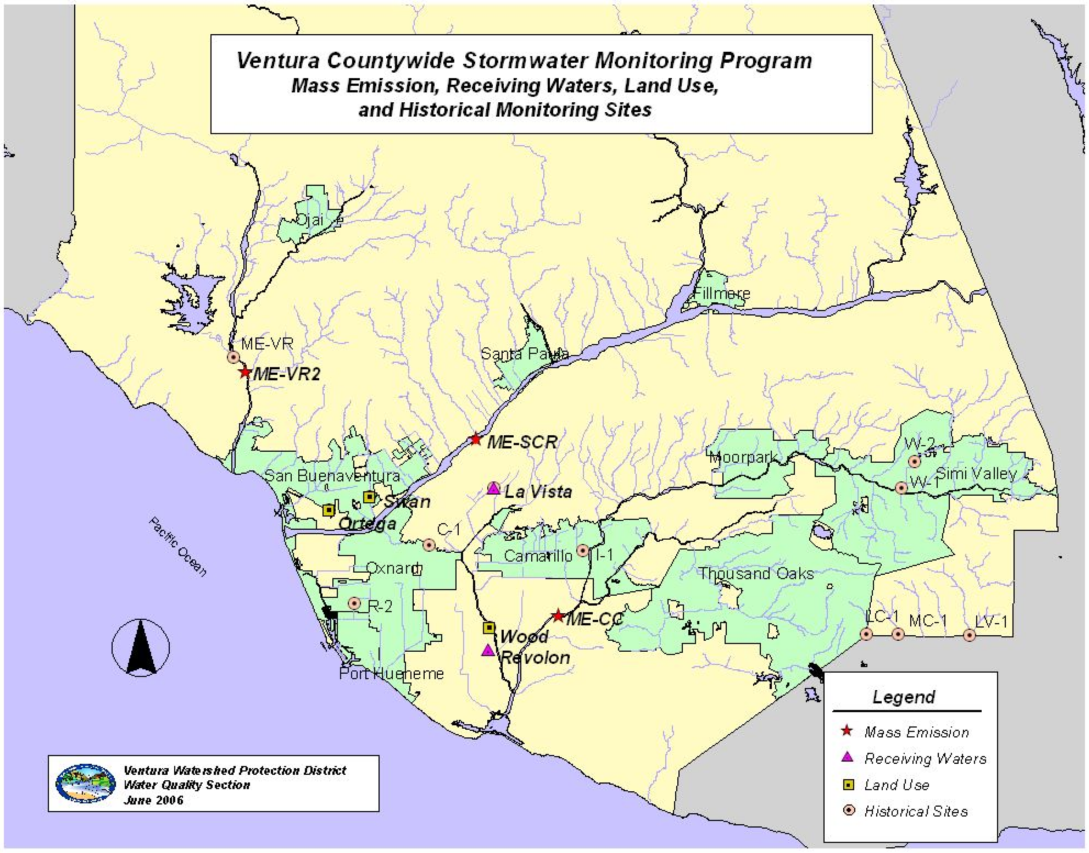

Figure 4: Ventura County Stormwater Monitoring Locations

Table 2 lists rain gauges and their corresponding gauge numbers used by the Stormwater Monitoring Program for recording precipitation that falls near NPDES stormwater monitoring sites.

Table 2: Rain Gauge Sites

ALERT No.	Standard No.	Gauge	Assoc. Monitoring Site
—	194	Camarillo-Adohr	ME-CC
2633	165	Ojai-Stewart Canyon	ME-VR2
110	222a	Ventura County Government Center	I-2, R-1
—	190	Somis-Bard	W-3
2660	171	Fillmore Fish Hatchery	ME-SCR
—	168	Oxnard Airport	A-1, W-4

Sites with multiple gauge numbers represent two different rain gauges located at the same location. The ALERT gauge transmits electronic data to the flood warning ALERT (Automated Local Evaluation in Real Time) system and measures precipitation with an accuracy of 0.04 inches. The standard gauge is a tipping bucket that measures rainfall with an accuracy of 0.01 inches. The more accurate tipping bucket data are used for calculating rainfall totals unless they are unavailable. ALERT gauge numbers are typically 4 digits (i.e. 2633) while tipping bucket gauge numbers are 3 digits (i.e. 165), with the exception of the Ventura County Government Center (i.e., 222/110).

Land Use Sites

The Stormwater Monitoring Program includes three Land Use monitoring sites: Swan Street (R-1), Ortega Street (I-2), and Wood Road (A-1) as shown in Figure 4. Each station is identified by a code related to the primary land use in the monitored watershed: I for industrial, A for agricultural, and R for residential. Photographs of the Swan Street (R-1) and Ortega Street (I-2) stations are provided in Figure 5, and a photograph of the Wood Road (A-1) site is included in Figure 6. The monitoring schedule for the Land Use sites is specified in the *Ventura Countywide Stormwater Monitoring Program: Standard Operating Procedures 2000-2005 Stormwater Monitoring*. During the 2005/06 monitoring season, all Land Use sites were monitored during one wet weather event (Event 1 – 10/17/05) for aquatic toxicity. Only aquatic toxicity grab samples were collected at the Ortega Street (I-2) and Swan Street (R-1) Land Use sites during Event 1 because the Stormwater Monitoring Program had already satisfied its NPDES permit condition which states that these two Land Use sites must be monitored a minimum of three times per permit term with respect to the collection of water chemistry samples. However, the Stormwater Monitoring Program is still under a regulatory obligation to collect aquatic toxicity grab samples at these sites in order to amass baseline toxicity information related to land use discharges. Water chemistry samples were collected at the agricultural (Wood Road, A-1) monitoring site during Event 1 as directed in the NPDES permit. Land Use station characteristics are summarized in Table 3.

Table 3: Land Use Site Characteristics

Station Code	Year Installed	Location	Primary Land Use	Drainage Basin Area (acres)	Rain Gauge Location
R-1	1992 (2003 Upgrade)	Swan Street and Macaw Avenue (City of San Buenaventura)	Residential	65	County Government Center
I-2	1992 (2003 Upgrade)	Ortega Street (City of San Buenaventura)	Industrial	189	County Government Center
A-1	1994 (2001 Upgrade)	Wood Road at Revolon Slough	Agricultural	350 (estimated)	Oxnard Airport

The Swan Street (R-1) site receives runoff from a relatively new (15 to 20 year old) residential neighborhood consisting of single-family dwellings, churches, parks, and a recreation center. The Ortega Street (I-2) site is located in an area of older manufacturing facilities, newer industrial parks, and a few undeveloped city lots. The associated drainage basin for (I-2) consists of diverse types of industrial facilities. The Wood Road (A-1) site receives drainage from the Oxnard Agricultural Plain and is comprised almost entirely of agricultural land (primarily row crops), including a small number of farm residences and ancillary farm facilities for equipment maintenance and storage. All three Land Use monitoring sites are equipped with automated monitoring equipment that collects composite water quality samples as time-paced composites. Sites R-1 and I-2 were upgraded in 2003 with new, portable refrigerated samplers and ISCO 4250 area velocity flow meters.

Receiving Water (Tributaries) Characterization Sites

Two Receiving Water stations are included among the Stormwater Monitoring Program's characterization sites: La Vista (W-3) and Revolon Slough (W-4). Photographs of each site are provided in Figure 6. The land use surrounding both Receiving Water sites is dominated by agriculture. The La Vista station is located in the upper Revolon Slough watershed, and the Revolon Slough station is located in the lower Revolon Slough Watershed at Wood Road as shown in Figure 4. Both Receiving Water sites were sampled during one wet weather event (Event 1 – 10/17/05) for water chemistry and aquatic toxicity during the current monitoring season. Composite water quality samples at sites W-3 and W-4 are collected as time-paced composites. Receiving Water site characteristics are summarized in Table 4.

Figure 5: Land Use Station Photos: R-1 (Swan Street) and I-2 (Ortega Street)

Figure 6: Land Use and Receiving Water Station Photos: A-1 (Wood Road), W-3 (La Vista), and W-4 (Revolon Slough)

Table 4: Receiving Water Site Characteristics

Station Code	Year Installed	Location	Land Uses	Percent Developed	Watershed Area (acres)	Rain Gauge
W-3	1997 (2003 Upgrade)	La Vista Avenue south of Center Road	Agricultural/ Open Space	<2%	752	Somis-Bard
W-4	2001 (2003 Upgrade)	Revolon Slough at Wood Road	Agricultural/ Mixed Use	20%	28,800	Oxnard Airport

Mass Emission Sites

Mass Emission monitoring was conducted in the Santa Clara River, Calleguas Creek, and Ventura River watersheds at the stations shown in Figure 4. Photographs of each Mass Emission monitoring location are presented in Figure 7 (Event 2, November 2005) and Figure 8 (Event 4, February 2006). The two sets of photos show the range of flows observed at the monitoring stations during the 2005/06 season. The site characteristics are summarized in Table 5. Both the ME-SCR and ME-VR2 stations are located in large watersheds possessing diverse inputs of runoff sources, which are dominated by agricultural and urban land uses.

Table 5: Mass Emission Site Characteristics

Station Code	Location	Land Uses	Watershed Area (acres)	Rain Gauge
ME-CC	Calleguas Creek – CSUCI north side of Hueneme Road, just east of Lewis Road at the CSUCI Bridge	Mixed Use	160,640	Camarillo-Adohr
ME-SCR	Santa Clara River – at Freeman Diversion Dam	Mixed Use	1,003,524	Fillmore Fish Hatchery
ME-VR2	Ventura River – Ojai Valley Sanitation District Treatment Plant (OVSDTP)	Mixed Use	134,490	Ojai-Stewart Canyon

The Mass Emission station ME-CC was installed and monitored for the first time during the 2000/01 monitoring season. The ME-SCR site was installed and first monitored during the 2001/02 season. The extremely heavy rainfalls and correspondingly high flows observed in the Ventura River Watershed during January and February 2005 resulted in landslides near the original ME-VR Mass Emission station (monitored since February 2001). Due to safety concerns associated with the landslide activity, the Ventura River Mass Emission site was moved downstream approximately one mile. The new ME-VR2 Mass Emission site (located at the Ojai Valley Sanitation District Treatment Plant, above the POTW outfall) was first monitored using portable sampling equipment in May 2005. A refrigerated sampler, flow meter, and tipping bucket rain gauge were permanently installed at the ME-VR2 site in September 2005 (see Figure 9).

ME-CC and ME-VR2 mass emission samples are collected using automated flow-proportional ISCO 6712 composite samplers. The ME-SCR station also uses an ISCO 6712FR sampler, but the sampler is programmed to collect composite samples on a time-paced basis due to the configuration of the sampling location. The ME-SCR station is located at a dam where water is diverted by United Water Conservation District for ground water infiltration. The diversion configuration poses challenges to the accurate measurement of flows at this location (as discussed in Section 4). Consequently, time-based composite samples are collected at this site rather than flow-proportional composite samples.

Figure 7: Mass Emission Site Photos: ME-CC (Calleguas Creek), ME-SCR (Santa Clara River), and ME-VR2 (Ventura River) during low flows in November 2005 (Event 2)

Figure 8: Mass Emission Site Photos: ME-CC (Calleguas Creek), ME-SCR (Santa Clara River), and ME-VR2 (Ventura River) during higher flows in February 2006 (Event 4)

The Mass Emission stations are also configured for remote access monitoring using state-of-the-art telemetry equipment. Additionally, rain gauges are located at all three Mass Emission sites, and the ME-VR2 and ME-SCR stations feature refrigerated sampling units. These refrigerated sampling units allow the Stormwater Monitoring Program to keep its water quality samples at a constant temperature throughout the duration of a monitoring event and thus comply with sample handling QA/QC objectives. The ME-CC station is monitored using a non-refrigerated, portable sampler which requires the constant icing of samples collected at the site in order to keep them at a temperature of 4° C.

Figure 9: Newly installed ISCO 6712 refrigerated sampler, ISCO 4230 bubbler/flow meter, and steel enclosure at Mass Emission site ME-VR2 located at the Ojai Valley Sanitation District Treatment Plant

4. Precipitation and Flow

Rainfall data compiled for the monitoring sites were obtained from six rain gauges. The data from the gauges associated with a particular monitoring site and events are identified in Figure 10 through Figure 15. With the exception of Land Use sites R-1 and I-2, each monitoring site is equipped with an automatic tipping bucket rain gauge. As mentioned previously, monitoring sites may have two different rain gauges, a tipping bucket and a standard gauge. All precipitation data presented herein are from tipping bucket measurements. As shown in Figure 4, these gauges are located nearby associated monitoring stations or within the tributary watershed. The Ventura County Watershed Protection District currently operates and maintains these gauges.

Historical average annual rainfall in the monitored area varies from 14 to 16 inches per year (based on data for the period between 1950 and 1989). The rainfall totals from October 2005 to May 2006 ranged from 13.0 inches at the Camarillo Sanitation Plant gauge (Station #194) to 23.40 inches at the Ojai-Stewart Canyon gauge (Station #165). The 2005-2006 rain year has produced slightly above normal precipitation totals throughout most of Ventura County. Daily precipitation during the 2005/06 monitoring year and the corresponding monitored storm event dates are shown in Figure 10 through Figure 15. Dry weather monitoring was conducted during the 2005/06 monitoring season at each of the three Mass Emission sites. While the dates of all six monitoring events are noted on each precipitation graph, it should be noted that as few as one event (at Land Use and Receiving Water stations) and as many as six events (at Mass Emission stations) were monitored at any given site. The daily precipitation data from October 2005 through July 2006 used to generate these graphs are presented in Appendix A. The seasonal precipitation pattern at these sites is representative of the pattern throughout the monitoring area.

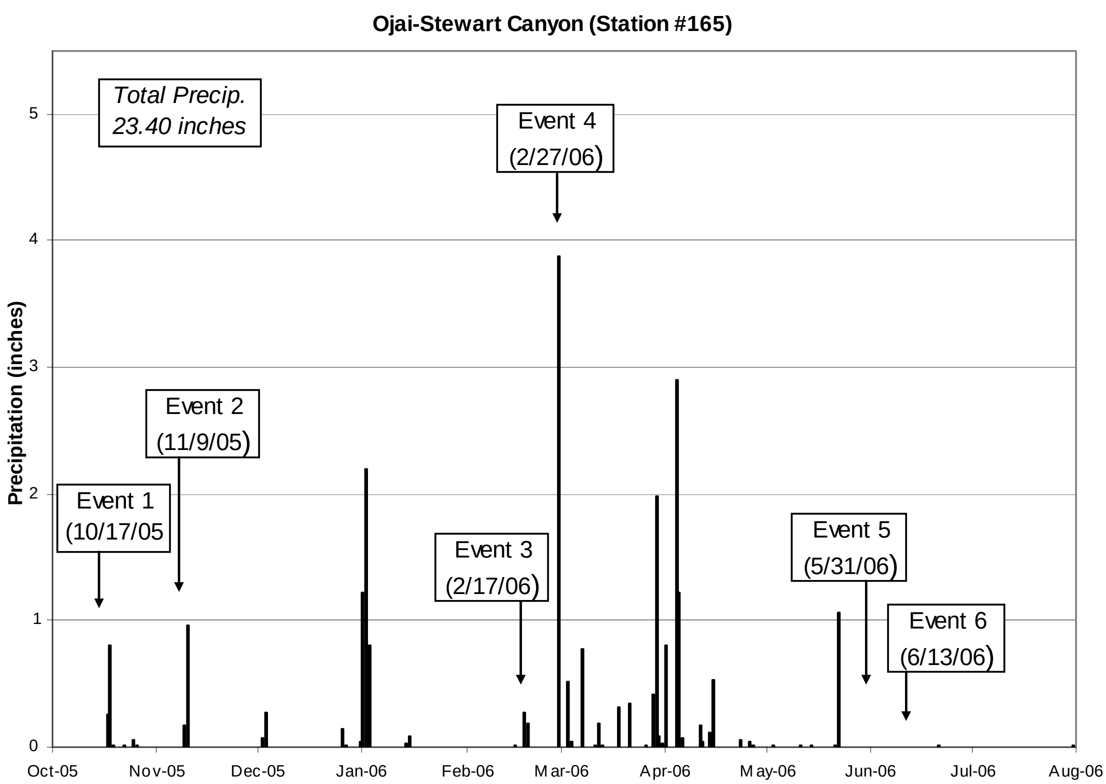

Figure 10: Ojai-Stewart Canyon Rain Gauge (ME-VR2 Monitoring Station)

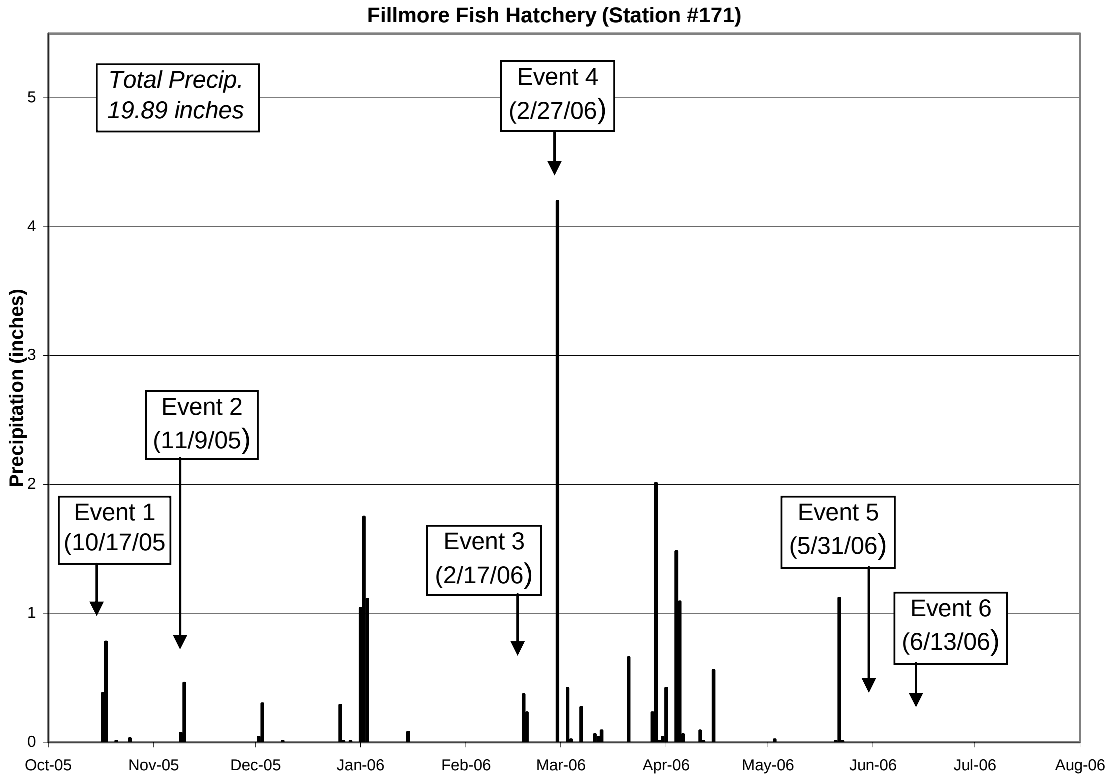

Figure 11: Fillmore Fish Hatchery Rain Gauge (ME-SCR Monitoring Station)

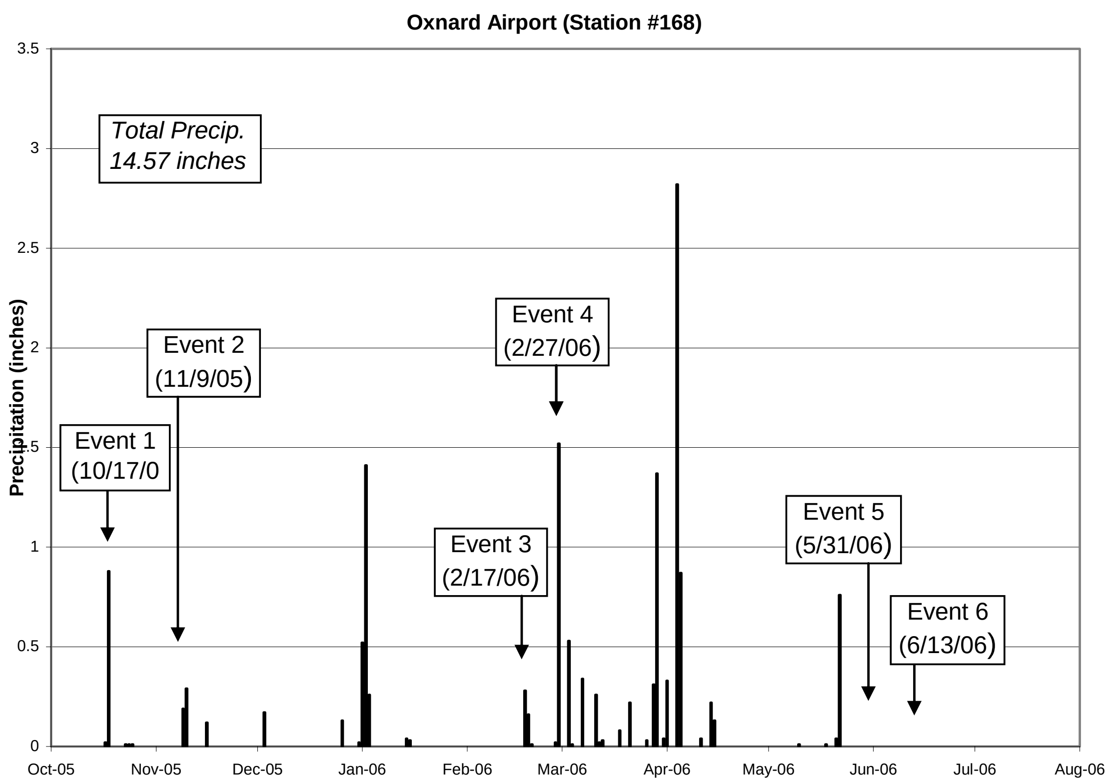

Figure 12: Oxnard Airport Rain Gauge (W-4 and A-1 Monitoring Stations)

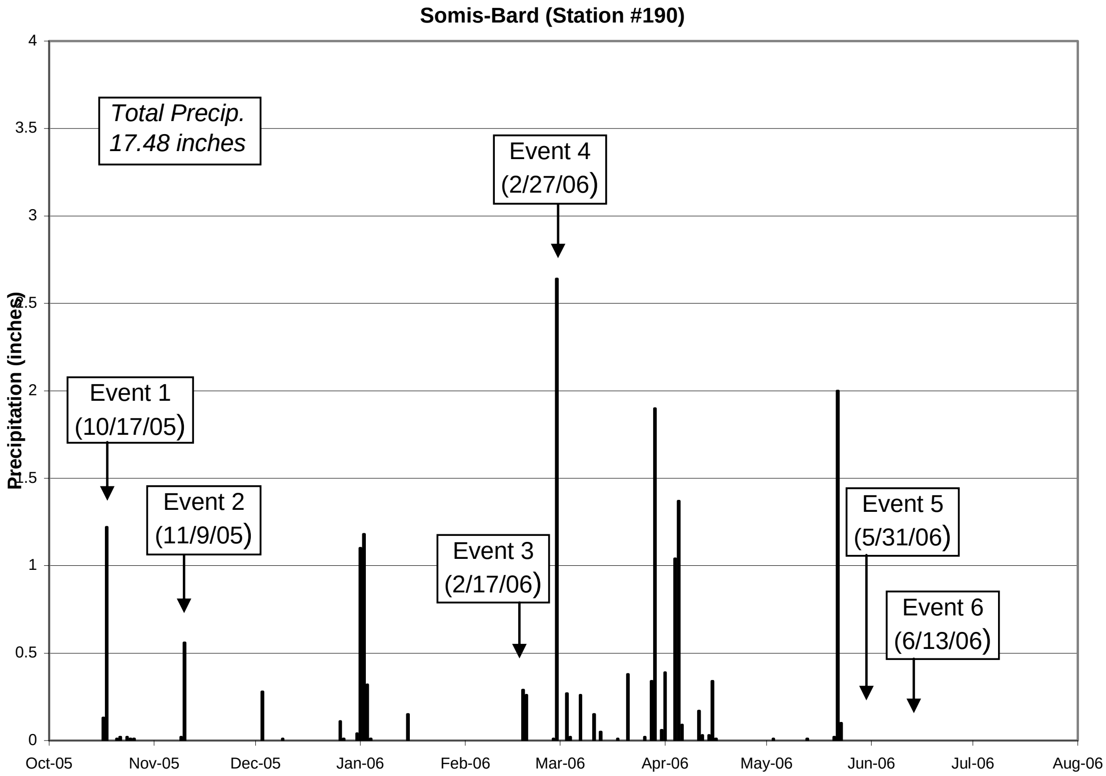

Figure 13: Somis-Bard Rain Gauge (W-3 Monitoring Station)

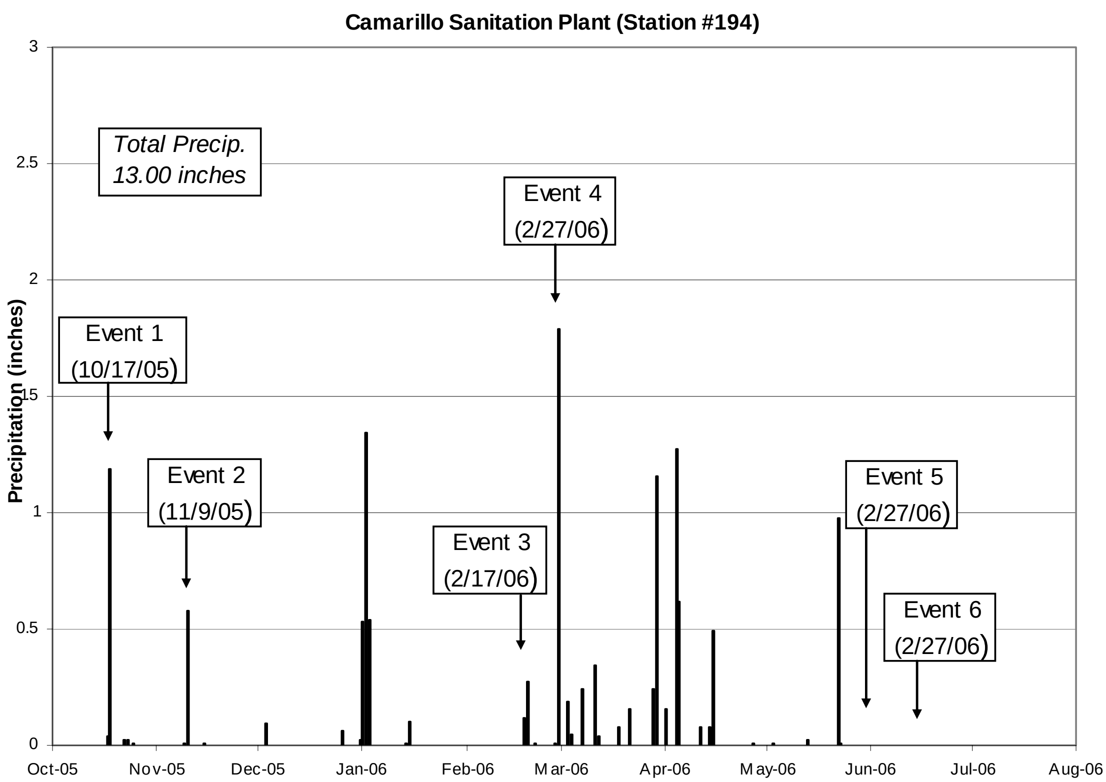

Figure 14: Camarillo-Adohr Rain Gauge (ME-CC Monitoring Station)

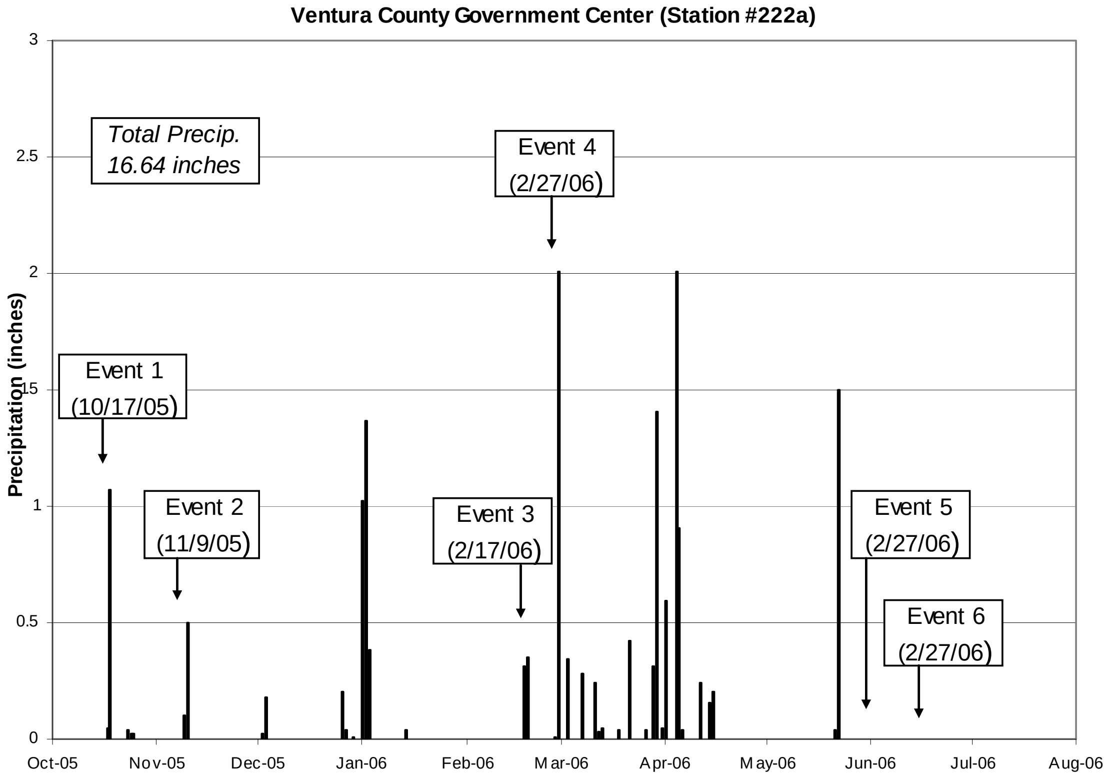

Figure 15: Ventura County Government Center Rain Gauge (R-1 and I-2 Monitoring Stations)

Rainfall variability among all rain gauges employed by the Stormwater Monitoring Program is shown in a graph of cumulative rainfall from October 1, 2005, through July 31, 2006 (see Figure 16). This cumulative rainfall graph nicely illustrates the rainfall variability throughout Ventura County, and hence among the Stormwater Monitoring Program's sites. Unique rainfall and runoff patterns exhibited by each of the monitoring sites adds to the complexity of sample collection for the Stormwater Monitoring Program in terms of capturing the first flush runoff or peak of the hydrograph at a site for any given monitoring event.

Flow Rates

Flow rates were calculated at each of the Mass Emission sites to establish baseline conditions and load estimates. The automated composite sampling equipment collects information on flow rates (in cubic feet per second, CFS) and volumes (in cubic feet, CF) passing by the composite sampler during the monitoring period. Flowlink software, provided by Teledyne/ISCO, the manufacturer of the sampling equipment, allows the user to analyze the data collected by the sampling equipment to calculate flow rates and volumes over any designated time period. The output from this software was used to calculate average flow rates for the four wet weather and two dry weather events monitored during the season. Flowlink software also allows the generation of a composite graph showing an event hydrograph, sample collection times, and precipitation record for a particular monitoring event. These composite graphs were produced for each event monitored during the 2005/06 season and are presented in Appendix B.

The Stormwater Monitoring Program's composite samples are made up of multiple sub-samples (aliquots) collected over a temporal range. Such temporal composite samples can be collected on a flow-proportional basis or time-paced basis. Flow-proportional composite samplers are programmed prior to the monitoring event to collect samples over certain flow volume increments. During flow-proportional sampling, samples are collected on a volumetric-flow interval basis, with a set aliquot volume collected at passage of each equal, pre-set flow volume. These flow volume increments are determined by predicting the duration of rainfall for a storm event and adjusting the sampler accordingly to collect samples during the course of the flow event that best represent the storm event (i.e., capture peak flow). Sample adjustment is based on the estimated volume of water passing by the monitoring station for a given size rain event. The estimate is based on 60 years of rainfall data and takes into account antecedent conditions. Time-paced composite samplers are also programmed according to the predicted duration of rainfall prior to a monitoring event. Under time-paced sampling, equal sample aliquot volumes are collected at equal time intervals. Although composite samplers are automated, VCWPD staff actively monitor storm and flow conditions during each event in order to adaptively adjust the sampler to capture the best representation of storm flow.

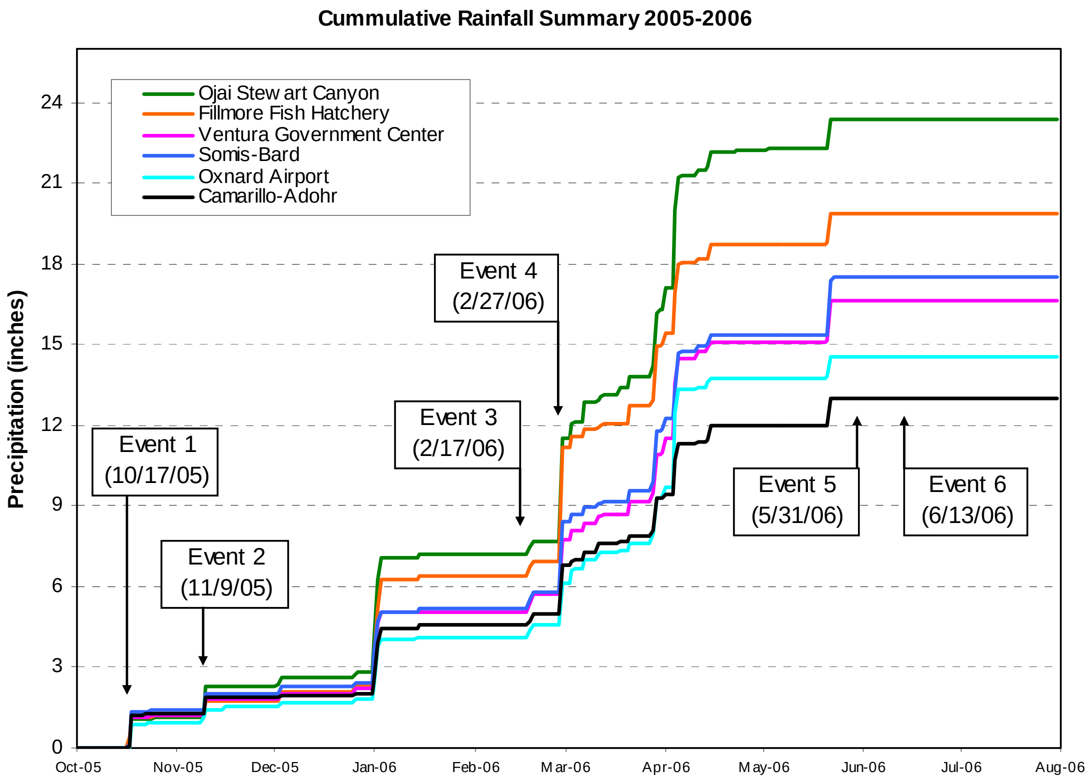

Figure 16: 2005-2006 Cumulative Rainfall Summary for all VCWPD Rain Gauges

Flows at the Santa Clara River (ME-SCR) Mass Emission site are measured using two different meters, one for dry weather and one for wet weather sampling. The ME-SCR site is located on the Santa Clara River at the Freeman Diversion Dam which diverts water into infiltration ponds for groundwater recharge. The United Water Conservation District diverts water from the Santa Clara River during dry conditions for their infiltration facilities. An area velocity flow meter is installed inside the dry weather diversion channel downstream of the infiltration channel gate and is used for measuring dry weather flows (See Figure 17 and Figure 18). No water flows over the diversion dam during dry weather conditions. During wet weather, the Santa Clara River primarily flows through a river diversion gate, shown in Figure 18, in order to maintain connectivity between the diversion structure and the river. However, during higher wet weather flows, water flows through the river diversion gate and over the diversion dam itself. A flow gauge is presently installed at the top of the diversion dam for wet weather monitoring. There is no flow meter installed at the river diversion gate. VCWPD plans on installing a flow meter at the river diversion gate in the future in order to allow the collection of flow-proportional composite samples at the ME-SCR site. However, there are technical challenges involved in placing a non-intrusive flow meter (ultrasonic) at the river diversion gate due to equipment limitations and debris in the flow. Debris present in wet weather flows, such as trees, vegetation or sediment, could cause inaccurate flow readings and damage this type of meter. VCWPD is currently investigating the use of a radar or non-intrusive flow meter for measuring flow at this gate. These types of meters are capable of measuring open channel flows that contain debris. As mentioned previously, composite samples at Mass

Emssion site ME-SCR are collected on a time-paced basis. Figure 17 through Figure 19 show the configuration of the different flow channels at ME-SCR.

Figure 17: ME-SCR Freeman Diversion Dam (Facing Upstream)

Flow measurement in the infiltration channel during dry weather monitoring can also be problematic in that there is no fixed time schedule for diverting water from the river into the infiltration channel which makes it difficult to determine a daily average flow in the infiltration channel. The aforementioned challenges associated with measuring wet and dry weather flows preclude the complete measurement of flows at ME-SCR at this time. However, the VCWPD is working to overcome these difficulties and develop methods for measuring all wet and dry weather flows at the ME-SCR site. Figure 18 through Figure 20 show the river diversion gate, infiltration channel, and diversion dam at ME-SCR.

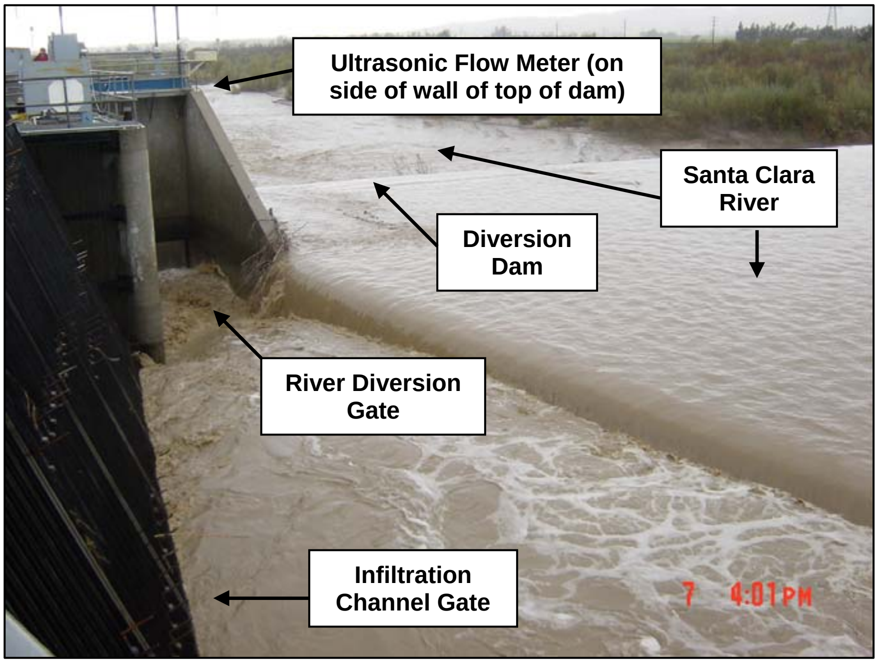

Figure 18: ME-SCR Freeman Diversion Dam (Facing Downstream)

Figure 19: River Diversion Gate (Facing Downstream)

Figure 20: Infiltration Channel (Facing Upstream)

Table 6 summarizes flow rates at the Mass Emission, Land Use, and Receiving Water stations for each of the monitoring events conducted in 2005/06. Event duration is defined as the number of hours elapsed between the first aliquot distributed into the first sample bottle collected through the last aliquot distributed into the last sample bottle collected by a composite sampler. Average flow is determined by averaging all available flow data over the event duration time period. It should be noted that all wet weather flows listed for ME-SCR in Table 6 do not include flow at the river diversion gate, and depending on the flow volume of a particular wet weather event, may represent only a fraction of the total wet weather flow.

Table 6: Site Flow Data and Event Durations

Station	Event No.	Event Date[A]	Average Flow (CFS)	Start Date, Time	End Date, Time	Event Duration
ME-CC						
Wet	1	10/17/2005	62.84	10/17/2005 0:01	10/17/2005 18:02	18:01:00
Wet	2	11/9/2005	116.11	11/9/2005 0:01	11/10/2005 9:42	33:41:00
Wet	3	2/17/2006	60.23	2/17/2006 17:50	2/21/2006 9:44	87:54:00
Wet	4	2/27/2006	1114.88	2/27/2006 6:00	3/1/2006 1:28	43:28:00
Dry	5	5/31/2006	17.97	5/31/2006 5:58	6/1/2006 8:10	26:12:00
Dry	6	6/13/2006	15.47	6/13/2006 5:58	6/14/2006 5:36	23:38:00
ME-VR2						
Wet	1	10/17/2005	10.44	10/17/2005 0:01	10/19/2005 10:59	58:58:00
Wet	2	11/9/2005	23.00	11/9/2005 0:01	11/10/2005 10:31	34:30:00
Wet	3	2/17/2006	21.22	2/17/2006 16:00	2/19/2006 12:12	44:12:00
Wet	4	2/27/2006	263.82	2/27/2006 6:00	3/1/2006 7:17	49:17:00
Dry	5	5/31/2006	33.36	5/31/2006 6:01	6/1/2006 9:56	27:55:00
Dry	6	6/13/2006	32.09	6/13/2006 6:01	6/14/2006 5:36	23:35:00
ME-SCR[B]						
Wet	1	10/17/2005	0.15	10/17/2005 0:01	10/18/2005 14:26	38:25:00
Wet	2	11/9/2005	0.04	11/9/2005 0:01	11/10/2005 0:01	24:00:00
Wet	3	2/17/2006	*C*	2/17/2006 19:11	2/19/2006 18:41	47:30:00
Wet	4	2/27/2006	541.31	2/27/2006 6:00	3/1/2006 9:45	51:45:00
Dry	5	5/31/2006	7.31	5/31/2006 6:00	6/1/2006 5:44	23:44:00
Dry	6	6/13/2006	7.30	6/13/2006 6:00	6/14/2006 5:44	23:44:00
A-1						
Wet	1	10/17/2005	0.92	10/17/2005 0:01	10/18/2005 8:13	32:12:00
I-2						
Wet	1	10/17/2005	*D*	10/17/2005 12:30	10/17/2005 12:30	N/A
R-1						
Wet	1	10/17/2005	*D*	10/17/2005 11:30	10/17/2005 11:30	N/A
W-3						
Wet	1	10/17/2005	1.55	10/17/2005 0:01	10/18/2005 13:59	37:58:00
W-4						
Wet	1	10/17/2005	*E*	10/17/2005 0:01	10/18/2005 12:59	36:58:00

A. Event Date describes the date on which composite sampling began for a particular monitoring event.

B. During wet weather the Santa Clara River flows through the river diversion gate and over the diversion dam. Currently, there is no flow meter installed at the river diversion gate where a majority of the wet weather flow passes. It should be noted that until a flow meter is installed at the river diversion gate, these values only represent a portion of the total wet weather flow at ME-SCR (see Flow Rates section above for further information).

C. Event 3 (2/17/06) at the ME-SCR site produced insufficient flows to be measured by the flow meter located at the top of the diversion dam. Ostensibly, all flows produced during this event were redirected through the river diversion gate and into the infiltration channel.

D. Only aquatic toxicity grab samples were collected from Land Use sites I-1 and R-1 during Event 1 (10/17/05).

E. Flow measured at the W-4 site during Event 1 (10/17/05) was considered erroneous due to approximately one foot of sediment that has built up at the stream gauge since its installation. Sediment build up has produced a back water effect that prevents the accurate measurement of water levels and flow volumes in Revolon Slough. Due to these conditions, the VCWPD Hydrology Section has since moved the stream gauge 776A – Revolon Slough from Laguna Road upstream to Pleasant Valley Road.

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5. Sample Collection

Sampling conducted by the Stormwater Monitoring Program during the 2005/06 monitoring season consisted of the capturing of the first flush storm event in Ventura County on October 17, 2005, followed by the monitoring of one early-season (November) and two mid-season (February) storms. Storm event sampling criteria contained in the NPDES permit specify that not more than 0.1 inch of rain shall occur during the 72 hours preceding a monitored event. Storms are selected for monitoring based on the antecedent conditions (72-hour dry period), fulfillment of the dry period, and predicted precipitation. The two dry weather events were monitored during the months of May (Event 5) and June (Event 6). Dry weather events are monitored when there has been at least a 72-hour antecedent dry period without measurable rainfall (< 0.01 inches).

At the Calleguas Creek (ME-CC) and Ventura River (ME-VR2) sites automated composite samplers are programmed to collect flow-proportional samples based on water volume passing by the station during wet and dry weather monitoring. The flow volume necessary to trigger sample collection is determined based on the predicted amount of precipitation over a specific period of time and the estimated volume of runoff from the watershed. These values are based on 60 years of historic precipitation data used to develop runoff tables included in the Standard Operating Procedures. Samples at ME-SCR are collected on a time-paced basis during wet weather monitoring because flow-proportional compositing is not possible due to the diversion of Santa Clara River water by the United Water Conservation District. The Stormwater Monitoring Program has installed a flow gauge in the diversion channel to monitor flow diverted to infiltration ponds during dry weather, as well as a flow meter on top of the Freeman Diversion Dam to measure flow during wet weather. Due to the absence of permit requirements specifying the collection of flow proportional samples, time-paced composite samples were collected at the Land Use (A-1) and Receiving Water (W-3, W-4) sites. Only aquatic toxicity grab samples were collected at the Ortega Street (I-2) and Swan Street (R-1) Land Use sites during Event 1 (10/17/05) because the Stormwater Monitoring Program had already satisfied its NPDES permit condition stating that these two Land Use sites must be monitored a minimum of three times per permit term with respect to the collection of water chemistry samples. However, the Stormwater Monitoring Program is still under a regulatory obligation to collect aquatic toxicity grab samples at these sites in order to amass baseline toxicity information related to land use discharges.

The Santa Clara River (ME-SCR), Wood Road (A-1), and both Receiving Water (La Vista, W-3, and Revolon Slough, W-4) monitoring sites have hard line phone and electrical connections and refrigerated sampling units. The Ventura River (ME-VR2) site also possesses an electrical connection and refrigerated sampling unit, but communication with the sampling equipment is made possible via a cellular phone connection. The Calleguas Creek (ME-CC) station possesses a cellular phone connection and runs on solar/battery power. The Ortega Street (I-2) and Swan Street (R-1) Land Use sites do not possess phone or power connections, and utilize portable refrigerated samplers for sample collection. Automated data logging is available at all sites, while tipping bucket rain gauges are installed at all sites except for I-2 and R-1. Additionally, all sites except for I-2 and R-1 can be remotely accessed via telemetry, including the area velocity flow meter installed in the infiltration channel at ME-SCR.

The sampling methods and sample handling procedures used during the 2005/06 monitoring year are based on EPA Method 1669 and are described in the revised *Ventura Countywide Stormwater Monitoring Program: Water Quality Monitoring Standard Operating Procedures 2000-2005 Stormwater Monitoring* (LWA, 2001) – a document also referred to as the *Land Use and Receiving Water SOP*. The sampling methods and sample handling procedures employed at Mass Emission monitoring sites are also based on EPA Method 1669 and are described in *Ventura Countywide Stormwater Monitoring Program: Mass Emission Stations Water Quality Monitoring Standard Operating Procedures 2000-2005* (VCWPD, 2003) – a document also referred to as the *Mass Emission SOP*. The parameters required to be monitored by the Stormwater Monitoring Program are described as a part of NPDES Permit No. CAS004002 Section No. CL 7388. The Stormwater Monitoring Program produces an *event sample matrix* for each event prior to its monitoring as a means of documenting the specific environmental and QA/QC samples to be collected at any given monitoring site for a particular event, as well as the specific sample container to be used when collecting a certain sample. All event sample matrices associated with the 2005/06 monitoring season are presented in Appendix C.

Figure 21: Grab Sample Collection in the Ventura River using EPA Sampling Protocols

Figure 22: ISCO 6712 sampler (cover removed showing iced carboy) and ISCO 4230 bubbler/flow meter used to collect composite samples at Mass Emission site ME-CC

At Mass Emission, Receiving Water, and Land Use sites, both composite and grab samples are collected. Composite samples are collected in glass containers and then delivered to the lab where they are split by pouring off with a tipper. When the splitting of a composite sample is performed, the composite sample is continually rocked in a sample-pouring stand to provide as much "non-invasive" mixing as possible. Sample splitting allows homogeneous aliquots of a single, large water sample to be divided into several smaller samples for the purpose of delivering these smaller volumes of water to individual analytical laboratories as necessary. The volume of sample collected depends upon the volume required by the lab to perform requested water quality and QA/QC analyses.

In an effort to maintain quality control for the sampling program, the sampling crew, in cooperation with the analytical laboratories, has minimized the number of laboratories and sample bottles used for analysis. This has minimized bottle breakage, increased efficiency, and reduced the chances for contamination of the samples. Also, a dedicated monitoring team is used to provide consistent sample collection and handling. Remote access capability at all but two Land Use monitoring sites (I-2 and R-1) also provides data-on-demand which allows immediate onsite evaluation of stream conditions.

For constituents analyzed from samples required to be collected as “grabs”, samples are ideally taken at the peak runoff flow to provide the best estimate for an event mean concentration (EMC). In practice it is difficult to both predict the peak flow and to allocate manpower such that all sites are grab-sampled at the storm event peak flow. It should be noted that peak flow times vary for each monitoring station due to the size and inherent characteristics of the watershed in which the site is located. All grab and composite wet weather samples collected during the 2005/06 monitoring season are considered best available estimates of storm EMCs. During dry weather, time-paced composite samples are collected at each site over a 24 to 48-hour period. Dry weather grab samples are collected during this composite sample period. Table 7 summarizes the samples collected at each of the monitoring locations during the 2005/06 monitoring season. As a means of documenting all preparatory, operational, observational, and concluding activities of a monitoring event, the Stormwater Monitoring Program produces an *event summary* for each monitoring event it conducts. These event summaries include, but are not limited to information related to event duration, predicted and actual precipitation, weather conditions, the programming of sampling equipment, equipment malfunctions, sample collection and handling, and sample tracking with respect to delivery to an analytical laboratory. All event summaries associated with the 2005/06 monitoring season are presented in Appendix D.

Table 7: 2005/06 Monitoring Event Summary

Event Number	*Event Date*	*A-1 Wood Road*	*I-2 Ortega Street*	*R-1 Swan Street*	*W-3 La Vista Avenue*	*W-4 Revolon Slough*	*ME-CC Calleguas Creek-CSUCI*	*ME-SCR Santa Clara River*	*ME-VR2 Ventura River-OVSDTP*
1	10/17/05	CGT	T	T	CGT	CGT	CGT	CGT	CGT
2	11/9/05	-	-	-	-	-	CGT	CGT	CGT
3	2/17/06	-	-	-	-	-	CG	CG	CG
4	2/27/06	-	-	-	-	-	CG	CG	CG
5	5/31/06	-	-	-	-	-	CGT	CGT	CGT
6	6/13/06	-	-	-	-	-	CG	CG	CG

Notes:
“G” indicates that a grab sample was collected.
“C” indicates that a composite sample was collected.
“T” indicates that toxicity samples were collected.
“-” indicates that no sample was collected.

In addition to documenting the water quality samples scheduled for collection during an event through the generation of an event sample matrix, the Stormwater Monitoring Program also documents the actual samples it collects – and their date and time of collection – during the course of an event by completing a chain of custody (COC) form for each sampling event conducted at a monitoring site. The COC form not only documents sample collection, but also notifies an analytical laboratory that a particular sample should be analyzed for a certain constituent or group of constituents, oftentimes specifying the analytical method to be employed. Finally, the COC form acts as an evidentiary document noting how many samples were relinquished – and at what date and time – to a particular laboratory by the Stormwater Monitoring Program. All chain of custody forms associated with the 2005/06 monitoring season are presented in Appendix E.

Figure 23: A Great Egret feeding along the bank of Calleguas Creek, February 2006

6. Analyses Performed

Stormwater Monitoring Program analyses include those for anions, bacteriologicals, conventionals, hydrocarbons, trace metals, nutrients, semi- and non-volatile organics, PCBs, various pesticides, including chlorinated and organophosphorus compounds, acute and chronic toxicity, and bioassessment. The following laboratories analyzed Stormwater Monitoring Program water quality samples during the 2005/06 monitoring season:

- CRG Marine Laboratories, Inc. of Torrance, CA performed all tests except for perchlorate, BOD, TOC, TKN, MTBE, Glyphosate, pesticides analyzed via EPA 8151A, bacteria, toxicity, and bioassessment;

- Calscience Environmental Laboratories, Inc. performed the following analyses: perchlorate, BOD, TOC, TKN (Events 1 and 2), MTBE, 2,4,5-T, 2,4,5-TP (Silvex), 2,4-D, 2,4-DB,Dalapon, Dicamba, Dichlorprop, Dinoseb, MCPA, and MCPP;

- Ventura County Health Care Agency Laboratory performed bacteriological tests for E. coli, Enterococcus, and Total and Fecal Coliforms for Events 1 – 4;

- Thomas Analytical Laboratory was used to perform Total Kjeldahl Nitrogen (TKN) analyses for Events 3 – 6;

- MWH Laboratories was used to perform Glyphosate analyses for Events 1 – 3;

- Weck Laboratories, Inc. was used to perform Glyphosate analyses for Events 4 – 6; and

- Aquatic Bioassay & Consulting Laboratories, Inc. performed all toxicity tests, as well as bacteriological tests for E. coli, Enterococcus, and Total and Fecal Coliforms for Events 5 – 6.

Analytical methods employed by all laboratories comply with those outlined in the permit. The analytical methods employed allow the laboratories to achieve the lowest possible detection limits.

The aquatic toxicity tests were conducted by Aquatic Bioassay & Consulting Laboratories, Inc. of Ventura, CA under the guidelines prescribed in *Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms* (EPA 600/4-85/013). The toxicity tests included acute *Ceriodaphnia dubia* survival and chronic purple sea urchin (*Strongylocentrotus purpuratus*) fertilization bioassays. Aquatic Bioassay & Consulting also performs the macroinvertebrate bioassessment testing (including taxonomic identification and data analysis) and reporting in addition to aquatic toxicity bioassays and bacteriological analyses.

Table 8 provides a complete listing of the constituents and associated analytical methods for all water quality analyses conducted by the Stormwater Monitoring Program during the 2005/06 monitoring year.

Table 8: Constituents and Analytical Methods for Water Quality Analyses Conducted by the Stormwater Monitoring Program 2005/06

Classification	Constituent	Fraction	Method	Analytical Laboratory
Anion Analyses	Bromide	n/a	SM 4500-Br	CRG
	Chloride	n/a	SM 4500-Cl E	CRG
	Perchlorate	n/a	EPA 314.0	Calscience
Bacteriological Analyses	E. coli	n/a	MMO-MUG[1] & Colilert-18[2]	VCHCA and ABC
	Enterococcus	n/a	Enterolert	VCHCA and ABC
	Fecal Coliform	n/a	SM 9221 E[1] & Colilert-18[2]	VCHCA and ABC
	Total Coliform	n/a	MMO-MUG[1] & Colilert-18[2]	VCHCA and ABC
Conventional Analyses	BOD	n/a	EPA 405.1	Calscience
	Conductivity	n/a	SM 2510	CRG
	Hardness as CaCO3	Total	SM 2340 B	CRG
	pH	n/a	EPA 150.1	CRG
	Total Dissolved Solids	n/a	SM 2540 C	CRG
	Total Organic Carbon	n/a	EPA 415.1	Calscience
	Total Suspended Solids	n/a	SM 2540 D	CRG
	Turbidity	n/a	EPA 180.1	CRG
Hydrocarbon Analyses	Oil and Grease	n/a	EPA 1664A	CRG
	TRPH	n/a	EPA 418.1 & EPA 1664	CRG
Metals Analyses	Aluminum	Dissolved	EPA 200.8m	CRG
	Aluminum	Total	EPA 200.8m	CRG
	Arsenic	Dissolved	EPA 200.8m	CRG
	Arsenic	Total	EPA 200.8m	CRG
	Cadmium	Dissolved	EPA 200.8m	CRG
	Cadmium	Total	EPA 200.8m	CRG
	Chromium	Dissolved	EPA 200.8m	CRG
	Chromium	Total	EPA 200.8m	CRG
	Chromium VI	Total	SM 3500-Cr	CRG
	Copper	Dissolved	EPA 200.8m	CRG
	Copper	Total	EPA 200.8m	CRG
	Lead	Dissolved	EPA 200.8m	CRG
	Lead	Total	EPA 200.8m	CRG
	Mercury	Dissolved	EPA 1631E	CRG
	Mercury	Total	EPA 1631E	CRG
	Nickel	Dissolved	EPA 200.8m	CRG
	Nickel	Total	EPA 200.8m	CRG
	Selenium	Dissolved	EPA 200.8m	CRG
	Selenium	Total	EPA 200.8m	CRG
	Silver	Dissolved	EPA 200.8m	CRG
	Silver	Total	EPA 200.8m	CRG
	Thallium	Dissolved	EPA 200.8m	CRG
	Thallium	Total	EPA 200.8m	CRG
	Zinc	Dissolved	EPA 200.8m	CRG
	Zinc	Total	EPA 200.8m	CRG

Table 8 (Continued): Constituents and Analytical Methods for Water Quality Analyses Conducted by the Stormwater Monitoring Program 2005/06

Classification	Constituent	Fraction	Method	Analytical Laboratory
Nutrient Analyses	Ammonia as N	n/a	SM 4500-NH3 F	CRG
	Nitrate as N	n/a	EPA 300.0	CRG
	Nitrite as N	n/a	EPA 300.0	CRG
	Orthophosphate as P (Diss)	n/a	EPA 300.0	CRG
	TKN	n/a	EPA 351.3[3] & EPA 351.1[4]	Calscience and TA
	Total Phosphorus	Dissolved	SM 4500-P C	CRG
	Total Phosphorus	Total	SM 4500-P C	CRG
Organic Analyses	1,2,4-Trichlorobenzene	n/a	EPA 625m	CRG
	1,2-Dichlorobenzene	n/a	EPA 625m	CRG
	1,3-Dichlorobenzene	n/a	EPA 625m	CRG
	1,4-Dichlorobenzene	n/a	EPA 625m	CRG
	1-Methylnaphthalene	n/a	EPA 625m	CRG
	1-Methylphenanthrene	n/a	EPA 625m	CRG
	2,3,5-Trimethylnaphthalene	n/a	EPA 625m	CRG
	2,4,6-Trichlorophenol	n/a	EPA 625m	CRG
	2,4-Dichlorophenol	n/a	EPA 625m	CRG
	2,4-Dimethylphenol	n/a	EPA 625m	CRG
	2,4-Dinitrophenol	n/a	EPA 625m	CRG
	2,4-Dinitrotoluene	n/a	EPA 625m	CRG
	2,6-Dimethylnaphthalene	n/a	EPA 625m	CRG
	2,6-Dinitrotoluene	n/a	EPA 625m	CRG
	2-Chloronaphthalene	n/a	EPA 625m	CRG
	2-Chlorophenol	n/a	EPA 625m	CRG
	2-Methyl-4,6-dinitrophenol	n/a	EPA 625m	CRG
	2-Methylnaphthalene	n/a	EPA 625m	CRG
	2-Nitrophenol	n/a	EPA 625m	CRG
	3,3'-Dichlorobenzidine	n/a	EPA 625m	CRG
	4-Bromophenyl phenyl ether	n/a	EPA 625m	CRG
	4-Chloro-3-methylphenol	n/a	EPA 625m	CRG
	4-Chlorophenyl phenyl ether	n/a	EPA 625m	CRG
	4-Nitrophenol	n/a	EPA 625m	CRG
	Acenaphthene	n/a	EPA 625m	CRG
	Acenaphthylene	n/a	EPA 625m	CRG
	Anthracene	n/a	EPA 625m	CRG
	Azobenzene	n/a	EPA 625m	CRG
	Benzidine	n/a	EPA 625m	CRG
	Benzo(a)anthracene	n/a	EPA 625m	CRG
	Benzo(a)pyrene	n/a	EPA 625m	CRG
	Benzo(b)fluoranthene	n/a	EPA 625m	CRG
	Benzo(e)pyrene	n/a	EPA 625m	CRG
	Benzo(g,h,i)perylene	n/a	EPA 625m	CRG
	Benzo(k)fluoranthene	n/a	EPA 625m	CRG
	Biphenyl	n/a	EPA 625m	CRG

Table 8 (Continued): Constituents and Analytical Methods for Water Quality Analyses Conducted by the Stormwater Monitoring Program 2005/06

Classification	*Constituent*	*Fraction*	*Method*	*Analytical Laboratory*
Organic Analyses	Bis(2-chloroethoxy)methane	n/a	EPA 625m	CRG
	Bis(2-chloroethyl)ether	n/a	EPA 625m	CRG
	Bis(2-chloroisopropyl)ether	n/a	EPA 625m	CRG
	Bis(2-ethylhexyl)phthalate	n/a	EPA 625m	CRG
	Butyl benzyl phthalate	n/a	EPA 625m	CRG
	Chrysene	n/a	EPA 625m	CRG
	Dibenz(a,h)anthracene	n/a	EPA 625m	CRG
	Dibenzothiophene	n/a	EPA 625m	CRG
	Diethyl phthalate	n/a	EPA 625m	CRG
	Dimethyl phthalate	n/a	EPA 625m	CRG
	Di-n-butylphthalate	n/a	EPA 625m	CRG
	Di-n-octylphthalate	n/a	EPA 625m	CRG
	Fluoranthene	n/a	EPA 625m	CRG
	Fluorene	n/a	EPA 625m	CRG
	Hexachlorobenzene	n/a	EPA 625m	CRG
	Hexachlorobutadiene	n/a	EPA 625m	CRG
	Hexachlorocyclopentadiene	n/a	EPA 625m	CRG
	Hexachloroethane	n/a	EPA 625m	CRG
	Indeno(1,2,3-cd)pyrene	n/a	EPA 625m	CRG
	Isophorone	n/a	EPA 625m	CRG
	Methyl tert-butyl ether (MTBE)	n/a	EPA 8260B	Calscience
	Naphthalene	n/a	EPA 625m	CRG
	Nitrobenzene	n/a	EPA 625m	CRG
	N-Nitrosodimethylamine	n/a	EPA 625m	CRG
	N-Nitrosodi-N-propylamine	n/a	EPA 625m	CRG
	N-Nitrosodiphenylamine	n/a	EPA 625m	CRG
	Pentachlorophenol	n/a	EPA 625m	CRG
	Perylene	n/a	EPA 625m	CRG
	Phenanthrene	n/a	EPA 625m	CRG
	Phenol	n/a	EPA 625m	CRG
	Pyrene	n/a	EPA 625m	CRG
	Total Detectable PAHs	n/a	EPA 625m	CRG
PCB Analyses	Aroclor 1016	n/a	EPA 625m	CRG
	Aroclor 1221	n/a	EPA 625m	CRG
	Aroclor 1232	n/a	EPA 625m	CRG
	Aroclor 1242	n/a	EPA 625m	CRG
	Aroclor 1248	n/a	EPA 625m	CRG
	Aroclor 1254	n/a	EPA 625m	CRG
	Aroclor 1260	n/a	EPA 625m	CRG
	PCB 018	n/a	EPA 625m	CRG
	PCB 028	n/a	EPA 625m	CRG
	PCB 031	n/a	EPA 625m	CRG
	PCB 033	n/a	EPA 625m	CRG

Table 8 (Continued): Constituents and Analytical Methods for Water Quality Analyses Conducted by the Stormwater Monitoring Program 2005/06

Classification	Constituent	Fraction	Method	Analytical Laboratory
PCB Analyses	PCB 037	n/a	EPA 625m	CRG
	PCB 044	n/a	EPA 625m	CRG
	PCB 049	n/a	EPA 625m	CRG
	PCB 052	n/a	EPA 625m	CRG
	PCB 066	n/a	EPA 625m	CRG
	PCB 070	n/a	EPA 625m	CRG
	PCB 074	n/a	EPA 625m	CRG
	PCB 077	n/a	EPA 625m	CRG
	PCB 081	n/a	EPA 625m	CRG
	PCB 087	n/a	EPA 625m	CRG
	PCB 095	n/a	EPA 625m	CRG
	PCB 097	n/a	EPA 625m	CRG
	PCB 099	n/a	EPA 625m	CRG
	PCB 101	n/a	EPA 625m	CRG
	PCB 105	n/a	EPA 625m	CRG
	PCB 110	n/a	EPA 625m	CRG
	PCB 114	n/a	EPA 625m	CRG
	PCB 118	n/a	EPA 625m	CRG
	PCB 119	n/a	EPA 625m	CRG
	PCB 123	n/a	EPA 625m	CRG
	PCB 126	n/a	EPA 625m	CRG
	PCB 128 + 167	n/a	EPA 625m	CRG
	PCB 138	n/a	EPA 625m	CRG
	PCB 141	n/a	EPA 625m	CRG
	PCB 149	n/a	EPA 625m	CRG
	PCB 151	n/a	EPA 625m	CRG
	PCB 153	n/a	EPA 625m	CRG
	PCB 156	n/a	EPA 625m	CRG
	PCB 157	n/a	EPA 625m	CRG
	PCB 158	n/a	EPA 625m	CRG
	PCB 168 + 132	n/a	EPA 625m	CRG
	PCB 169	n/a	EPA 625m	CRG
	PCB 170	n/a	EPA 625m	CRG
	PCB 177	n/a	EPA 625m	CRG
	PCB 180	n/a	EPA 625m	CRG
	PCB 183	n/a	EPA 625m	CRG
	PCB 187	n/a	EPA 625m	CRG
	PCB 189	n/a	EPA 625m	CRG
	PCB 194	n/a	EPA 625m	CRG
	PCB 200	n/a	EPA 625m	CRG
	PCB 201	n/a	EPA 625m	CRG
	PCB 206	n/a	EPA 625m	CRG
	Total Detectable PCBs	n/a	EPA 625m	CRG

Table 8 (Continued): Constituents and Analytical Methods for Water Quality Analyses Conducted by the Stormwater Monitoring Program 2005/06

Classification	Constituent	Fraction	Method	Analytical Laboratory
Pesticide Analyses	2,4,5-T	n/a	EPA 8151A	Calscience
	2,4,5-TP (Silvex)	n/a	EPA 8151A	Calscience
	2,4-D	n/a	EPA 8151A	Calscience
	2,4-DB	n/a	EPA 8151A	Calscience
	2,4'-DDD	n/a	EPA 625m	CRG
	2,4'-DDE	n/a	EPA 625m	CRG
	2,4'-DDT	n/a	EPA 625m	CRG
	4,4'-DDD	n/a	EPA 625m	CRG
	4,4'-DDE	n/a	EPA 625m	CRG
	4,4'-DDT	n/a	EPA 625m	CRG
	Aldrin	n/a	EPA 625m	CRG
	BHC-alpha	n/a	EPA 625m	CRG
	BHC-beta	n/a	EPA 625m	CRG
	BHC-delta	n/a	EPA 625m	CRG
	BHC-gamma (Lindane)	n/a	EPA 625m	CRG
	Bolstar	n/a	EPA 625m	CRG
	Chlordane-alpha	n/a	EPA 625m	CRG
	Chlordane-gamma	n/a	EPA 625m	CRG
	Chlorpyrifos	n/a	EPA 625m	CRG
	cis-Nonachlor	n/a	EPA 625m	CRG
	Dalapon	n/a	EPA 8151A	Calscience
	Demeton-O	n/a	EPA 625m	CRG
	Diazinon	n/a	EPA 625m	CRG
	Dicamba	n/a	EPA 8151A	Calscience
	Dichlorprop	n/a	EPA 8151A	Calscience
	Dichlorvos	n/a	EPA 625m	CRG
	Dieldrin	n/a	EPA 625m	CRG
	Dimethoate	n/a	EPA 625m	CRG
	Dinoseb	n/a	EPA 8151A	Calscience
	Disulfoton	n/a	EPA 625m	CRG
	Endosulfan sulfate	n/a	EPA 625m	CRG
	Endosulfan-I	n/a	EPA 625m	CRG
	Endosulfan-II	n/a	EPA 625m	CRG
	Endrin	n/a	EPA 625m	CRG
	Endrin aldehyde	n/a	EPA 625m	CRG
	Endrin ketone	n/a	EPA 625m	CRG
	Ethoprop	n/a	EPA 625m	CRG
	Fenchlorophos (Ronnel)	n/a	EPA 625m	CRG
	Fensulfothion	n/a	EPA 625m	CRG
	Fenthion	n/a	EPA 625m	CRG
	Glyphosate	n/a	EPA 547	MWH and WL
	Heptachlor	n/a	EPA 625m	CRG
	Heptachlor epoxide	n/a	EPA 625m	CRG

Table 8 (Continued): Constituents and Analytical Methods for Water Quality Analyses Conducted by the Stormwater Monitoring Program 2005/06

Classification	*Constituent*	*Fraction*	*Method*	*Analytical Laboratory*
Pesticide Analyses	Malathion	n/a	EPA 625m	CRG
	MCPA	n/a	EPA 8151A	Calscience
	MCPP	n/a	EPA 8151A	Calscience
	Merphos	n/a	EPA 625m	CRG
	Methoxychlor	n/a	EPA 625m	CRG
	Methyl parathion	n/a	EPA 625m	CRG
	Mevinphos	n/a	EPA 625m	CRG
	Mirex	n/a	EPA 625m	CRG
	Oxychlordane	n/a	EPA 625m	CRG
	Phorate	n/a	EPA 625m	CRG
	Tetrachlorovinphos (Stirofos)	n/a	EPA 625m	CRG
	Tokuthion	n/a	EPA 625m	CRG
	Total Detectable DDTs	n/a	EPA 625m	CRG
	Toxaphene	n/a	EPA 625m	CRG
	trans-Nonachlor	n/a	EPA 625m	CRG
	Trichloronate	n/a	EPA 625m	CRG

1. Ventura County Health Care Agency Laboratory performed all bacteriological analyses for Events 1 – 4.
2. Aquatic Bioassay & Consulting Laboratories, Inc. performed all bacteriological analyses for Events 5 and 6.
3. Calscience Environmental Laboratories, Inc. analyzed TKN via EPA method 351.3 for Events 1 and 2.
4. Thomas Analytical Laboratory analyzed TKN via EPA method 351.1 for Events 3 – 6.

Land Use and Receiving Water Characterization Sites

A summary of the composite and grab samples (including lab duplicates and matrix spike samples) collected and analyzed during the 2005/06 monitoring year for the Land Use and Receiving Water sites are shown in Table 9 and Table 10, respectively.

Table 9: Environmental and QA/QC Samples Collected at Land Use Sites

Event	***Event 1***		
Monitoring Site	***A-1***	***R-1***	***I-2***
Date	***10/17/2005***	***10/17/2005***	***10/17/2005***
Composite Constituents			
Bromide	✓ (LD)	—	—
Chloride	✓ (LD)	—	—
BOD[1]	✓ (LD)	—	—
Hardness as $CaCO_3$	✓ (LD)	—	—
Total Dissolved Solids	✓ (LD)	—	—
Total Organic Carbon[1]	✓ (LD)	—	—
Total Suspended Solids	✓ (LD)	—	—
Turbidity	✓ (LD)	—	—
Metals, Total Recoverable	✓ (LD)	—	—
Metals, Dissolved	✓ (LD)	—	—
Chromium VI	✓ (LD)	—	—
Nitrate as N	✓ (LD)	—	—
Nitrite as N	✓ (LD)	—	—
Orthophosphate as P (Diss)	✓ (LD)	—	—
TKN[1]	✓ (LD)	—	—
Total Phosphorus, Total	✓ (LD)	—	—
Total Phosphorus, Dissolved	✓ (LD)	—	—
Organic – EPA 625m	✓ (LD)	—	—
PCB – EPA 625m	✓ (LD)	—	—
Pesticide – EPA 547[2]	✓ (LD)	—	—
Pesticide – EPA 625m	✓ (LD)	—	—
Pesticide – EPA 8151A[1]	✓ (LD)	—	—
Grab Constituents			
Perchlorate[1]	✓ (LD)	—	—
Bacteriological[3]	✓ (LD)	—	—
pH/Conductivity	✓ (LD)	—	—
Hydrocarbons	✓ (LD)	—	—
Mercury, Total Recoverable	— (comp)	—	—
Mercury, Dissolved	— (comp)	—	—
Ammonia as N	✓ (LD, MS/MSD)	—	—
MTBE – EPA 8260B[1]	✓ (LD)	—	—
Aquatic Toxicity Bioassay[4]	✓	✓	✓

Notes

"✓" indicates that the analysis was performed on an environmental sample; "—" indicates that no sample was collected.
"LD" indicates that a laboratory duplicate analysis was performed.
"MS/MSD" indicates that a matrix spike/matrix spike duplicate analysis was performed.
Hydrocarbons include: Oil & Grease, TRPH; Metals include: Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, Ag, Tl, & Zn.
"— (comp)" indicates that Total Recoverable and Dissolved Mercury were collected as composite samples during Event 1.
Unless noted otherwise, all analyses performed by CRG Marine Laboratories, Inc.
1. Performed by Calscience Environmental Laboratories, Inc.
2. Performed by MWH Laboratories
3. Performed by Ventura County HCA Laboratories
4. Performed by Aquatic Bioassay & Consulting Labs, Inc.

Table 10: Environmental and QA/QC Samples Collected at Receiving Water Sites

Event	***Event 1***	
Monitoring Site	***W-3***	***W-4***
Date	***10/17/2005***	***10/17/2005***
Composite Constituents		
Bromide	✓	✓
Chloride	✓	✓
BOD[1]	✓	✓
Hardness as $CaCO_3$	✓	✓
Total Dissolved Solids	✓	✓
Total Organic Carbon[1]	✓	✓
Total Suspended Solids	✓	✓
Turbidity	✓	✓
Metals, Total Recoverable	✓	✓
Metals, Dissolved	✓	✓
Chromium VI	✓	✓
Nitrate as N	✓	✓
Nitrite as N	✓	✓
Orthophosphate as P (Diss)	✓	✓
TKN[1]	✓	✓
Total Phosphorus, Total	✓	✓
Total Phosphorus, Dissolved	✓	✓
Organic – EPA 625m	✓	✓
PCB – EPA 625m	✓	✓
Pesticide – EPA 547[2]	✓	✓
Pesticide – EPA 625m	✓	✓
Pesticide – EPA 8151A[1]	✓	✓
Grab Constituents		
Perchlorate[1]	✓	✓
Bacteriological[3]	✓	✓
pH/Conductivity	✓	✓
Hydrocarbons	✓	✓
Mercury, Total Recoverable	— (comp)	— (comp)
Mercury, Dissolved	— (comp)	— (comp)
Ammonia as N	✓	✓
MTBE – EPA 8260B[1]	✓	✓
Aquatic Toxicity Bioassay[4]	✓	✓

Notes

"✓" indicates that the analysis was performed on an environmental sample; "—" indicates that no sample was collected.
Hydrocarbons include: Oil & Grease, TRPH
Metals include: Al, As, Cd, Cr, Cu, Pb, Hg, Ni, Se, Ag, Tl, & Zn.
"— (comp)" indicates that Total Recoverable and Dissolved Mercury were collected as composite samples during Event 1.
Unless noted otherwise, all analyses performed by CRG Marine Laboratories, Inc.
1. Performed by Calscience Environmental Laboratories, Inc.
2. Performed by MWH Laboratories
3. Performed by Ventura County HCA Laboratories
4. Performed by Aquatic Bioassay & Consulting Labs, Inc.

Mass Emission Sites

A summary of the composite and grab samples (including field blanks, field duplicates, lab duplicates, and matrix spike samples) collected and analyzed during the 2005/06 monitoring season at the Mass Emission monitoring sites are shown in Table 11 through Table 16.

Table 11: Composite Environmental and QA/QC Samples Collected at Mass Emission Site ME-CC

	ME-CC Calleguas Creek					
Event	***Event 1***	***Event 2***	***Event 3***	***Event 4***	***Event 5***	***Event 6***
Date	***10/17/05***	***11/9/05***	***2/17/06***	***2/27/06***	***5/31/06***	***6/13/06***
Composite Constituents						
Bromide	✓	✓	✓ (LD)	✓	✓	✓ (LD, MS/MSD)
Chloride	✓	✓	✓ (LD, MS/MSD)	✓	✓ (LD, MS/MSD)	✓
BOD[1]	✓	✓	✓	✓	✓	✓
Hardness as $CaCO_3$	✓	✓	✓	✓	✓ (FB)	✓
Total Dissolved Solids	✓	✓	✓ (LD)	✓	✓	✓ (LD)
Total Organic Carbon[1]	✓ (MS/MSD)	✓	✓ (LD, MS/MSD)	✓	✓	✓
Total Suspended Solids	✓	✓	✓ (LD)	✓	✓	✓
Turbidity	✓	✓	✓	✓	✓	✓ (LD)^
Metals, Total Recoverable	✓ (MS/MSD)	✓ (FB)	✓ (LD, MS/MSD)	✓	✓ (FB)	✓
Metals, Dissolved	✓	✓	✓ (LD, MS/MSD)	✓	✓	✓
Chromium VI	✓	✓	✓ (LD, MS/MSD)	✓ (MS/MSD)	✓	✓ (LD)
Nitrate as N	✓ (MS/MSD)	✓	✓ (LD, MS/MSD)	✓	✓	✓ (LD, MS/MSD)
Nitrite as N	✓ (MS/MSD)	✓	✓ (LD, MS/MSD)	✓	✓	✓ (LD, MS/MSD)
Orthophosphate as P (Diss)	✓ (MS/MSD)	✓	✓ (LD, MS/MSD)	✓	✓	✓ (LD, MS/MSD)
TKN[1,5]	✓[1]	✓[1]	✓ (LD, MS/MSD)[5]	✓[5]	✓ (LD)[5]	✓ (LD)[5]
Total Phos., Total	✓	✓	✓ (LD, MS/MSD)	✓	✓	✓ (LD)
Total Phos., Dissolved	✓	✓	✓ (LD, MS/MSD)	✓	✓	✓ (LD)
Organic – EPA 625	✓ (MS/MSD)	✓ (FB)	✓ (LD, MS/MSD)	✓	✓	✓
PCB – EPA 625	✓ (MS/MSD)	✓ (FB)	✓ (LD, MS/MSD)	✓	✓	✓
Pesticide – EPA 547[2,6]	✓[2]	✓[2]	✓ (LD, MS/MSD)[2]	✓[6]	✓[6]	✓[6]
Pesticide – EPA 625	✓ (MS/MSD)	✓ (FB)	✓ (LD, MS/MSD)	✓	✓	✓
Pesticide – EPA 8151A[1]	✓ (MS/MSD)	✓	✓ (MS/MSD)	✓	✓	✓

Notes – See bottom of Table 12.

Table 12: Grab Environmental and QA/QC Samples Collected at Mass Emission Site ME-CC

	ME-CC Calleguas Creek					
Event	***Event 1***	***Event 2***	***Event 3***	***Event 4***	***Event 5***	***Event 6***
Date	***10/17/05***	***11/9/05***	***2/17/06***	***2/27/06***	***5/31/06***	***6/13/06***
Grab Constituents						
Perchlorate[1]	✓	✓	✓	✓	✓	✓
Bacteriological Analyses[3,4]	✓[3]	✓ (FB)[3]	✓[3]	✓[3]	✓ (FB)[4]	✓[4]
pH/Conductivity	✓	✓	✓ (LD)	✓	✓	✓ (LD)
Hydrocarbons	✓	✓	✓	✓	✓	✓
Mercury, Total Recoverable	— (comp)	— (comp)	— (comp)	— (comp)	✓ (FB)	✓
Mercury, Dissolved	— (comp)	— (comp)	— (comp)	— (comp)	✓	✓
Ammonia as N	✓	✓	✓ (LD, MS/MSD)	✓	✓	✓ (MS/MSD)
Aquatic Toxicity Bioassay[4]	✓	✓	—	—	✓	—

Notes

"✓" indicates that the analysis was performed on an environmental sample; "—" indicates that no sample was collected.
"FB" indicates that a field blank analysis was performed.
"LD" indicates that a laboratory duplicate analysis was performed.
"MS/MSD" indicates that a matrix spike/matrix spike duplicate analysis was performed.
Hydrocarbons include: Oil & Grease, TRPH
Metals include: Al, As, Cd, Cr, Cu, Pb, Hg (Events 1-4), Ni, Se, Ag, Tl, & Zn.
"^" indicates that Turbidity was measured from a grab sample during Event 6.
"— (comp)" indicates that Total Recoverable and Dissolved Mercury were collected as composite samples during Events 1-4.
Unless noted otherwise, all analyses performed by CRG Marine Laboratories, Inc.

1. Performed by Calscience Environmental Laboratories, Inc.
2. Performed by MWH Laboratories
3. Performed by Ventura County HCA Laboratories
4. Performed by Aquatic Bioassay & Consulting Labs, Inc.
5. Performed by Thomas Analytical Laboratory
6. Performed by Weck Laboratories, Inc.

Table 13: Composite Environmental and QA/QC Samples Collected at Mass Emission Site ME-VR2

	ME-VR2 Ventura River					
Event	***Event 1***	***Event 2***	***Event 3***	***Event 4***	***Event 5***	***Event 6***
Date	***10/17/05***	***11/9/05***	***2/17/06***	***2/27/06***	***5/31/06***	***6/13/06***
Composite Constituents						
Bromide	✓ (FB)	✓ (FD)	✓	✓	✓	✓
Chloride	✓	✓ (FD)	✓	✓	✓	✓
BOD[1]	✓	✓ (FD, LD)	✓	✓	✓	✓
Hardness as $CaCO_3$	✓ (FB)	✓ (FD)	✓	✓	✓	✓ (LD)
Total Dissolved Solids	✓	✓ (FD)	✓	✓	✓	✓
Total Organic Carbon[1]	✓	✓ (FD)	✓	✓	✓	✓
Total Suspended Solids	✓	✓ (FD)	✓	✓	✓	✓ (LD)
Turbidity	✓	✓ (FD, LD)	✓	✓	✓	✓^
Metals, Total Recoverable	✓ (FB)	✓ (FD)	✓	✓ (MS/MSD)	✓	✓ (LD, MS/MSD)
Metals, Dissolved	✓	✓ (FD)	✓	✓	✓	✓ (LD)
Chromium VI	✓	✓ (FD, MS/MSD)	✓	✓	✓	✓ (MS/MSD)
Nitrate as N	✓	✓ (FD, MS/MSD)	✓	✓	✓	✓
Nitrite as N	✓	✓ (FD, MS/MSD)	✓	✓	✓	✓
Orthophosphate as P (Diss)	✓	✓ (FD, MS/MSD)	✓	✓	✓	✓
TKN[1,5]	✓[1]	✓ (FD)[1]	✓[5]	✓ (MS/MSD)[5]	✓ (MS/MSD)[5]	✓ (MS/MSD)[5]
Total Phos., Total	✓	✓ (FD)	✓	✓	✓	✓ (MS/MSD)
Total Phos., Dissolved	✓	✓ (FD, MS/MSD)	✓	✓ (MS/MSD)	✓	✓ (MS/MSD)
Organic – EPA 625	✓ (FB)	✓ (FD)	✓	✓ (MS/MSD)	✓	✓ (LD, MS/MSD)
PCB – EPA 625	✓ (FB)	✓ (FD)	✓	✓ (MS/MSD)	✓	✓ (LD, MS/MSD)
Pesticide – EPA 547[2,6]	✓[2]	✓[2]	✓[2]	✓[6]	✓ (MS/MSD)[6]	✓[6]
Pesticide – EPA 625	✓ (FB)	✓ (FD)	✓	✓ (MS/MSD)	✓	✓ (LD, MS/MSD)
Pesticide – EPA 8151A[1]	✓	✓ (FD)	✓	✓	✓	✓ (MS/MSD)

Notes – See bottom of Table 14.

Table 14: Grab Environmental and QA/QC Samples Collected at Mass Emission Site ME-VR2

	ME-VR2 Ventura River					
Event	***Event 1***	***Event 2***	***Event 3***	***Event 4***	***Event 5***	***Event 6***
Date	***10/17/05***	***11/9/05***	***2/17/06***	***2/27/06***	***5/31/06***	***6/13/06***
Grab Constituents						
Perchlorate[1]	✓	✓ (FD, MS/MSD)	✓ (MS/MSD)	✓	✓	✓
Bacteriological Analyses[3,4]	✓ (FB)[3]	✓ (FD)[3]	✓[3]	✓[3]	✓[4]	✓[4]
pH/Conductivity	✓	✓ (FD)	✓	✓	✓ (LD)	✓
Hydrocarbons	✓	✓ (FD)	✓	✓	✓ (LD)	✓
Mercury, Total Recoverable	— (comp)	— (comp)	— (comp)	— (comp)	✓	✓ (LD, MS/MSD)
Mercury, Dissolved	— (comp)	— (comp)	— (comp)	— (comp)	✓	✓
Ammonia as N	✓	✓ (FD, MS/MSD)	✓	✓	✓	✓
Aquatic Toxicity Bioassay[4]	✓	✓	—	—	✓	—

Notes

"✓" indicates that the analysis was performed on an environmental sample; "—" indicates that no sample was collected.
"FB" indicates that a field blank analysis was performed.
"FD" indicates that a field duplicate analysis was performed.
"LD" indicates that a laboratory duplicate analysis was performed.
"MS/MSD" indicates that a matrix spike/matrix spike duplicate analysis was performed.
Hydrocarbons include: Oil & Grease, TRPH
Metals include: Al, As, Cd, Cr, Cu, Pb, Hg (Events 1-4), Ni, Se, Ag, Tl, & Zn.
"^" indicates that Turbidity was measured from a grab sample during Event 6.
"— (comp)" indicates that Total Recoverable and Dissolved Mercury were collected as composite samples during Events 1-4.
Unless noted otherwise, all analyses performed by CRG Marine Laboratories, Inc.

1. Performed by Calscience Environmental Laboratories, Inc.
2. Performed by MWH Laboratories
3. Performed by Ventura County HCA Laboratories
4. Performed by Aquatic Bioassay & Consulting Labs, Inc.
5. Performed by Thomas Analytical Laboratory
6. Performed by Weck Laboratories, Inc.

Table 15: Composite Environmental and QA/QC Samples Collected at Mass Emission Site ME-SCR

	ME-SCR Santa Clara River					
Event	***Event 1***	***Event 2***	***Event 3***	***Event 4***	***Event 5***	***Event 6***
Date	***10/17/05***	***11/9/05***	***2/17/06***	***2/27/06***	***5/31/06***	***6/13/06***
Composite Constituents						
Bromide	✓	✓ (LD)	✓ (FB)	✓ (LD)	✓ (LD, MS/MSD)	✓ (FD)
Chloride	✓	✓	✓	✓ (LD)	✓	✓ (FD)
BOD[1]	✓	✓	✓	✓ (LD)	✓ (LD)	✓ (FD, LD)
Hardness as $CaCO_3$	✓	✓ (LD)	✓ (FB)	✓ (LD)	✓ (LD)	✓ (FD)
Total Dissolved Solids	✓	✓	✓	✓ (LD)	✓ (LD)	✓ (FD)
Total Organic Carbon[1]	✓	✓	✓	✓ (LD)	✓ (MS/MSD)	✓ (FD)
Total Suspended Solids	✓	✓	✓	✓ (LD)	✓ (LD)	✓ (FD)
Turbidity	✓	✓	✓ (LD)	✓ (LD)	✓ (LD)	✓ (FD)^
Metals, Total Recoverable	✓	✓ (LD, MS/MSD)	✓ (FB)	✓ (LD)	✓ (LD, MS/MSD)	✓ (FD)
Metals, Dissolved	✓	✓ (LD)	✓	✓ (LD)	✓	✓ (FD)
Chromium VI	✓	✓	✓	✓ (LD)	✓ (LD, MS/MSD)	✓ (FD)
Nitrate as N	✓	✓	✓	✓ (LD)	✓ (LD, MS/MSD)	✓ (FD)
Nitrite as N	✓	✓	✓	✓ (LD)	✓ (LD, MS/MSD)	✓ (FD)
Orthophosphate as P (Diss)	✓	✓	✓	✓ (LD)	✓ (LD, MS/MSD)	✓ (FD)
TKN[1,5]	✓[1]	✓ (LD)[1]	✓[5]	✓ (LD)[5]	✓[5]	✓ (FD)[5]
Total Phos., Total	✓	✓	✓	✓ (LD)	✓ (LD, MS/MSD)	✓ (FD)
Total Phos., Dissolved	✓	✓	✓	✓ (LD)	✓ (LD, MS/MSD)	✓ (FD)
Organic – EPA 625	✓	✓ (LD, MS/MSD)	✓ (FB)	✓ (LD)	✓ (LD, MS/MSD)	✓ (FD)
PCB – EPA 625	✓	✓ (LD, MS/MSD)	✓ (FB)	✓ (LD)	✓ (LD, MS/MSD)	✓ (FD)
Pesticide – EPA 547[2,6]	✓[2]	✓[2]	✓[2]	✓ (LD)[6]	✓	✓ (FD)[6]
Pesticide – EPA 625	✓	✓ (LD, MS/MSD)	✓ (FB)	✓ (LD)	✓ (LD, MS/MSD)	✓ (FD)
Pesticide – EPA 8151A[1]	✓	✓ (MS/MSD)	✓	✓ (LD)	✓ (MS/MSD)	✓ (FD)

Notes – See bottom of Table 16.

Table 16: Grab Environmental and QA/QC Samples Collected at Mass Emission Site ME-SCR

	ME-SCR Santa Clara River					
Event	***Event 1***	***Event 2***	***Event 3***	***Event 4***	***Event 5***	***Event 6***
Date	***10/17/05***	***11/9/05***	***2/17/06***	***2/27/06***	***5/31/06***	***6/13/06***
Grab Constituents						
Perchlorate[1]	✓	✓	✓ (MS/MSD)	✓ (LD)	✓	✓ (FD)
Bacteriological Analyses[3,4]	✓[3]	✓[3]	✓ (FB)[3]	✓ (LD)[3]	✓[4]	✓ (FD)[4]
pH/Conductivity	✓	✓	✓	✓ (LD)	✓	✓ (FD)
Hydrocarbons	✓	✓	✓	✓ (LD)	✓	✓ (FD)
Mercury, Total Recoverable	— (comp)	— (comp)	— (comp)	— (comp)	✓ (LD, MS/MSD)	✓ (FD)
Mercury, Dissolved	— (comp)	— (comp)	— (comp)	— (comp)	✓	✓ (FD)
Ammonia as N	✓	✓	✓	✓ (LD)	✓	✓ (FD)
Aquatic Toxicity Bioassay[6]	✓	✓	—	—	✓	—

Notes

"✓" indicates that the analysis was performed on an environmental sample; "—" indicates that no sample was collected.
"FB" indicates that a field blank analysis was performed.
"FD" indicates that a field duplicate analysis was performed.
"LD" indicates that a laboratory duplicate analysis was performed.
"MS/MSD" indicates that a matrix spike/matrix spike duplicate analysis was performed.
Hydrocarbons include: Oil & Grease, TRPH
Metals include: Al, As, Cd, Cr, Cu, Pb, Hg (Events 1-4), Ni, Se, Ag, Tl, & Zn.
"^" indicates that Turbidity was measured from a grab sample during Event 6.
"— (comp)" indicates that Total Recoverable and Dissolved Mercury were collected as composite samples during Events 1-4.
Unless noted otherwise, all analyses performed by CRG Marine Laboratories, Inc.

1. Performed by Calscience Environmental Laboratories, Inc.
2. Performed by MWH Laboratories
3. Performed by Ventura County HCA Laboratories
4. Performed by Aquatic Bioassay & Consulting Labs, Inc.
5. Performed by Thomas Analytical Laboratory
6. Performed by Weck Laboratories, Inc.

Table 11 through Table 16 include information related to QA/QC samples scheduled for collection and analysis by the Stormwater Monitoring Program, as well as results from unsolicited QA/QC analyses provided by various analytical laboratories. Unsolicited QA/QC analyses received by the Stormwater Monitoring Program during the 2005/06 monitoring season took the forms of non-requested matrix spike and lab duplicate analyses provided by most laboratories. Since these additional QA/QC analyses provide valuable information related to the laboratory's ability to accurately (matrix spike analyses) and precisely (lab duplicate analyses) evaluate water quality samples, they were included in the Stormwater Monitoring Program's database and considered along with all requested QA/QC analyses during the Stormwater Monitoring Program's QA/QC evaluation.

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7. Quality Assurance and Quality Control (QA/QC)

The following is a discussion of the results of the quality assurance and quality control (QA/QC) analyses performed on the 2005/06 stormwater quality monitoring data. The data were evaluated for overall sample integrity, holding time exceedances, contamination, accuracy, and precision using field- and lab-initiated QA/QC sample results according to the Stormwater Monitoring Program's *2005/06 Data Quality Evaluation Plan* and *Data Quality Evaluation Standard Operating Procedures*. The Data Quality Evaluation Plan (DQEP) describes the process by which water chemistry data produced by the Stormwater Monitoring Program are evaluated. Data quality evaluation is a multiple step process used to identify errors, inconsistencies, or other problems potentially associated with Stormwater Monitoring Program data. The DQEP contains a detailed discussion of the technical review process, based on U.S. Environmental Protection Agency (EPA) guidance[2] and requirements set forth by the Stormwater Monitoring Program, used to evaluate water quality monitoring data. The DQEP provides a reference point from which a program-consistent quality assurance/quality control (QA/QC) evaluation can be performed by the Stormwater Monitoring Program. The Data Quality Evaluation Standard Operating Procedures (SOPs) document provides a set of written instructions that documents the process used by the Stormwater Monitoring Program to evaluate water quality data. The SOPs describe both technical and administrative operational elements undertaken by the Stormwater Monitoring Program in carrying out its DQEP. The SOPs act as a set of prescriptive instructions detailing in a step-by-step manner how District staff carry out the data evaluation and data quality objectives set forth in the DQEP. QA/QC sample results from the 2005/06 monitoring season are presented in Appendix G.

QA/QC sample collection and analysis relies upon QA/QC samples collected in the field (such as equipment blank, field blank, field duplicate, and matrix spike samples), as well as QA/QC samples prepared and analyzed by the analytical laboratory (i.e., lab-initiated samples, such as method blanks, filter blanks, and laboratory control spikes) performing the analysis. The actual chemical analysis of lab-initiated and field-initiated QA/QC samples is conducted in an identical manner as the analysis of field-collected environmental samples. After all analyses are complete, the results of the field-initiated and lab-initiated QA/QC sample results are compared to particular Data Quality Objectives (DQOs), also commonly referred to as QA/QC limits. These limits are typically established by the analytical laboratory based on EPA protocols and guidance. However, in some cases, the Stormwater Monitoring Program will set a particular DQO, such as the QA/QC limit for field duplicate results.

QA/QC sample results are evaluated in order to compare them to their appropriate QA/QC limits and identify those results that fall outside of these limits. This QA/QC evaluation occurs in two separate steps as the laboratory will review those results that fall outside of their QA/QC limits and typically label these results with some type of qualification or note. If a QA/QC sample result falls grossly outside of its associated QA/QC limit, and thus indicates that there is a major problem with the lab's instrumentation and/or analytical process, then the laboratory should re-run both the affected QA/QC and environmental samples as necessary. The second step in the QA/QC evaluation process occurs when the Stormwater Monitoring Program performs the overall sample integrity, holding time, contamination, accuracy, and precision checks mentioned above. This second evaluation step provides an opportunity to thoroughly review the Stormwater Monitoring Program's data to identify potential errors in a laboratory's reporting of analytical data and/or recognize any significant data quality issues that may need to be addressed. After this evaluation the Stormwater Monitoring Program is ready to qualify their environmental data as necessary based on the findings of the QA/QC assessment.

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[2] U.S. Environmental Protection Agency. February 1994. ***USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review.*** EPA-540/R-94-013.

U.S. Environmental Protection Agency. December 1994. ***USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review.*** EPA-540/R-94-090.

U.S. Environmental Protection Agency. April 1995. ***Guidance on the Documentation and Evaluation of Trace Metals Data Collected for Clean Water Act Compliance Monitoring.*** EPA-821/B-95-002.

Environmental sample results are qualified in order to provide the user of the data with information regarding the quality of the data. Depending on the planned use of the data, qualifications may help to determine whether or not the data are appropriate for a given analysis. In general, data that are qualified with anything other than an "R" (meaning a rejected data point) are suitable for most analyses. However, the qualifications assigned to the data allow the user to assess the appropriateness of the data for a given use. The Stormwater Monitoring Program used its NDPES Stormwater Quality Database to conduct a semi-automated QA/QC evaluation of the current season's data contained in the database. The use of the database allows the Stormwater Monitoring Program to expedite and standardize the QA/QC evaluation of its monitoring data in conjunction with the use of the DQEP and SOPs. After reviewing the qualifications assigned to each qualified data point in the 2005/06 monitoring year data set, the environmental data are considered to be of high quality and sufficient for all future general uses. However, all data qualifiers should be reviewed and considered prior to the use of the data in a specific analysis or application. Environmental data from the 2005/06 monitoring season are presented in Appendix F.

This section provides a discussion of (1) the sample collection procedure for field-initiated QA/QC samples, (2) the QA/QC samples analyzed by the Stormwater Monitoring Program, along with remarks on QA/QC issues of significance observed during the 2005/06 season, and (3) a summary of the 2005/06 QA/QC sample results presented in Table 25 through Table 31 at the end of this section.

Field-Initiated QA/QC Sample Collection

Both environmental and field-initiated QA/QC samples are collected in the field using clean sampling techniques. To minimize the potential for contamination, CRG Marine Laboratories, Inc. cleans all bottles used for composite samples. Only new containers are used for grab sample collection, with the appropriate preservative added to grab bottles by CRG. Intake lines for the automated samplers are cleaned using nitric acid (30% dilution) and distilled water. A dedicated sampling crew is provided by VCWPD to ensure that consistent sample collection and handling techniques are followed during every monitoring event.

Field-initiated QA/QC samples include equipment blanks, field blanks, and field duplicates. Equipment blanks are typically prepared prior to the start of the monitoring season to check that tubing and strainers, and sample containers – especially composite bottles – aren't sources of contamination for the Stormwater Monitoring Program's environmental samples. Automated sampler intake lines (i.e., sample tubing) are cleaned using nitric acid (30% dilution; supplied by CRG) prior to equipment blank collection. Equipment blanks are collected by passing blank water through cleaned tubing and into brand new sample bottles. These blanks are collected using clean techniques, prior to field sample collection, before the sampling equipment has been contaminated by environmental sample water or other sources. After collection, equipment blanks are submitted to the analytical laboratory and analyzed using the same methods as those employed for routine, environmental sample analysis. CRG supplied new, clean sample bottles and blank water for equipment blanks analyzed for total recoverable and dissolved metals (EPA 200.8m and EPA 1631E) and trace organic compounds (EPA 625m).

Field blanks are collected using the same techniques as used for environmental sample collection, but instead of sample water, blank water is poured into the sample bottle while in the field. CRG supplied sample bottles and blank water for all field blank analyses except for those associated with bacteriological analyses. In these instances, VCHCA (Events 1 – 4) and ABC (Event 5 – 6) provided sample bottles and blank water for bacteriological field blank analyses. For metals (EPA 200.8m and EPA 1631E) and trace organic compounds (including organics, PCBs, and pesticides), the blank water is de-ionized water. The de-ionized water is purified to 18 megOhm quality by CRG by passing it through de-ionized resin beads to remove ionic compounds, such as metals, and then through a carbon filter to remove trace organic compounds.

Duplicate samples – both field duplicates and lab duplicates – are collected in the field using the same techniques as used for all environmental sample collection. For composite samples a larger volume of water is collected during the monitoring event, and then the duplicates are split in the field (when generating a field duplicate) or in the lab (when generating a lab duplicate) while constantly mixing the contents of the composite containers to ensure the production of homogeneous duplicate samples. The collection of field duplicate grab samples requires either the simultaneous collection of two side-by-side samples or the collection of two samples in immediate succession. Depending on the volume of water required to perform a particular analysis, a lab duplicate analysis of a grab sample may require the collection of a separate sample, or may be run on a single environmental sample.

QA/QC Sample Analysis and Issues of Significance

The QA/QC evaluation process identifies isolated incidents of out-of-range QA/QC results, but more importantly, identifies potential trends in sampling and laboratory analytical performance. An important and ongoing component of the QA/QC evaluation process is to identify, report, and correct these problems as they arise. The types of QA/QC analyses and evaluations of these results performed during the 2005/06 monitoring season are described below, along with identified QA/QC issues associated with a particular QA/QC sample type.

As a member of the Southern California Coastal Water Research Project's (SCCWRP) Stormwater Monitoring Coalition (SMC), VCWPD jointly sponsored the Stormwater Laboratory Intercalibration Study that was conducted by the SMC in 2003. Five analytical laboratories currently employed by the Stormwater Monitoring Program took part in the intercalibration study: CRG Marine Laboratories, Calscience Environmental Laboratories, MWH Laboratories, Weck Laboratories, and Aquatic Bioassay & Consulting Laboratories. The goal of the study was to establish performance-based guidelines for the analysis of stormwater samples through the setting of minimum standards for sensitivity, precision, and accuracy across different analytical laboratories so that individual data sets can be combined with estimated levels of confidence for making regional assessments of stormwater quality. The study's performance-based guidelines are considered key in achieving comparability across laboratories.

In brief, the intercalibration study focused on inter-laboratory comparability between a core group of 15 target analytes including total suspended solids, nutrients, and trace metals. The study set reporting levels for its target constituents that were sufficient to assess if environmental samples contained pollutant concentrations below relevant water quality objectives, such as the California Toxics Rule. The study's authors believed that reporting levels should be technologically achievable, but far enough below water quality objectives that observed exceedances cannot be attributable to methodological uncertainty. The study also set accuracy and precision DQOs for the analysis of stormwater matrices. Laboratory precision was based on the reproducibility of replicate sample analyses, while laboratory accuracy was judged via the analysis of spike environmental samples and reference materials. It is believed that the study's performance-based guidelines will be useful to stormwater programs in establishing specifications for work assignments or requests for proposals (RFPs) to conduct stormwater analyses. The intercalibration study and resulting guideline/protocols were documented in a Laboratory Guidance Manual for SMC member laboratories.

In April 2006, a new Laboratory Intercalibration Program agreement was signed by SCCWRP, three Regional Water Quality Control Boards, and six municipal parties, including the VCWPD, in order to fill three informational gaps left by the 2003 study. The goal of the new study is to complete three areas of missing information to make the Laboratory Guidance Manual an ongoing and effective document. The new Laboratory Intercalibration Program will include three steps: (1) repeat the laboratory intercalibration for TSS, nutrients, and trace metals; (2) initiate an intercalibration for organic constituents; and (3) create draft contract language for integration into stormwater monitoring programs. The study is expected to be completed in 2009.

Currently the Stormwater Monitoring Program uses generally established QA/QC limits and information provided by the laboratories to evaluate the QA/QC sample results. With regard to the 2005/06 monitoring season, it should be noted that all laboratories analyzing the 15 target analytes considered in the intercalibration study were able to meet or go below the reporting levels set forth by the study. It is believed that the results of the Stormwater Laboratory Intercalibration Study, along with information gathered from the Stormwater Monitoring Program will help to refine QA/QC limits for the Ventura Countywide Stormwater Quality Management Program in the future.

Calculation of QA/QC Success Rates

For each type of QA/QC analysis conducted, a percent success rate is calculated. The success rate is defined as the total number of QA/QC samples of a given type minus the number of samples that fall outside of QA/QC limits – that is, exceed the Stormwater Monitoring Program's DQO for a particular QA/QC sample type – divided by the total number of samples, multiplied by 100%.

$$Success\ Rate = \left(\frac{TNS\ \text{-}\ NSO}{TNS}\right) * 100\%$$

where: TNS is the total number of QA/QC samples of a given type
NSO is the number of QA/QC samples of a given type that fall outside of specific QA/QC limits

It should be noted that the QA/QC success rate calculated for a given QA/QC sample type may or may not be directly correlated to the number of environmental samples that ultimately require qualification by the Stormwater Monitoring Program due to a QA/QC sample result exceeding its DQO. For example, a detected concentration in a field blank sample may or may not result in the qualification of a *single* environmental sample, and a detected concentration in a method blank sample may or may not result in the qualification of *one or more* environmental samples. Furthermore, a matrix spike RPD result exceeding its DQO will always result in the qualification of the environmental sample collected at the same monitoring site as the matrix spike/matrix spike duplicate (MS/MSD) sample. Each of the following descriptions of QA/QC sample types evaluated by the Stormwater Monitoring Program includes a discussion of the particular QA/QC sample type's DQO, its relationship to environmental samples (one-to-one or one-to-many), and the process by which it is determined if an out-of-control QA/QC sample result will result in the qualification of environmental data.

Equipment Blanks

Equipment blanks, often referred to as pre-season blanks, are collected prior to the monitoring season to test for contamination in sample containers (e.g., jars, bottles, carboys, etc.) and sample equipment (e.g., intake lines, tubing, and strainers). The Stormwater Monitoring Program routinely analyzes pre-season *carboy blanks* by testing for contamination of these large glass bottles used to collect composite samples. The carboys are filled with laboratory-prepared blank water (acidified to pH < 2 for metals analyses) and allowed to stand for a minimum of 24 hours before analysis. Carboy blank analyses are performed to test for contamination of sample containers due to residues left from the manufacturing process (in the case of new carboys) or residues left from the cleaning process (in the case of cleaned, used carboys). Sampling equipment blanks – referred to as *tubing blanks* – are also routinely analyzed by the Stormwater Monitoring Program and consist of laboratory prepared blank water processed through sampler tubing to identify potential contamination of field-collected samples as a result of "dirty" tubing. Equipment blank "hits" or measured concentrations above the laboratory's quantitation limit (RL, PQL, etc.) for a constituent are assessed and acted upon using the guidelines listed below:

1. The Stormwater Monitoring Program requests that the laboratory confirm the reported results against lab bench sheets or other original analytical instrument output. Any calculation or reporting errors should be corrected and reported by the laboratory in an amended laboratory report.

2. If the previous step does not identify improperly reported results, then the analytical laboratory should be asked to identify any possible sources of contamination in the laboratory.

3. If no laboratory contamination is identified, then a note should be made that documents that the equipment blank results indicate that the sample equipment may have introduced contamination into the blank samples.

When practical, remedial measures are initiated by the Stormwater Monitoring Program to replace or re-clean sampling equipment and re-analyze equipment blank samples in an effort to eliminate field contamination. No environmental samples are qualified by the Stormwater Monitoring Program based on the results of pre-season equipment blank analyses. Only the results of field-initiated and laboratory-initiated QA/QC samples associated with the environmental samples collected for any given monitoring event are used to qualify Stormwater Monitoring Program environmental samples.

Equipment Blank Check – The Stormwater Monitoring Program reviewed the results of its carboy and tubing blank analyses performed approximately two weeks (10/6/06) prior to monitoring of the first event (10/17/06) of the 2005/06 monitoring season. The results showed low-level, detected concentrations of five phthalate compounds (Bis(2-ethylhexyl)phthalate, Butyl benzyl phthalate, Diethyl phthalate, Dimethyl phthalate, and Di-n-butylphthalate) known by the Stormwater Monitoring Program to be regular laboratory contaminants of CRG Marine Laboratories, Inc. Additionally, a handful of metals (Aluminum, Copper, Nickel, and Zinc) and polynuclear aromatic hydrocarbons (1-Methlynaphthalene, 2-Methylnaphthalene, Biphenyl, and Naphthalene), as well as single examples of acid extractable (Phenol) and base/neutral extractable (1,2-Dichlorobenzene) compounds were found in detectable concentrations in equipment blanks. The Stormwater Monitoring Program confirmed with CRG Marine Laboratories, Inc., that these detected equipment blank concentrations were accurately reported and requested that all sampling equipment to be used in the upcoming monitoring season be re-cleaned by the laboratory. Instead of performing a second round of equipment blank analyses on the re-cleaned equipment, the Stormwater Monitoring Program chose to monitor potential sampling equipment contamination through a review of field blank and method blank results generated during the subsequent wet weather monitoring events. With the exception of phthalate compound contamination, the field blank and method blank results from the wet weather events (Events 1 – 4) showed no systemic contamination of those constituents detected in pre-season carboy and tubing blanks, thus providing evidence that rigorous re-cleaning of sampling equipment eliminated trace-level contamination observed in pre-season blanks. Carboy and tubing blank results are presented along with all other QA/QC data in Appendix G.

Field and Lab Duplicates

When duplicates are analyzed, a sample is split into two separate sub-samples and analyzed independently of one another in the laboratory. Field duplicates are split by the sampling crew and provide a measure of the variability of field sampling techniques. Laboratory duplicates are split by the laboratory and provide information on the reproducibility of results by the lab.

The success of a duplicate analysis is measured by the relative percent difference (RPD) between the environmental sample result and the duplicate result. The RPD is calculated using the following equation:

$$RPD = \left(\frac{|ES - D|}{(ES + D)/2} \right) * 100\%$$

where: ES is the environmental sample result
D is the duplicate sample result

Field Duplicate Check – This precision analysis checks the relative percent difference (RPD) between the measured concentration of an analyte in an environmental sample and the measured concentration of the same analyte in its associated field duplicate sample. Calculated RPD values greater than 30% (that also possess an absolute difference greater than or equal to their associated detection limit) are considered to exceed the Stormwater Monitoring Program's DQO for this QA/QC sample type. This QA/QC limit was set by the Stormwater Monitoring Program at 30% because the limit could be no more restrictive than the QA/QC limit set for laboratory duplicates (see discussion below). Only 24 of 451 total field duplicates analyzed in 2005/06 fell outside of QA/QC limits, for an overall success rate of 94.7%. Field duplicate results are summarized in Table 17.

Table 17: Field Duplicate Success Rates

Classification	*Total Number*	*Number Outside DQO*	*Success Rate*
Anion	6	0	100%
Bacteriological	8	1	87.5%
Conventional	16	3	81.3%
Hydrocarbon	4	2	50%
Metal	50	8	84%
Nutrient	14	2	85.7%
Organic	132	8	93.9%
PCB	106	0	100%
Pesticide	115	0	100%

Field duplicate results were reviewed to determine if any reasons for observed success rates lower than 75% for some classes of constituents could be identified. In general, it is sometimes difficult to maintain a homogeneous mixture when splitting composite sample duplicates. Composite field duplicate samples were collected at ME-VR2 (Event 2) and ME-SCR (Event 6), with several common field duplicate exceedance issues observed among both events (e.g., Total Lead, Orthophosphate as P (Dissolved), Bis(2-ethylhexyl)phthalate, Fluoranthene, and Pyrene). Exceedances associated with methods EPA 405.1 (BOD), EPA 180.1 (Turbidity), SM 2540 D (Total Dissolved Solids), EPA 200.8 (total and dissolved metals), EPA 300.0 (Orthophosphate as P (Dissolved)), and EPA 625m (organics) were observed collectively during Event 2 (wet event) and Event 6 (dry event). Grab field duplicate samples were collected at ME-VR2 (Event 2) and ME-SCR (Event 6), with common field duplicate exceedances for TRPH observed at both sites. Exceedances associated with methods Coliltert-18 (Fecal Coliform) and EPA 418.1 (TRPH) were observed during Event 2 (wet event), while an exceedance for EPA 1664 (TRPH, alternate analytical method) was observed during Event 6 (dry event). No trends in either composite or grab field duplicate data quality objective exceedances were observed when comparing wet and dry monitoring events. It should be noted that differences in duplicate sample results are often observed when there is more solid material in one sample of the duplicate pair. When the splitting of a composite sample is performed, the composite sample is continually rocked in a sample pouring stand to provide as much "non-invasive" mixing as possible. However, the splitting process can still result in some variation in the solids content of duplicate samples.

Additionally, it should be noted that water quality samples collected from storm events typically have higher concentrations of suspended solids than do water samples collected during dry weather events. As a result, the splitting of homogeneous duplicate samples could have been further encumbered due to the high solids content of these environmental samples. Figure 24 shows a typical, turbid, wet weather sample collected at Mass Emission site ME-CC during February 2006 (Event 4). The lower success rate observed for hydrocarbons (less than 80%) was not considered significant enough to warrant follow-up investigation with the analyzing laboratory. All affected data were qualified as “estimated”. It should be noted that the success rate for organics was close to 95%.

Lab Duplicate Check – This precision analysis checks the relative percent difference (RPD) between the original measured concentration of an analyte in a sample and a replicate measured concentration of the analyte in the same sample. The original and replicate analyses are the result of “sample splitting” by the laboratory. Calculated RPD values greater than 20 – 30% (depending on laboratory) are considered to exceed the Stormwater Monitoring Program’s DQO for this QA/QC sample type. CRG Marine Laboratories, Inc. maintains a lab duplicate, RPD QA/QC limit of 30%, while all other laboratories (expect the Ventura County Health Care Agency) employed by the Stormwater Monitoring Program set their lab duplicate, RPD QA/QC limit between 20 – 25%, depending on analytical method. The Ventura County Health Care Agency Laboratory does not maintain a QA/QC limit for lab duplicate analyses performed on bacteriological samples. In this instance, the Stormwater Monitoring Program log-transformed bacteriological sample results before calculating RPD values and comparing this to a QA/QC limit of 30%. Only 110 of 1253 total lab duplicates analyzed during the current monitoring season fell outside of QA/QC limits, for an overall success rate of 91.2%. Of the 110 lab duplicates falling outside of data quality objectives, 49 were associated with Event 4. The highly turbid samples collected during the higher flows of this wet weather event likely impacted the laboratory's ability to evaluate completely homogenous sample aliquots. Lab duplicate results are summarized in Table 18.

Table 18: Laboratory Duplicate Success Rates

Classification	Total Number	Number Outside DQO	Success Rate
Anion	12	0	100%
Bacteriological	8	0	100%
Conventional	39	4	89.7%
Hydrocarbon	5	2	60%
Metal	135	27	80%
Nutrient	34	2	94.1%
Organic	397	72	81.9%
PCB	318	0	100%
Pesticide	305	3	99%

Figure 24: Wet weather composite sample collected at Mass Emission Station ME-CC during February 2006 (Event 4) showing high suspended solids content

Lab duplicate results were reviewed to determine if any reasons for observed success rates lower than 90% for some classes of constituents could be identified. Placing a higher burden of success on lab duplicate analyses (90%) than field duplicate analyses (75%) is common due to the much higher variability inherent in the collection of field duplicate samples. Differences among the calculated RPD values of lab duplicate pairs can be attributed to both sample variation, stemming from the sample splitting described above, as well as analytical variation. The overall 91.2% success rate across all lab duplicate samples analyzed was impacted by lower-than-expected lab duplicate success rates observed during Event 4. The lower success rates observed during Event 4 for conventionals (50%), hydrocarbons (0%), metals (28%), nutrients (50%), and organics (65.2%) were considered significant enough to warrant follow-up contact with the analyzing laboratories to remind them of the importance of homogenous sample splitting. It should be noted that the splitting of homogenous samples could have been further encumbered by the high total suspended solids content of the environmental samples (see Mass Emission station water quality results presented in Table 40 through Table 42). Figure 24 shows a typical, turbid, wet weather sample collected at Mass Emission site ME-CC during February 2006. All affected environmental data were qualified as "estimated". It should be noted that success rates for pesticides were very close to 100%.

Field Blanks

Field blank analyses are performed to test for contamination of environmental samples by field sample collection activities. Field blanks use blank water that is assumed to be void of all constituents for which a given set of analyses are to be performed. Filtered and purified de-ionized water is used for metals and trace organics field blanks, while standard de-ionized water is used for all other field blanks. Any constituents detected in field blanks are considered to be sources of contamination in the field. Field blanks are "collected" by pouring water from a laboratory-provided bottle directly into a sample container using clean sampling techniques and without the use of any extraneous equipment. This minimizes the possibility of any contamination of the field blanks.

Field Blank Check – This contamination analysis checks for a "hit" or the detection of an analyte in a field blank. A detected field blank concentration is considered an exceedance of the Stormwater Monitoring Program's DQO for this QA/QC sample type. Even though a detected concentration is an indication that contamination has occurred at some point during the field sampling or analytical process, it doesn't necessarily result in the qualification of an environmental sample. If a detected field blank result is greater than 20% of the concentration measured in an environmental sample, then the field blank contamination would result in the qualification of a single environmental sample collected at the same monitoring site as the field blank sample. As shown in Table 19, the majority of field blanks posted a 100% success rate with the exception of a handful of EPA 200.8m (total and dissolved metals) and EPA 625m (organics) blanks having success rates between 72.7 and 92.4%, and three occurrences of EPA 1631E (total and dissolved mercury) field blanks posting 0% success rates (Events 1 – 3).

Since the detection of an analyte in a field blank sample does not necessarily mean that the contamination impacts a particular environmental result, one must look further to determine if the environmental sample concentration is greater than five times the concentration measured in the detected field blank. Put another way, one must determine if the analyte concentration measured in the blank is greater than 20% of the analyte concentration measured in the associated environmental sample. Only if the blank contamination is greater than 20% of the measured environmental concentration would the environmental sample receive a qualification. For example, a dissolved zinc field blank hit of 0.2 µg/L that is associated with an environmental sample with a measured concentration of 8.0 µg/L would not result in the qualification of the environmental sample because its concentration is 40 times greater than that of the contamination measured in the field blank.

Field blank samples were collected at ME-VR2 (Event 1), ME-CC (Event 2 and Event 5), and ME-SCR (Event 3) during the 2005/06 monitoring season. Field contamination of Stormwater Monitoring Program environmental samples as evaluated through field blank analyses is minimal with only 27 hits out of 567 total field blank samples. This corresponds to an overall "non-detection" success rate of 95.7%; that is, no analyte was detected in 95.7% of the field blank samples. Only 14 of 567 total field blank samples analyzed in 2005/06 resulted in the qualification of environmental samples, for an overall success rate of 97.5%. Of the 14 field blanks showing contamination and having concentrations greater than 20% of that measured in their associated environmental samples, seven were from Event 1 (wet), three were from Event 2 (wet), and four were from Event 3 (wet). While only a limited number of field blank analyses were performed for dry weather Event 5, all blank results except for total mercury were reported as non-detect and the mercury detection did not require the qualification of environmental samples. Mercury was also detected in field blanks from the first three wet weather monitoring events, while copper and lead were hits in an Event 1 blank and zinc was found in field blanks from both Events

1 and 2. The total mercury field blank detections not withstanding, the other field blank detections for metals were not considered indicative of any type of reoccurring contamination issue present during sample collection in the field. VCWPD monitoring staff will continue to employ clean techniques when preparing mercury field blank samples and will work with CRG Marine Labs to identify and remove any mercury contamination of sample containers. With regard to organics contamination, field blank analyses from the first three wet weather monitoring events revealed detectable concentrations of phthalate compounds, while three polynuclear aromatic hydrocarbons (PAHs) were detected in an Event 1 blank and 1,2-Dichlorobenzene was detected in an Event 3 blank. However, as discussed in the method blank section below, phthalate contamination in the laboratory appears to be an issue. The 14 affected environmental samples were qualified as "upper limit" due to field blank contamination.

Table 19: Field Blank Success Rates

Event ID	Classification	Method	Total Number	Number Outside DQO	Qualified Environ. Samples	Success Rate
2005/06-1	Anion	SM 4500-Br	1	0	0	100%
	Bacteriological	Enterolert	1	0	0	100%
	Bacteriological	MMO-MUG	2	0	0	100%
	Bacteriological	SM 9221E	1	0	0	100%
	Conventional	SM 2340B	1	0	0	100%
	Metal	EPA 1631E	1	1	0	0%
	Metal	EPA 200.8m	11	3	1	72.7%
	Organic	EPA 625m	66	8	6	87.9%
	PCB	EPA 625m	53	0	0	100%
	Pesticide	EPA 625m	47	0	0	100%
2005/06-2	Bacteriological	Enterolert	1	0	0	100%
	Bacteriological	MMO-MUG	2	0	0	100%
	Bacteriological	SM 9221E	1	0	0	100%
	Metal	EPA 1631E	1	1	0	0%
	Metal	EPA 200.8m	11	1	0	90.9%
	Organic	EPA 625m	66	5	3	92.4%
	PCB	EPA 625m	53	0	0	100%
	Pesticide	EPA 625m	47	0	0	100%
2005/06-3	Anion	SM 4500-Br	1	0	0	100%
	Bacteriological	Enterolert	1	0	0	100%
	Bacteriological	MMO-MUG	2	0	0	100%
	Bacteriological	SM 9221E	1	0	0	100%
	Conventional	SM 2340B	1	0	0	100%
	Metal	EPA 1631E	1	1	0	0%
	Metal	EPA 200.8m	11	0	0	100%
	Organic	EPA 625m	66	6	4	90.9%
	PCB	EPA 625m	53	0	0	100%
	Pesticide	EPA 625m	47	0	0	100%
2005/06-5	Bacteriological	Colilert-18	3	0	0	100%
	Bacteriological	Enterolert	1	0	0	100%
	Conventional	SM 2340B	1	0	0	100%
	Metal	EPA 1631E	1	1	0	0%
	Metal	EPA 200.8m	11	0	0	100%

Method Blanks

Method blanks are prepared by the laboratory using blank water, and then analyzed for every batch of environmental samples analyzed. A detected concentration or "hit" in a method blank is an indication of contamination in the analytical process; that is, contamination occurring somewhere in the laboratory. If the result for a single method blank is greater that the *method detection limit* (MDL), or if the average method blank concentration plus two standard deviations of three or more blanks is greater than the *reporting limit* (RL) for a particular analyte, then associated environmental sample results, depending on their measured concentrations, have the potential to be qualified.

Method Blank Check – This contamination analysis checks for "hits" or the detection of an analyte in a method blank. A detected method blank concentration is considered an exceedance of the Stormwater Monitoring Program's DQO for this QA/QC sample type. Even though a detected concentration is an indication that contamination has occurred during the analytical process, it doesn't necessarily result in the qualification of environmental samples. If a detected method blank value is greater than 20% of the concentration measured in associated environmental samples, then the method blank contamination would result in the qualification of one or more environmental samples analyzed in the same QA/QC batch as the out-of-control method blank. Table 20 below summarizes only those method blank results having less than 100% success rates. A summary of all method blanks analyzed during the 2005/06 monitoring season is presented in Appendix H. All method blanks except for those associated with organic compounds analyzed via EPA 625m posted a 100% success rate. On average, EPA 625m method blanks for all trace organic compounds (including PCBs and pesticides) analyzed by the Stormwater Monitoring Program posted a success rate of 97.3% across Events 1 – 6. Method blank success rates for individual 2005/06 monitoring events are shown in Table 20.

Table 20: Method Blank Success Rates

Event ID	Classification	Method	Total Number	Number Outside DQO	Qualified Environ. Samples	Success Rate[1]
2005/06-1	Organic	EPA 625m	66	5	19	92.4%
2005/06-2	Organic	EPA 625m	66	5	10	92.4%
2005/06-3	Organic	EPA 625m	66	5	11	92.4%
2005/06-4	Organic	EPA 625m	66	3	4	95.5%
2005/06-5	Organic	EPA 625m	66	4	10	93.9%
2005/06-6	Organic	EPA 625m	66	5	12	92.4%

1. Only method blanks having less that 100% success rates are summarized in this table. A summary of all method blanks analyzed during the 2005/06 monitoring season is presented in Appendix H.

Similar to field blanks, the detection of an analyte in a method blank sample does not necessarily mean that the contamination impacts environmental results. One must look further to determine if environmental sample concentrations are greater than five times the concentration measured in the detected method blank. Stated differently, one must determine if the analyte concentration measured in the blank is greater than 20% of the analyte concentration measured in the associated environmental samples. Only if the blank contamination is greater than 20% of the measured environmental concentration would the environmental sample receive a qualification. For example, a Butyl benzyl phthalate method blank hit of 0.02 μg/L would result in the qualification of all Butyl benzyl phthalate environmental samples with measured concentrations of less than 0.1 μg/L. A hypothetical environmental sample with a measured concentration of 0.7 μg/L would not be qualified because this concentration far overshadows the 0.02 μg/L contamination measured in the method blank.

The vast majority of method blanks run by the various analytical laboratories employed by the Stormwater Monitoring Program detected no analytes in the method blanks they analyzed. However, trace organic method blanks analyzed by CRG Marine Laboratories, Inc. using method EPA 625m did show contamination. Specifically, five phthalate compounds (Bis(2-ethylhexyl)phthalate, Butyl benzyl phthalate, Diethyl phthalate, Dimethyl phthalate, and Di-n-butylphthalate) were detected in each EPA 625m base/neutral extractable compound method blank analyzed by CRG during the course of monitoring Events 1 – 3 and 6. The Event 4 EPA 625m method blanks showed contamination by Bis(2-ethylhexyl)phthalate, Diethyl phthalate, and Di-n-butylphthalate, while the Event 5 method blanks posted hits for Bis(2-ethylhexyl)phthalate, Butyl benzyl phthalate, Diethyl phthalate, and Di-n-butylphthalate. It should be noted that all five phthalate compounds were also detected by CRG in tubing and carboy pre-season equipment blanks. In total, phthalate compounds were detected in pre-season equipment blanks, field blanks, method blanks, and environmental samples. Phthalate contamination is common in analytical laboratories and is most often associated with exposure to plastic materials. CRG Marine Laboratories, Inc., the laboratory performing EPA 625m analyses for the Stormwater Monitoring Program, maintains that all measures have been taken to avoid sample contact with plastics. CRG's low detection limits (MDL = 0.005 µg/L for the detected phthalates) also lend themselves to the identification of constituents that would not be detected by laboratories having higher detection limits. The relatively high detected concentration of phthalates in environmental samples also indicates that these constituents are indeed present in the environment as well. In response to the observed phthalate contamination issue, all affected environmental data (66 of 105 total samples associated with the five phthalate compounds) were qualified as "upper limit" due to method blank contamination.

Matrix Spikes and Matrix Spike Duplicates

A matrix spike (MS) is an environmental sample that is spiked by the laboratory with a known amount of the constituent being analyzed. Once the analysis is run, the analysis results are compared to the spike amount to determine how much of the spike was detected through the analytical process. The amount of the spike recovered is described as the "percent recovery" of the target analyte. A matrix spike duplicate (MSD) is a duplicate of this analysis that checks whether or not the lab is able to duplicate the results of the initial matrix spike analysis. These analyses help to confirm that the laboratory's instrumentation and procedures are accurate and compliant with typical laboratory performance standards.

For both matrix spikes and matrix spike duplicates, lower and upper limits are placed on the recovery of the spike by the laboratory performing the analysis. Once percent recoveries are available for both matrix spike and matrix spike duplicate analyses, a relative percent difference can be calculated for the two results. Table 21 below summarizes the matrix spike recovery and matrix spike RPD qualification limits (QA/QC limits) established by the laboratories employed by the Stormwater Monitoring Program. Unless specifically identified in EPA analytical guidance for a particular method, QA/QC limits are usually developed by laboratories using the average percent recovery for an analyte and setting lower and upper limits at two or three standard deviations below and above the average recovery, respectively. Trace organic compound matrix spike recovery rates vary widely among these constituents, and therefore no single recovery acceptance range (i.e., 70 – 130%) can be used for these analytes. Instead, each constituent's recovery is compared to a unique constituent-specific acceptance range.

Matrix Spike Recovery Check – This accuracy analysis verifies that secondary spike analyses (such as matrix spike recovery analyses) performed by the laboratory show that the laboratory's instrumentation and procedures are accurate and compliant with typical laboratory performance standards. Matrix spike recovery values (for both MS and MSD analyses) outside of laboratory-determined QA/QC ranges (set with lower and upper limits) are considered to exceed the Stormwater Monitoring Program's DQO for this QA/QC sample type.

Matrix spike recovery success rates ranged from 95.2% (Event 3, EPA 625m organics) to 100% for the majority of matrix spike recovery analyses performed across wet weather Events 1 – 4. Dry weather Events 5 and 6 posted success rates that ranged from 66.7% (Event 6, EPA 300.0 nutrients and EPA 8151A pesticides) to 100% for the majority of matrix spike recovery analyses performed for these two events. A summary of success rates for matrix spike recovery samples analyzed during the 2005/06 monitoring season is presented in Appendix I. No particular classifications of constituents or analytical methods appear to be more prone to recovery problems than any other classification or method. Likewise, particular monitoring sites showed no tendency toward recovery problems. Recoveries below the lower QA/QC limit or above the upper QA/QC limit are generally attributed to matrix interference. Matrix interference occurs when substances contained in the sample water, or *matrix*, interfere with the ability of the laboratory instrumentation to accurately detect a compound being analyzed. Stormwater matrices tend to be "dirtier" than other matrices and are prone to contain substances that cause matrix interference. Matrix spike recoveries above their upper limit resulted in two Event 1 environmental samples (EPA 625m organics) being qualified as "high biased" due to matrix interference, while matrix spike recoveries below their lower limits resulted in three Event 3 (EPA 625m organics) and one Event 6 (Nitrate as N) environmental samples being qualified as "low biased" due to matrix interference.

Table 21: Matrix Spike Qualification Limits

Classification or Constituent	MS Percent Recovery Limits		MS RPD Percent Limit
	Lower Limit	Upper Limit	Maximum RPD
Anion (Calscience)	80%	120%	15%
Anion (CRG)	70%	130%	30%
Conventional	70%	130%	25%
Aluminum*	50%	140%	30%
Arsenic*	65%	135%	30%
Cadmium*	60%	140%	30%
Chromium*	70%	130%	30%
Chromium VI	70%	130%	30%
Copper*	70%	130%	30%
Lead*	65%	135%	30%
Mercury*	60%	140%	30%
Nickel*	70%	130%	30%
Selenium*	40%	160%	30%
Silver*	50%	155%	30%
Thallium*	70%	130%	30%
Zinc*	50%	150%	30%
Nutrient	70%	130%	30%
TKN	80%	120%	20%
Organic EPA 625m	variable	variable	30%
PCB EPA 625m*	65%	135%	30%
EPA 547*	68%	134%	30%
Pesticide EPA 625m	variable	variable	30%
Pesticide EPA 8151A	30%	130%	30%

RPD = Relative Percent Difference

*Lower and Upper Limits vary – widest possible range presented.

Matrix Spike RPD Check – This precision analysis checks the relative percent difference (RPD) between two related matrix spike recovery results. RPD values greater than 20 – 30% (depending on constituent and analytical method) are considered to exceed the Stormwater Monitoring Program's DQO for this QA/QC sample type.

Matrix spike relative percent difference (RPD) success rates ranged from 50% (Event 3, SM 4500 P-C analyzing for Total Phosphorus) to 100% for the vast majority of matrix spike RPD analyses performed across wet weather Events 1 – 4. Matrix spike RPD values calculated from EPA 625m trace organic compound (organics, PCBs, and pesticides) matrix spike recoveries posted an average success rate of 97.5% across Events 1 – 4, whereas the matrix spike RPD success rate for SM 4500 P-C (Total Phosphorus) was 75% over the same averaging period. Dry weather Events 5 and 6 posted success rates that ranged from 66.7% (EPA 8151A pesticides) to 100% for the majority of matrix spike recovery analyses performed for these two events. Matrix spike RPD values calculated from EPA 200.8 metals matrix spike recoveries showed an average success rate of 95.5% for Events 5 and 6. All other analytical methods across all six monitoring events showed 100% success in meeting the DQO for a matrix spike RPD evaluation. A summary of success rates for matrix spike RPD values calculated during the 2005/06 monitoring season is presented in Appendix J. In general, the greater the matrix interference in individual matrix spike recoveries, especially if one recovery leans low and the other lean high, the greater their relative percent difference. Calculated matrix spike RPD values in excess of their associated QA/QC limit resulted in 17 affected environmental samples in the 2005/06 data set being qualified as "estimated".

Surrogate Spikes

Surrogate spikes are compounds added to all trace organics samples by the laboratory to check the efficiency of the organics extraction process when testing samples using gas chromatography (GC) or gas chromatography-mass spectroscopy (GC/MS) analytical methods. Surrogates are compounds that are chemically and analytically similar to the compounds ("target analytes") for which the analysis is being performed. They are added to both laboratory blank water and environmental samples undergoing analyses for trace organic compounds. The success of a particular sample extraction is based on the amount of the surrogate compound that is recovered through the analytical process. The amount of the spike recovered is described as the "percent recovery". Different analytical methods, as well as individual constituents analyzed by those methods, possess different QA/QC limits for the recovery of surrogates. Table 22 summarizes the lower and upper QA/QC limits for the recovery of surrogate compounds via three analytical methods used to measure trace organic compounds by the Stormwater Monitoring Program. Limits displayed in the table represent the lowest and highest possible recoveries for a particular analytical method.

Table 22: Surrogate Spike Recovery Limits

Analytical Method	*Surrogate Recovery Limits*	
	Lower Limit	*Upper Limit*
EPA 8151A	0%	123%
EPA 8260B*	74%	146%
EPA 625m*	6%	162%

*Lower and Upper Limits vary – widest possible range presented.

Results coming from the analysis of surrogate compounds are not used to directly qualify environmental samples when a surrogate result is found to fall outside of its associated QA/QC limits. Instead, surrogate results are used to elucidate trends in a laboratory's analysis of organic constituents. High and low surrogate recoveries can inform the laboratory that a particular analytical process is out of control or moving toward that state, and prompt the laboratory to take corrective measures as necessary. For the current monitoring season, the surrogate method blank success rate for all trace organic analytical methods was 100%, while the surrogate field blank success rate for analytical method EPA 625m was 97%. Surrogate matrix spike recovery success rates were all 100%. Surrogate environmental recovery results – evaluated in conjunction with matrix spike recovery results – showed a 99.3% success rate across all six monitoring events. Surrogate recoveries outside of QA/QC limits were associated with method EPA 625m surrogate field blank recoveries (Event 1) and method EPA 8151A surrogate environmental recoveries (Event 6), but did not show any discernable patterns with regard to matrix, in the case of surrogate environmental analyses, or associated monitoring site or event.

Laboratory Control Spikes

Laboratory control spike (LCS) analyses are used to test the accuracy of the entire laboratory analytical process. These primary spike analyses are performed by the laboratory to certify that the instrumentation and laboratory procedures are accurate and compliant with typical laboratory performance. LCS recovery samples can also be run in duplicate similar to matrix spike duplicate analyses. LCS samples are standards prepared internally by the laboratory using a known amount of analyte. A laboratory can also purchase pre-prepared standards called standard reference material (SRM) or certified reference material (CRM). Regardless of how the standard is prepared, it is run through the entire analytical process as if it was an environmental sample. Since the standard contains a known amount of a compound, the results of the analysis can be compared to the expected result and a percent recovery calculated. LCS recoveries are reviewed to determine if the percent recovery is within control limits provided by the laboratory. If a LCS recovery is below the lower QA/QC acceptance limit for a constituent, then an environmental sample is qualified as "low biased". If a LCS recovery is above the upper QA/QC acceptance limit for a constituent, then an environmental sample is qualified as "high biased". In the absence of matrix spike recovery data for a particular monitoring site, a LCS result outside of QA/QC limits would lead to the qualification of all environmental data from the same analytical batch as the out-of-control LCS recovery. However, in instances where in-control matrix spike recovery results exist for an analyte, these matrix spike recovery results would "trump" LCS recovery results. An environmental sample associated with in-control matrix spike results would not be qualified as either "low biased" or "high biased" due to poor LCS recovery. Table 23 shows the lower and upper LCS recovery limits associated with those constituents for which laboratory control spike analyses were performed during the current monitoring season.

Laboratory Control Spike Check – This accuracy analysis verifies that primary spike analyses, such as LCS, SRM, and CRM recovery analyses, performed by a laboratory show that the lab's instrumentation and procedures are accurate and compliant with typical laboratory performance standards. LCS, SRM, and CRM recovery values outside of laboratory-determined ranges are considered to exceed the Stormwater Monitoring Program's DQO for this QA/QC sample type.

The success rate of all laboratory control spike recoveries (including LCS and LCS duplicate recoveries) analyzed in the 2005/06 monitoring season is 100%. No environmental samples were biased either low or high due to LCS recoveries, and therefore no environmental samples were qualified based on this particular QA/QC evaluation. A summary of success rates for LCS recovery analyses performed during the 2005/06 monitoring season is presented in Appendix K.

Table 23: Laboratory Control Spike Recovery Limits

Classification	***Constituent(s)***	***LCS Recovery Limits***	
		Lower Limit	***Upper Limit***
Anion	Chloride	70	130
Anion	Perchlorate	85	115
Conventional	Total Dissolved Solids	70	130
Conventional	Total Organic Carbon	80	120
Hydrocarbon	Oil and Grease	70	130
Hydrocarbon	TRPH	70	130
Metal	Al, Cr, Cu, Pb, Hg, Ni, Ag, Tl, Zn	75	125
Metal	Arsenic	65	135
Metal	Cadmium	60	140
Metal	Chromium VI	70	130
Metal	Selenium	40	160
Nutrient	Ammonia as N, Nitrate as N, Nitrite as N, Orthophosphate as P (Diss), and Total Phosphorus	70	130
Nutrient	TKN	80	120
Organic	Methyl tert-butyl ether (MTBE)	82	118
Pesticide	2,4,5-T	30	130
Pesticide	2,4-D	30	130
Pesticide	2,4-DB	30	130
Pesticide	Glyphosate	71	137

*Lower and Upper Limits vary – widest possible range presented.

Laboratory Control Spike RPD Check – This precision analysis checks the relative percent difference (RPD) between two related laboratory control spikes (LCS), standard reference material (SRM), or certified reference material (CRM) recovery analyses. RPD values greater than 10 – 30% (depending on constituent and analytical method) are considered to exceed the Stormwater Monitoring Program's DQO for this QA/QC sample type.

Only a single calculated LCS RPD value out of a total of 119 calculated values exceeded the DQO for a LCS RPD evaluation. A LCS RPD result calculated from two TRPH LCS recoveries exceeded its 30% maximum QA limit. To this end, three TRPH environmental samples from Event 3 were qualified at "estimated". A summary of success rates for LCS RPD values calculated during the 2005/06 monitoring season is presented in Appendix L.

Holding Time Exceedances

The large majority of analytical methods used to analyze water quality samples specify a certain time period in which an analysis must be performed in order to ensure confidence in the result provided from the analysis. A sample that remains unanalyzed for too long a period of time sometimes shows analytical results different from those that would have been observed had the sample been analyzed earlier in time. This difference is due to the breakdown, transformation, and/or dissipation of substances in the sample over time. A holding time can be either the time between sample collection and sample preparation (the preparation holding time limit) or between the sample preparation and sample analysis (the analysis holding time limit). If a particular sample doesn't require any pre-analysis preparation, then the analysis holding time is the time between sample collection and sample analysis.

Holding Time Exceedance Check – This analysis determines the elapses time between sample collection and sample analysis, the elapsed time between sample collection and sample preparation, and the elapsed time between sample preparation and sample analysis. These elapsed times are then compared to holding time values (typically provided in EPA guidance for analytical methods) to determine if a holding time exceedance has occurred. Elapsed times greater than specified holding time limits are considered to exceed the Stormwater Monitoring Program's DQO for this QA/QC sample type.

All holding times were met by laboratories during the current monitoring season. Samples evaluated for holding time exceedances during the 2005/06 monitoring season are presented in Appendix M.

Data Qualification Codes

As discussed above, the Stormwater Monitoring Program's QA/QC evaluation process looked for and found various environmental and QA/QC sample results that fell outside of particular data quality objectives or QA/QC limits. In some instances these exceedances of QA/QC limits resulted in the qualification of affected environmental data. Data are literally qualified by attaching specific qualification codes used by the Stormwater Monitoring Program to individual data points as necessary. The various qualification codes assigned to environmental data during the current monitoring season are presented in Table 24.

The codes listed in Table 24 appear in the "Qualifier" data field included in Appendix F that presents all environmental sample results generated by the Stormwater Monitoring Program during the 2005/06 monitoring season. It should be noted that with the exception of holding time exceedances for field blank and field duplicate results, the Stormwater Monitoring Program does not assign qualifications to QA/QC samples. Appendix G presents all QA/QC results generated by the Stormwater Monitoring Program during the 2005/06 monitoring season.

In summary, a total of 5269 environmental samples (including 457 field duplicate results) were analyzed during the 2005/06 monitoring season. Field duplicate analyses are considered to be surrogates of environmental analyses and are therefore included in the calculation of environmental sample totals. The Stormwater Monitoring Program's QA/QC evaluation process identified 227 environmental samples in need of qualification. An additional 79 environmental results were reported as "estimated" by the laboratory upon completion of its sample analysis. In total, there were 307 qualified environmental samples from the current monitoring season, which translates into the Stormwater Monitoring Program achieving a 94.2% success rate in meeting program data quality objectives. Additionally, five QA/QC data records were rejected from the current monitoring season's data set. All five rejected records were matrix spike results (for Bis(2-ethylhexyl)phthalate and Total Aluminum) from Event 4 that were insufficiently spiked by the laboratory due to the parameter concentration in the sample exceeding the spike concentration. As a matter of course, insufficiently spiked matrix spike samples are removed from the Stormwater Monitoring Program's QA/QC data set as they cannot be used to evaluate target analyte recovery. Overall, the four wet weather and two dry weather events monitored during the current season produced a high quality data set in terms of the low percentage of qualified data, as well as the low reporting levels achieved by all laboratories analyzing the Stormwater Monitoring Program's water quality samples. Table 25 through Table 31 present the success rates observed for each QA/QC evaluation performed by the Stormwater Monitoring Program during the 2005/06 monitoring season on a classification-by-classification basis.

Table 24: Program Data Qualification Codes

Qualification Code	***Qualification Description***
EST-FD	Result is considered "estimated" due to field duplicate DQO exceedance.
EST-HT	Result is considered "estimated" due to holding time limit exceedance.
EST-LCSRPD	Result is considered "estimated" due to laboratory control spike, RPD DQO exceedance.
EST-LD	Result is considered "estimated" due to laboratory duplicate DQO exceedance.
EST-MSRPD	Result is considered "estimated" due to matrix spike, RPD DQO exceedance.
HB-MSR	Result is considered "high biased" due to a matrix spike recovery greater than the established upper limit for the analyte. Both matrix spike and matrix spike duplicate results can exceed the upper limit due to matrix interference and therefore result in qualification of environmental data.
LB-MSR	Result is considered "low biased" due to a matrix spike recovery less than the established lower limit for the analyte. Both matrix spike and matrix spike duplicate results can fall below the lower limit due to matrix interference and therefore result in qualification of environmental data.
UL-FB	Result is considered an "upper limit" of its true concentration due to field blank DQO exceedance (i.e., field blank contamination).
UL-FLTRB	Result is considered an "upper limit" of its true concentration due to filter blank DQO exceedance (i.e., filter blank contamination).
UL-MB	Result is considered an "upper limit" of its true concentration due to method blank DQO exceedance (i.e., method blank contamination).
EST*	Result is estimated; numeric value below the RL and above the MDL.

*The EST qualification code is assigned by the analytical laboratory that analyzed the sample, not by the Program.

Table 25: QA/QC Success Rates for Anions

QAQC Sample Type	*Total Number*	*Number Successful*	*Success Rate*
Holding Time (HT)*	71	71	100%
Method Blank (MB)	19	19	100%
Field Blank (FB)	2	2	100%
Laboratory Control Spike (LCS)	15	15	100%
Laboratory Control Spike Duplicate (LCSD)	15	15	100%
Laboratory Control Spike, RPD (LSCRPD)	15	15	100%
Matrix Spike (MS)	7	7	100%
Matrix Spike Duplicate (MSD)	7	7	100%
Matrix Spike, RPD (MSRPD)	7	7	100%
Laboratory Duplicate (LD)	12	12	100%
Field Duplicate (FD)	6	6	100%

*Holding Time is not a specific type of QA/QC sample, rather a specific QA/QA evaluation performed by the Stormwater Monitoring Program.

Table 26: QA/QC Success Rates for Bacteriologicals

QAQC Sample Type	*Total Number*	*Number Successful*	*Success Rate*
Holding Time (HT)*	108	108	100%
Field Blank (FB)	16	16	100%
Laboratory Duplicate (LD)	8	8	100%
Field Duplicate (FD)	8	7	87.5%

*Holding Time is not a specific type of QA/QC sample, rather a specific QA/QA evaluation performed by the Stormwater Monitoring Program.

Table 27: QA/QC Success Rates for Conventionals

QAQC Sample Type	*Total Number*	*Number Successful*	*Success Rate*
Holding Time (HT)*	187	187	100%
Method Blank (MB)	42	42	100%
Field Blank (FB)	3	3	100%
Laboratory Control Spike (LSC)	12	12	100%
Laboratory Control Spike Duplicate (LCSD)	7	7	100%
Laboratory Control Spike, RPD (LCSRPD)	7	7	100%
Matrix Spike (MS)	3	3	100%
Matrix Spike Duplicate (MSD)	3	3	100%
Matrix Spike, RPD (MSRPD)	3	3	100%
Laboratory Duplicate (LD)	39	35	89.7%
Field Duplicate (FD)	16	13	81.2%

*Holding Time is not a specific type of QA/QC sample, rather a specific QA/QA evaluation performed by the Stormwater Monitoring Program.

Table 28: QA/QC Success Rates for Hydrocarbons

QAQC Sample Type	Total Number	Number Successful	Success Rate
Holding Time (HT)*	46	46	100%
Method Blank (MB)	12	12	100%
Laboratory Control Spike (LSC)	12	12	100%
Laboratory Control Spike Duplicate (LCSD)	12	12	100%
Laboratory Control Spike, RPD (LCSRPD)	12	11	91.7%
Laboratory Duplicate (LD)	5	3	60%
Field Duplicate (FD)	4	2	50%

*Holding Time is not a specific type of QA/QC sample, rather a specific QA/QA evaluation performed by the Stormwater Monitoring Program.

Table 29: QA/QC Success Rates for Nutrients

QAQC Sample Type	Total Number	Number Successful	Success Rate
Holding Time (HT)*	161	161	100%
Method Blank (MB)	42	42	100%
Laboratory Control Spike (LCS)	40	40	100%
Laboratory Control Spike Duplicate (LCSD)	36	36	100%
Laboratory Control Spike, RPD (LCSRPD)	36	36	100%
Matrix Spike (MS)	30	29	96.7%
Matrix Spike Duplicate (MSD)	30	29	96.7%
Matrix Spike, RPD (MS RPD)	30	29	96.7%
Laboratory Duplicate (LD)	34	32	94.1%
Field Duplicate (FD)	14	12	85.7%

*Holding Time is not a specific type of QA/QC sample, rather a specific QA/QA evaluation performed by the Stormwater Monitoring Program.

Table 30: QA/QC Success Rates for Metals

QAQC Sample Type	Total Number	Number Successful	Success Rate
Holding Time (HT)*	623	623	100%
Method Blank (MB)	138	138	100%
Field Blank (FB)	48	40	83.3%
Laboratory Control Spike (LCS)	30	30	100%
Laboratory Control Spike Duplicate (LCSD)	30	30	100%
Laboratory Control Spike, RPD (LCSRPD)	30	30	100%
Matrix Spike (MS)	87	86	98.9%
Matrix Spike Duplicate (MSD)	87	87	100%
Matrix Spike, RPD (MSRPD)	87	86	98.9%
Laboratory Duplicate (LD)	135	108	80%
Field Duplicate (FD)	50	42	84%

*Holding Time is not a specific type of QA/QC sample, rather a specific QA/QA evaluation performed by the Stormwater Monitoring Program.

Table 31: QA/QC Success Rates for Trace Organic Compounds

Method	QAQC Sample Type	Total Number	Number Successful	Success Rate
EPA 547	Holding Time (HT)*	22	22	100%
	Method Blank (MB)	8	8	100%
	Laboratory Control Spike (LCS)	8	8	100%
	Matrix Spike (MS)	2	2	100%
	Matrix Spike Duplicate (MSD)	2	2	100%
	Matrix Spike, RPD (MSRPD)	2	2	100%
	Laboratory Duplicate (LD)	3	3	100%
	Field Duplicate (FD)	1	1	100%
EPA 625m	Holding Time (HT)*	4394	4394	100%
	Method Blank (MB)	996	969	97.3%
	Surrogate Method Blank (SMB)	77	77	100%
	Field Blank (FB)	498	479	96.2%
	Surrogate Field Blank (SFB)	33	32	97%
	Matrix Spike (MS)	785	777	99%
	Matrix Spike Duplicate (MSD)	784	782	99.7%
	Matrix Spike, RPD (MSRPD)	784	771	98.3%
	Surrogate Matrix Spike (SMS)	66	66	100%
	Surrogate Matrix Spike Duplicate (SMSD)	66	66	100%
	Environmental Sample Surrogates (ESS)	253	253	100%
	Laboratory Duplicate (LD)	996	921	92.5%
	Field Duplicate (FD)	332	324	97.6%
EPA 8151A	Holding Time (HT)*	230	230	100%
	Method Blank (MB)	60	60	100%
	Surrogate Method Blank (SMB)	6	6	100%
	Laboratory Control Spike (LCS)	18	18	100%
	Laboratory Control Spike Duplicate (LCSD)	18	18	100%
	Laboratory Control Spike, RPD (LCSRPD)	18	18	100%
	Matrix Spike (MS)	15	14	93.3%
	Matrix Spike Duplicate (MSD)	15	14	93.3%
	Matrix Spike, RPD (MSRPD)	15	13	86.7%
	Environmental Sample Surrogates (ESS)	23	21	91.3%
	Laboratory Duplicate (LD)	20	20	100%
	Field Duplicate (FD)	20	20	100%
EPA 8260B	Holding Time (HT)*	3	3	100%
	Method Blank (MB)	1	1	100%
	Surrogate Method Blank (SMB)	4	4	100%
	Laboratory Control Spike (LCS)	1	1	100%
	Laboratory Control Spike Duplicate (LCSD)	1	1	100%
	Laboratory Control Spike, RPD (LCSRPD)	1	1	100%
	Environmental Sample Surrogates (ESS)	12	12	100%
	Laboratory Duplicate (LD)	1	1	100%

*Holding Time is not a specific type of QA/QC sample, rather a specific QA/QA evaluation performed by the Stormwater Monitoring Program.

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8. Water Quality Results

This section provides a brief description of the Stormwater Monitoring Program's NPDES Stormwater Quality Database, as well as presents the 2005/06 monitoring results from the Land Use, Receiving Water, and Mass Emission monitoring locations. All environmental sample results, as exported from the NPDES Stormwater Quality Database, are included in Appendix F. As mentioned earlier, these data include qualifiers that were assigned to them based on the outcome of the QA/QC data evaluation process described in Section 7.

NPDES Stormwater Quality Database

The Stormwater Monitoring Program manages all of its water chemistry environmental and QA/QC data in its NPDES Stormwater Quality Database (Database). Over the past three years, VCWPD has invested approximately $150,000 to develop and upgrade a water quality database (built using Microsoft Access XP Version 2002) to further expedite, standardize, and enhance the Stormwater Monitoring Program's data management and data analysis activities. Monitoring results for the 2005/06 monitoring year were reported by laboratories in the forms of electronic data deliverables (EDDs) and hard copy laboratory reports. This monitoring season marks the first time that water quality data were received by the Stormwater Monitoring Program as EDDs due to a recent upgrade of the Database that allows it to automatically import electronic data formatted in either Microsoft Excel worksheets or Microsoft Access data tables. As a means of facilitating the proper compilation and formatting of EDDs by laboratories, the Stormwater Monitoring Program produced the *NPDES Stormwater Water Quality Database Data Reporting Protocols* guidance document. This document was distributed to all laboratories providing electronically formatted water chemistry data to the Stormwater Monitoring Program in order to provide these laboratories with appropriate EDD formatting and data population guidance. VCWPD staff automatically imported, as well as hand entered data into the Database and checked the data for accuracy and completeness using the Stormwater Monitoring Program's new *Data Quality Evaluation Standard Operating Procedures* guidance document. The Database includes the following features employed by the Stormwater Monitoring Program to manage and evaluate its water chemistry data:

- Automatic importation and cursory evaluation of electronically formatted data
- Key data entry screens for single and multiple record data entry for data reported in hard copy form
- Data viewing/editing screens for the detailed evaluation of newly entered data
- Semi-automated QA/QC evaluation
- Data querying screens
- Automated comparison of the Stormwater Monitoring Program's data to water quality objectives (Region 4 Basin Plan and California Toxics Rule).

The database has allowed the Stormwater Monitoring Program to improve its overall data management effort by providing staff with a robust data management tool for the storage, analysis, and reporting of monitoring data. On a routine basis the reference information used by the Database to carry out its various functions is reviewed to confirm that it is accurate and up-to-date. During the current monitoring season, the Database's reference table of site-specific Basin Plan objectives was updated to include appropriate site-specific objectives for the new ME-VR2 Mass Emission site. The new station's specific location on the Ventura River features water quality objectives slightly different from those of the upstream reach where the original ME-VR site was located.

There are plans to expand the database beyond the capabilities listed above. Future upgrades to the database will eventually include (1) the ability to perform complex statistical analyses such as trend analysis, (2) the means to store the Stormwater Monitoring Program's aquatic toxicity and bioassessment data, and (3) the capability to export electronic data in specific data formats for the purpose of sharing data with other agencies. The addition of these features to the water quality database will provide additional tools to the Stormwater Monitoring Program that will improve data management and analysis in an effort to enhance the effectiveness of the overall program.

Monitoring Results

Land Use, Receiving Water, and Mass Emission water quality results for the 2005/06 monitoring year were generated from the collection and analysis of composite and grab samples. Results are reported as the concentrations measured from either flow-proportional or time-paced composite samples, or from single grab samples. As mentioned earlier, only samples collected from the ME-CC and ME-VR2 stations are collected as flow-proportional composite samples; all other composites are collected as time-paced samples. In either case, the results can be interpreted as the best available estimate of the event mean concentrations (EMC) for the given storm event.

The following constituents were collected as grab samples, with all other constituents analyzed from composite samples:

- Perchlorate
- E. coli
- Enterococcus
- Fecal Coliform
- Total Coliform
- Conductivity
- pH
- Turbidity (Event 6 only)
- Oil and Grease
- TRPH
- Mercury – Total Recoverable and Dissolved (Events 5 and 6 only)
- Ammonia-Nitrogen
- MTBE (Land Use and Receiving Water Stations)
- Aquatic Toxicity

Receiving Water and Land Use Site Results

Water quality results for the 2005/06 monitoring season from the Land Use and Receiving Water stations are presented in Table 32 through Table 39.

Table 32: Anion, Conventional, Hydrocarbon, and Nutrient Results from Agricultural Land Use Site A-1

Classification	Constituent	Fraction	Units	A-1 Event 1 10/17/05
Anion	Bromide	n/a	mg/L	10
Anion	Chloride	n/a	mg/L	26.6
Anion	Perchlorate	n/a	µg/L	< 2
Conventional	BOD	n/a	mg/L	6.8
Conventional	Conductivity	n/a	µmhos/cm	1030
Conventional	Hardness as CaCO3	Total	mg/L	1420
Conventional	pH	n/a	pH Units	7.86
Conventional	Total Dissolved Solids	n/a	mg/L	3158
Conventional	Total Organic Carbon	n/a	mg/L	14
Conventional	Total Suspended Solids	n/a	mg/L	136
Conventional	Turbidity	n/a	NTU	113
Hydrocarbon	Oil and Grease	n/a	mg/L	< 1
Hydrocarbon	TRPH	n/a	mg/L	< 0.01
Nutrient	Ammonia as N	n/a	mg/L	0.5
Nutrient	Nitrate as N	n/a	mg/L	48.7
Nutrient	Nitrite as N	n/a	mg/L	0.36
Nutrient	Orthophosphate as P	n/a	mg/L	0.26
Nutrient	TKN	n/a	mg/L	2.1
Nutrient	Total Phosphorus	Dissolved	mg/L	0.31
Nutrient	Total Phosphorus	Total	mg/L	0.50

*See Appendix F for a description of the data qualifier(s) associated with this sample result.
"<" – Constituent not detected above specified detection limit.

Table 33: Anion, Conventional, Hydrocarbon, and Nutrient Results from Receiving Water Sites W-3 and W-4

Classification	Constituent	Fraction	Units	W-3 Event 1 10/17/05	W-4 Event 1 10/17/05
Anion	Bromide	n/a	mg/L	1.56	2.08
Anion	Chloride	n/a	mg/L	32.6	22.6
Anion	Perchlorate	n/a	µg/L	< 2	< 2
Conventional	BOD	n/a	mg/L	26	5.9
Conventional	Conductivity	n/a	µmhos/cm	376	1960
Conventional	Hardness as CaCO3	Total	mg/L	297	776
Conventional	pH	n/a	pH Units	7.98	7.6
Conventional	Total Dissolved Solids	n/a	mg/L	881	1624
Conventional	Total Organic Carbon	n/a	mg/L	25	13
Conventional	Total Suspended Solids	n/a	mg/L	3180	2640
Conventional	Turbidity	n/a	NTU	6111	422
Hydrocarbon	Oil and Grease	n/a	mg/L	< 1	< 1
Hydrocarbon	TRPH	n/a	mg/L	< 0.01	< 0.01
Nutrient	Ammonia as N	n/a	mg/L	0.29	1.05
Nutrient	Nitrate as N	n/a	mg/L	4.51	22.4
Nutrient	Nitrite as N	n/a	mg/L	0.24	0.25
Nutrient	Orthophosphate as P	Total	mg/L	0.51	0.25
Nutrient	TKN	n/a	mg/L	10	12
Nutrient	Total Phosphorus	Dissolved	mg/L	0.47	0.25
Nutrient	Total Phosphorus	Total	mg/L	0.58	0.38

*See Appendix F for a description of the data qualifier(s) associated with this sample result.

"<" – Constituent not detected above specified detection limit.

Table 34: Metals Results from Agricultural Land Use Site A-1

Constituent	Fraction	Units	A-1 Event 1 10/17/05	
Aluminum	Total	µg/L	929	*
Arsenic	Total	µg/L	5.55	
Cadmium	Total	µg/L	1.23	*
Chromium	Total	µg/L	5.49	*
Chromium VI	Total	µg/L	< 5	
Copper	Total	µg/L	15.9	*
Lead	Total	µg/L	2.56	*
Mercury	Total	ng/L	13.4	
Nickel	Total	µg/L	26.4	
Selenium	Total	µg/L	15.7	
Silver	Total	µg/L	< 0.1	
Thallium	Total	µg/L	< 0.1	
Zinc	Total	µg/L	37.6	*
Aluminum	Dissolved	µg/L	5.31	*
Arsenic	Dissolved	µg/L	5.29	
Cadmium	Dissolved	µg/L	1.22	
Chromium	Dissolved	µg/L	4.14	
Copper	Dissolved	µg/L	13	
Lead	Dissolved	µg/L	0.27	
Mercury	Dissolved	ng/L	10.1	
Nickel	Dissolved	µg/L	24.3	
Selenium	Dissolved	µg/L	16.3	
Silver	Dissolved	µg/L	< 0.1	
Thallium	Dissolved	µg/L	< 0.1	
Zinc	Dissolved	µg/L	21.5	

*See Appendix F for a description of the data qualifier(s) associated with this sample result.
"<" – Constituent not detected above specified detection limit.

Table 35: Metals Results from Receiving Water Sites W-3 and W-4

Constituent	Fraction	Units	W-3 Event 1 10/17/05	W-4 Event 1 10/17/05
Aluminum	Total	µg/L	28600	8850
Arsenic	Total	µg/L	6.45	7.12
Cadmium	Total	µg/L	3.4	1.79
Chromium	Total	µg/L	45.6	17.4
Chromium VI	Total	µg/L	50	< 5
Copper	Total	µg/L	170	34.1
Lead	Total	µg/L	50.3	17.6
Mercury	Total	ng/L	129	43
Nickel	Total	µg/L	77.6	24.4
Selenium	Total	µg/L	8.72	11.4
Silver	Total	µg/L	< 0.1	< 0.1
Thallium	Total	µg/L	0.28 *	0.17 *
Zinc	Total	µg/L	302	115
Aluminum	Dissolved	µg/L	20	9.76
Arsenic	Dissolved	µg/L	3.09	3.71
Cadmium	Dissolved	µg/L	< 0.1	0.22
Chromium	Dissolved	µg/L	0.48 *	0.39 *
Copper	Dissolved	µg/L	21.2	4.62
Lead	Dissolved	µg/L	0.14	0.06 *
Mercury	Dissolved	ng/L	13	6.5
Nickel	Dissolved	µg/L	5.31	4.92
Selenium	Dissolved	µg/L	8.12	11.4
Silver	Dissolved	µg/L	< 0.1	< 0.1
Thallium	Dissolved	µg/L	< 0.1	< 0.1
Zinc	Dissolved	µg/L	4.49	6.53

*See Appendix F for a description of the data qualifier(s) associated with this sample result.
"<" – Constituent not detected above specified detection limit.

Table 36: Detected Trace Organic Results from Agricultural Land Use Site A-1

Classification	Method	Constituent	Units	A-1 Event 1 10/17/05
Organic	EPA 625m	1-Methylnaphthalene	µg/L	0.0022 *
Organic	EPA 625m	1-Methylphenanthrene	µg/L	< 0.001
Organic	EPA 625m	2-Methylnaphthalene	µg/L	0.0095
Organic	EPA 625m	Acenaphthene	µg/L	< 0.001
Organic	EPA 625m	Benzo(b)fluoranthene	µg/L	0.0096 *
Organic	EPA 625m	Benzo(k)fluoranthene	µg/L	0.0051
Organic	EPA 625m	Bis(2-ethylhexyl)phthalate	µg/L	0.298 *
Organic	EPA 625m	Butyl benzyl phthalate	µg/L	0.0255 *
Organic	EPA 625m	Chrysene	µg/L	0.0166
Organic	EPA 625m	Diethyl phthalate	µg/L	0.385 *
Organic	EPA 625m	Dimethyl phthalate	µg/L	0.13 *
Organic	EPA 625m	Di-n-butylphthalate	µg/L	0.0711 *
Organic	EPA 625m	Fluoranthene	µg/L	0.0188
Organic	EPA 625m	Fluorene	µg/L	< 0.001
Organic	EPA 625m	Naphthalene	µg/L	0.0123
Organic	EPA 625m	Pentachlorophenol	µg/L	0.62
Organic	EPA 625m	Phenanthrene	µg/L	0.0182
Organic	EPA 625m	Pyrene	µg/L	0.0172
Pesticide	EPA 625m	2,4'-DDD	µg/L	0.0131
Pesticide	EPA 625m	2,4'-DDE	µg/L	0.004 *
Pesticide	EPA 625m	2,4'-DDT	µg/L	0.0188 *
Pesticide	EPA 625m	4,4'-DDD	µg/L	0.049
Pesticide	EPA 625m	4,4'-DDE	µg/L	0.197
Pesticide	EPA 625m	4,4'-DDT	µg/L	0.069
Pesticide	EPA 625m	Chlorpyrifos	µg/L	0.0211 *
Pesticide	EPA 625m	Ethoprop	µg/L	< 0.01
Pesticide	EPA 547	Glyphosate	µg/L	63

*See Appendix F for a description of the data qualifier(s) associated with this sample result.
"<" – Constituent not detected above specified detection limit.

Table 37: Detected Trace Organic Results from Receiving Water Sites W-3 and W-4

Classification	Method	Constituent	Units	W-3 Event 1 10/17/05	W-4 Event 1 10/17/05
Organic	EPA 625m	1-Methylnaphthalene	µg/L	0.0141	0.0111
Organic	EPA 625m	2-Methylnaphthalene	µg/L	0.0144	0.0266
Organic	EPA 625m	Acenaphthene	µg/L	< 0.001	< 0.001
Organic	EPA 625m	Bis(2-ethylhexyl)phthalate	µg/L	0.411	1.85
Organic	EPA 625m	Butyl benzyl phthalate	µg/L	0.0267 *	0.187
Organic	EPA 625m	Diethyl phthalate	µg/L	0.227 *	0.505
Organic	EPA 625m	Dimethyl phthalate	µg/L	0.139 *	0.178 *
Organic	EPA 625m	Di-n-butylphthalate	µg/L	0.0967 *	0.124 *
Organic	EPA 625m	Di-n-octylphthalate	µg/L	< 0.005	0.142
Organic	EPA 625m	Fluoranthene	µg/L	0.0435	0.15
Organic	EPA 625m	Naphthalene	µg/L	0.0303	0.026
Organic	EPA 625m	Phenanthrene	µg/L	0.0727	0.0936
Organic	EPA 625m	Phenol	µg/L	0.837	< 0.1
Organic	EPA 625m	Pyrene	µg/L	0.0391	0.135
Pesticide	EPA 625m	2,4'-DDD	µg/L	0.0293	0.0909
Pesticide	EPA 625m	2,4'-DDT	µg/L	0.0538	< 0.001
Pesticide	EPA 625m	4,4'-DDD	µg/L	0.114	0.3
Pesticide	EPA 625m	4,4'-DDE	µg/L	0.742	1.45
Pesticide	EPA 625m	4,4'-DDT	µg/L	0.1575	< 0.001
Pesticide	EPA 625m	Chlorpyrifos	µg/L	0.415	0.219
Pesticide	EPA 547	Glyphosate	µg/L	60.7 *	19.9 *

*See Appendix F for a description of the data qualifier(s) associated with this sample result.
"<" – Constituent not detected above specified detection limit.

Table 38: Bacteriological Results from Agricultural Land Use Site A-1

Constituent	Units	A-1 Event 1 10/17/05
E. coli	MPN/100 mL	4611
Enterococcus	MPN/100 mL	165200
Fecal Coliform	MPN/100 mL	5000
Total Coliform	MPN/100 mL	2481000

Table 39: Bacteriological Results from Receiving Water Sites W-3 and W-4

Constituent	Units	W-3 Event 1 10/17/05	W-4 Event 1 10/17/05
E. coli	MPN/100 mL	32550	3873
Enterococcus	MPN/100 mL	59100	20500
Fecal Coliform	MPN/100 mL	50000	2400
Total Coliform	MPN/100 mL	120330	1986300

Mass Emission Site Results

Water quality results for the 2005/06 monitoring season from the Mass Emission stations are presented in Table 40 through Table 51.

Table 40: Anion, Conventional, Hydrocarbon, and Nutrient Results from Mass Emission Site ME-CC

Event Type	Wet	Wet	Wet	Wet	Dry	Dry
Constituent – Fraction (mg/L except where noted)	**Event 1 10/17/05**	**Event 2 11/9/05**	**Event 3 2/17/06**	**Event 4 2/27/06**	**Event 5 5/31/06**	**Event 6 6/13/06**
Anions						
Bromide	0.42	0.7	0.6	0.3	0.378	0.753
Chloride	62.8	95.1	125	41.2	178	191
Perchlorate (µg/L)	< 2	< 2	< 2	< 2	< 0.43	< 0.43
Conventionals						
BOD	1390	9.2	30	1000	120	53
Conductivity (µmhos/cm)	206	900	1100	400	1500	1500
Hardness as $CaCO_3$ – Total	7.63	275	340	185	331	317
pH (pH Units)	535	7.7	7.8	7.8	8.2	8.2
Total Dissolved Solids	14	626	758	420	972	1020
Total Organic Carbon	293	12	19	390	120	34
Total Suspended Solids	558	200	38.5	1940	212	23.3
Turbidity (NTU)	1390	146	20.4	1930	170	16.2
Hydrocarbons						
Oil and Grease	1.4 *	< 1	< 1	2.1	< 1	< 1
TRPH	< 0.01	1.29	< 0.1*	< 0.01	0.17	0.4
Nutrients						
Ammonia as N	0.42	0.16	0.28	0.1	0.04*	0.13
Nitrate as N	6.73	7.89	7.65	2.76	3.43	7.25*
Nitrite as N	0.209	0.12	0.46	0.3	0.08	0.16
Orthophosphate as P (Diss)	0.974	1.21	1.52	0.55	0.921	1.7
TKN	2.8	2.1	0.58	1.46	0.32	0.68
Total Phosphorus – Dissolved	1.07	1.28	1.11*	1.98	1.25	1.57
Total Phosphorus – Total	1.06	1.7	1.47	1.9	1.95	1.65

*See Appendix F for a description of the data qualifier(s) associated with this sample result.
"<" – Constituent not detected above specified detection limit.

Table 41: Anion, Conventional, Hydrocarbon, and Nutrient Results from Mass Emission Site ME-VR2

	ME-VR2					
Event Type	**Wet**	**Wet**	**Wet**	**Wet**	**Dry**	**Dry**
Constituent – Fraction (mg/L except where noted)	**Event 1 10/17/05**	**Event 2 11/9/05**	**Event 3 2/17/06**	**Event 4 2/27/06**	**Event 5 5/31/06**	**Event 6 6/13/06**
Anions						
Bromide	0.394	0.72	0.9	0.6	0.118	0.26
Chloride	48.8	50.7	66.5	40.7	42.1	43.6
Perchlorate (µg/L)	< 2	< 2	< 2	< 2	< 0.43	< 2
Conventionals						
BOD	3.7	40*	31	3.6	180	< 1
Conductivity (µmhos/cm)	1010	900	1300	900	100	1000
Hardness as $CaCO_3$ – Total	383	392	514	267	307	365
pH (pH Units)	8.19	8.4	8.2	7.8	8.3	8.35
Total Dissolved Solids	783	862	1004	648	681	570
Total Organic Carbon	7.5	40	16	9.7	69	4.3
Total Suspended Solids	< 0.5	15.3	17	1030	3.5*	1.95
Turbidity (NTU)	< 1	26.9*	8.1	1340	1.8*	1.6
Hydrocarbons						
Oil and Grease	< 1	< 1	< 1	1.7	< 1	< 1
TRPH	< 0.01	0.52*	< 0.1*	1.7	0.1	< 0.01
Nutrients						
Ammonia as N	0.03*	0.01*	< 0.01	0.15	< 0.01	< 0.01
Nitrate as N	0.451	0.85	1.34	0.97	0.24	0.04
Nitrite as N	0.144	0.04*	2.39	0.28	0.02*	< 0.02
Orthophosphate as P (Diss)	0.182	0.296*	< 0.0075	0.15	0.011	<0.0075
TKN	0.7	6	0.84	1.13	0.48	0.16
Total Phosphorus – Dissolved	0.155	0.759	0.06	0.59	0.079	0.043
Total Phosphorus – Total	0.158	0.871	0.155	0.551	0.059	< 0.016

*See Appendix F for a description of the data qualifier(s) associated with this sample result.
"<" – Constituent not detected above specified detection limit.

Table 42: Anion, Conventional, Hydrocarbon, and Nutrient Results from Mass Emission Site ME-SCR

Event Type	**Wet**	**Wet**	**Wet**	**Wet**	**Dry**	**Dry**
Constituent – Fraction (mg/L except where noted)	**Event 1 10/17/05**	**Event 2 11/9/05**	**Event 3 2/17/06**	**Event 4 2/27/06**	**Event 5 5/31/06**	**Event 6 6/13/06**
Anions						
Bromide	0.383	0.67	0.4	0.3	0.141	0.291
Chloride	23.5	41.9	48.9	25.2	52.6	56.3
Perchlorate (µg/L)	< 2	< 2	< 2	< 2	< 0.43	< 0.43
Conventionals						
BOD	7.6	69	56	36	180	150
Conductivity (µmhos/cm)	1400	1500	1500	1000	1400	1400
Hardness as $CaCO_3$ – Total	522	544	571	547*	397	417
pH (pH Units)	8.25	8.2	8.3	7.7	8.3	8.3
Total Dissolved Solids	1112	1060	1088	708	1060	1030
Total Organic Carbon	6.5	35	4.9	35*	160	86
Total Suspended Solids	648	1120	410	2530*	406	66*
Turbidity (NTU)	465	401	75.9	4260*	256	2.1
Hydrocarbons						
Oil and Grease	< 1	< 1	< 1	< 1*	< 1	< 1
TRPH	< 0.01	1.04	< 0.1*	1.7*	0.41	< 0.01*
Nutrients						
Ammonia as N	0.1	0.06	0.06	0.25*	0.03*	0.04
Nitrate as N	1.69	1.88	2.35	1.93	0.84	2.03
Nitrite as N	0.164	0.03*	0.27	0.28	0.03*	0.08
Orthophosphate as P (Diss)	0.208	0.075	0.22	0.18	0.021	0.03*
TKN	2.1	1.8	0.11	0.08*	0.16	0.17
Total Phosphorus – Dissolved	0.155	0.201	0.16	1.18	0.12	0.089
Total Phosphorus – Total	0.201	0.911	0.34	1.13	0.218	0.043

*See Appendix F for a description of the data qualifier(s) associated with this sample result.
"<" – Constituent not detected above specified detection limit.

Table 43: Metals Results from Mass Emission Site ME-CC

Event Type	**Wet**	**Wet**	**Wet**	**Wet**	**Dry**	**Dry**
Constituent – Fraction (µg/L except where noted)	**Event 1 10/17/05**	**Event 2 11/9/05**	**Event 3 2/17/06**	**Event 4 2/27/06**	**Event 5 5/31/06**	**Event 6 6/13/06**
Aluminum – Total	1480	4300	5720	12200	3170	659
Arsenic – Total	4.52	5.99	4.61	6.49	3.15	3.4
Cadmium – Total	0.88	4.58	1.56	4.32	0.979	0.8
Chromium – Total	4.14	13.8	23.8	26.2	15.8	4.6
Chromium VI – Total	5*	< 5	< 5	6*	< 5	< 5
Copper – Total	13.6	22.3	21.9	59.1	9.67	5.4
Lead – Total	11.7	6.62	5.7	16.1	0.99	0.44
Mercury – Total (ng/L)	23.2	37.2	36.88	79.6	6.7	5.9
Nickel – Total	13.5	27.8	28.4	56.5	21.1	9.4
Selenium – Total	2.15	3.88	3.26	1.28	3.25	3.4
Silver – Total	< 0.1	< 0.1	0.1	< 0.1	< 0.5	< 0.5
Thallium – Total	< 0.1	< 0.1	0.1	< 0.1	< 0.1	< 0.1
Zinc – Total	64.3	65.1	72	168	26.6	21.5
Aluminum – Dissolved	34	12.3	3.53*	737	< 5	< 5
Arsenic – Dissolved	3.84	3.28	3.07	4.31	3.42	3.4
Cadmium – Dissolved	0.2*	0.45	0.53	2.47	0.764	0.9
Chromium – Dissolved	0.55	0.52	0.75	2.93	1.37	1.2
Copper – Dissolved	5.01	4.71	4.13	13.8	4.2	4.3
Lead – Dissolved	0.39	0.07*	0.11*	2.86	< 0.05	0.17
Mercury – Dissolved (ng/L)	9.1	8.3	2.53	3.9	4.7	4
Nickel – Dissolved	5.7	5.04	4.69	12.5	7.2	6.8
Selenium – Dissolved	2.06	2.84	3.38	1.08	3.56	3.6
Silver – Dissolved	< 0.1	< 0.1	< 0.1	< 0.1	< 0.5	< 0.5
Thallium – Dissolved	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Zinc – Dissolved	15.1	14.5	16.1	63	14.2	13.8

*See Appendix F for a description of the data qualifier(s) associated with this sample result.
"<" – Constituent not detected above specified detection limit.

Table 44: Metals Results from Mass Emission Site ME-VR2

	ME-VR2					
Event Type	**Wet**	**Wet**	**Wet**	**Wet**	**Dry**	**Dry**
Constituent – Fraction (µg/L except where noted)	**Event 1 10/17/05**	**Event 2 11/9/05**	**Event 3 2/17/06**	**Event 4 2/27/06**	**Event 5 5/31/06**	**Event 6 6/13/06**
Aluminum – Total	22.5	151	8390	10100*	147	5
Arsenic – Total	1.34	3.65	5.05	2.35	0.755	0.8
Cadmium – Total	< 0.1	0.58	1.83	2.38	0.548	0.5
Chromium – Total	0.3*	0.67	13.1	16.9	0.99	0.5
Chromium VI – Total	< 5	< 5	< 5	53	< 5	< 5
Copper – Total	1.85	8.25	18	26.8	1.48	1.3
Lead – Total	0.12*	0.28*	6.93	9.77	0.168	0.23
Mercury – Total (ng/L)	9.7	17.7	29.28	64.9	3.9	2.3
Nickel – Total	3.02	5.66	23.5	43.8	2.7	2.6
Selenium – Total	3.56	5.54	5.84	2.29	2.22	2.4
Silver – Total	< 0.1	< 0.1	< 0.1	< 0.1	< 0.5	< 0.5
Thallium – Total	< 0.1	< 0.1	1960	< 0.1	< 0.1	< 0.1
Zinc – Total	6.43	7.21	64.1	79.4	4.68	2.1
Aluminum – Dissolved	1.93*	9.32	2.06*	769	< 5	< 5
Arsenic – Dissolved	1.29	3.85	1.14	1.03	0.72	0.7
Cadmium – Dissolved	0.15*	0.62	0.94	2.25	0.454	0.6
Chromium – Dissolved	0.21*	0.44*	0.54	0.76	0.55	0.4
Copper – Dissolved	1.94	7.26	2.88	7.07	1.53	1.5
Lead – Dissolved	< 0.05	< 0.05	< 0.05	1.56	< 0.05	0.15
Mercury – Dissolved (ng/L)	6.5	7.93	2.45	5.9	4.1	1.6
Nickel – Dissolved	3.17	5.5	3.42	10.3	2.11	2.5
Selenium – Dissolved	3.63	6.53	7.46	2.87	2.42	2.6
Silver – Dissolved	< 0.1	< 0.1	< 0.1	< 0.1	< 0.5	< 0.5
Thallium – Dissolved	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Zinc – Dissolved	6.66	6.3	3.86	17.3	2.92	< 0.1

*See Appendix F for a description of the data qualifier(s) associated with this sample result.
"<" – Constituent not detected above specified detection limit.

Table 45: Metals Results from Mass Emission Site ME-SCR

Event Type	**Wet**	**Wet**	**Wet**	**Wet**	**Dry**	**Dry**
Constituent – Fraction (µg/L except where noted)	**Event 1 10/17/05**	**Event 2 11/9/05**	**Event 3 2/17/06**	**Event 4 2/27/06**	**Event 5 5/31/06**	**Event 6 6/13/06**
Aluminum – Total	8580	12060	8390	43600*	3800*	1085*
Arsenic – Total	5.92	7.14	5.05	10.8*	3.24	1.6
Cadmium – Total	2.15	3.28	1.83	14.8*	1.31	1.2
Chromium – Total	17.1	20.1	13.1	43.6*	7.36	5.6*
Chromium VI – Total	< 5	< 5	< 5	41*	< 5	< 5
Copper – Total	21.7	38	18	149*	10.9	4.9*
Lead – Total	7.89	11.6	6.93	35.7*	3.19	0.96*
Mercury – Total (ng/L)	54.5	87.5	36.67	174	7.8	5.5
Nickel – Total	27.7	40.2	23.5	161*	11.3	4.9
Selenium – Total	6.7	5.9	5.84	5.8*	5.47	6.1
Silver – Total	< 0.1	< 0.1	< 0.1	< 0.1	< 0.5	< 0.5
Thallium – Total	0.25*	0.27*	1960	0.26*	< 0.1	< 0.1
Zinc – Total	67.5	96.4	64.1	341*	31.1	12.6*
Aluminum – Dissolved	9.16	8.42	2.19*	2950*	< 5	< 5
Arsenic – Dissolved	1.75	1.54	1.1	4.91*	1.12	1.2
Cadmium – Dissolved	0.35	0.58	0.77	7.96*	1.04	1
Chromium – Dissolved	0.19*	0.3*	0.4*	2.14*	1.17	0.9
Copper – Dissolved	2.74	2	2.11	18.1	1.94	1.9
Lead – Dissolved	< 0.05	< 0.05	< 0.05	1.79*	< 0.05	0.12
Mercury – Dissolved (ng/L)	7.8	6.89	1.54	3.6	5.2	2.3
Nickel – Dissolved	3.05	2.51	2.11	32*	2.14	2.3
Selenium – Dissolved	6.39	5.51	6.05	4.3*	5.36	6.3
Silver – Dissolved	< 0.1	< 0.1	< 0.1	< 0.1	< 0.5	< 0.5
Thallium – Dissolved	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Zinc – Dissolved	4.39	4.95*	2.13	63.9*	3.77	0.6*

*See Appendix F for a description of the data qualifier(s) associated with this sample result.
"<" – Constituent not detected above specified detection limit.

Table 46: Detected Trace Organic Results from Mass Emission Site ME-CC

Event Type	**Wet**	**Wet**	**Wet**	**Wet**	**Dry**	**Dry**
Constituent	**Event 1 10/17/05**	**Event 2 11/9/05**	**Event 3 2/17/06**	**Event 4 2/27/06**	**Event 5 5/31/06**	**Event 6 6/13/06**
EPA 625m Organics ~ µg/L						
1-Methylnaphthalene	0.002*	0.0139	0.0045*	0.0071	0.0107	0.0093
1-Methylphenanthrene	0.0077	< 0.001	< 0.001	0.0095	< 0.001	< 0.001
2,3,5-Trimethylnaphthalene	0.0056	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
2,6-Dimethylnaphthalene	0.0106	0.0106	0.0057*	0.0106	0.003*	< 0.001
2-Methylnaphthalene	0.0099	0.0396	0.0135*	0.0117	0.0265	0.0224
Acenaphthene	< 0.001	< 0.001	< 0.001	0.0025*	< 0.001	< 0.001
Anthracene	0.0081	< 0.001	< 0.001	0.0124	< 0.001	< 0.001
Benzo(a)anthracene	0.0148	0.0154	< 0.001*	0.0495	< 0.001	< 0.001
Benzo(a)pyrene	0.0226	0.0232	< 0.001*	0.0665	< 0.001	< 0.001
Benzo(b)fluoranthene	0.0472*	0.0403	< 0.001*	0.0708	< 0.001	< 0.001
Benzo(e)pyrene	0.037	0.0477	0.0061*	0.633	< 0.001	< 0.001
Benzo(g,h,i)perylene	0.0367	0.0299	< 0.001*	0.0537	0.003*	< 0.001
Benzo(k)fluoranthene	0.028	0.0198	< 0.001*	0.0724	< 0.001	< 0.001
Biphenyl	0.0037*	0.0053	0.0027*	0.0083	0.0048*	0.0029
Bis(2-ethylhexyl)phthalate	1.02*	1.99	0.521*	6.3	0.0933*	0.0789*
Butyl benzyl phthalate	0.219	0.108	0.0642*	0.305	0.0279*	0.0247*
Chrysene	0.0607	0.0652	0.0026*	0.0894	0.0028*	< 0.001
Dibenz(a,h)anthracene	< 0.001	< 0.001	< 0.001*	0.0093	0.0027*	< 0.001
Dibenzothiophene	0.0317	0.014	< 0.001	0.0134	< 0.001	< 0.001
Diethyl phthalate	0.578	0.163*	2.58	1.73	0.191*	0.815
Dimethyl phthalate	0.124*	0.145*	0.31*	0.125	0.0187	0.159*
Di-n-butylphthalate	0.122*	0.0946*	0.141*	0.187	0.0585*	0.0632*
Di-n-octylphthalate	0.0495	0.0596	< 0.005	0.242	< 0.005	< 0.005
Fluoranthene	0.0601	0.0304	0.0058*	0.101	0.0046*	< 0.001
Fluorene	0.0074	< 0.001	< 0.001	0.0051	0.0023*	< 0.001
Indeno(1,2,3-cd)pyrene	0.0337	0.0188	< 0.001*	0.0487	0.0039*	< 0.001
Naphthalene	0.0077	0.172	0.0342	0.0385	0.0934	0.046
Pentachlorophenol	0.106	< 0.05	< 0.05*	< 0.05	< 0.05	< 0.05
Perylene	0.0081	0.0413	< 0.001*	0.0373	< 0.001	< 0.001
Phenanthrene	0.036	0.0177	0.0064*	0.0476	0.0019*	< 0.001
Phenol	0.753	0.597	0.118*	< 0.1	0.546	0.183*
Pyrene	0.0467	0.0332	0.0032*	0.103	0.0029*	< 0.001
EPA 547 Pesticide ~ µg/L						
Glyphosate	19.1*	< 30	< 6	< 5	< 5	< 5
EPA 625m Pesticides ~ µg/L						
4,4'-DDD	0.0328	< 0.001	< 0.001	0.0205	0.0022*	< 0.001
4,4'-DDE	0.136	0.069	< 0.001	0.0891	0.0299	< 0.001
4,4'-DDT	< 0.001	< 0.001	< 0.001	0.0113	0.0187	< 0.001
Chlordane-alpha	< 0.001	< 0.001	< 0.001	0.0028*	< 0.001	< 0.001
Chlordane-gamma	< 0.001	< 0.001	< 0.001	0.0024*	< 0.001	< 0.001
Chlorpyrifos	0.0135	0.0423	< 0.005	0.231	0.0615	< 0.001
Diazinon	0.0588	0.0431	< 0.005	0.124	< 0.002	0.0224
Malathion	0.237	0.26	< 0.005	< 0.005	< 0.003	< 0.003
trans-Nonachlor	< 0.001	< 0.001	< 0.001	0.0053	< 0.001	< 0.001
Results from remaining EPA Methods 8151A and 8260B are non-detect.						

*See Appendix F for a description of the data qualifier(s) associated with this sample result.
"<" – Constituent not detected above specified detection limit.

Table 47: Detected Trace Organic Results from Mass Emission Site ME-VR2

	ME-VR2					
Event Type	**Wet**	**Wet**	**Wet**	**Wet**	**Dry**	**Dry**
Constituent	**Event 1 10/17/05**	**Event 2 11/9/05**	**Event 3 2/17/06**	**Event 4 2/27/06**	**Event 5 5/31/06**	**Event 6 6/13/06**
EPA 625m Organics ~ µg/L						
1-Methylnaphthalene	0.0091	0.0087	0.0113	0.0471	0.0056	0.0069
1-Methylphenanthrene	< 0.001	< 0.001	< 0.001	0.0407	< 0.001	< 0.001
2,3,5-Trimethylnaphthalene	< 0.001	< 0.001	< 0.001	0.0262	< 0.001	< 0.001
2,4-Dichlorophenol	< 0.05	< 0.05	0.0528 *	< 0.05	0.05	< 0.05
2,6-Dimethylnaphthalene	< 0.001	0.001	< 0.001	0.0512	< 0.001	0.0091
2-Methylnaphthalene	0.0237	0.0204	0.023	0.0617	0.0094	0.0172
Benzo(a)anthracene	< 0.001	< 0.001	< 0.001	0.008	< 0.001	< 0.001
Benzo(a)pyrene	< 0.001	< 0.001	< 0.001	0.0078	< 0.001	< 0.001
Benzo(b)fluoranthene	< 0.001	< 0.001	< 0.001	0.0159	< 0.001	< 0.001
Benzo(e)pyrene	< 0.001	< 0.001	< 0.001	0.0196	< 0.001	< 0.001
Benzo(g,h,i)perylene	< 0.001	< 0.001	< 0.001	0.0075	< 0.001	< 0.001
Benzo(k)fluoranthene	< 0.001	< 0.001	< 0.001	0.0083	< 0.001	< 0.001
Biphenyl	< 0.001	0.002 *	0.0042 *	0.0178	0.0032*	0.0019
Bis(2-ethylhexyl)phthalate	0.868 *	3.08 *	1.67	6.48	0.0611*	0.0834
Butyl benzyl phthalate	0.0118 *	< 0.005*	0.0429 *	< 0.005	0.0195*	0.0348
Chrysene	< 0.001	< 0.001	< 0.001	0.0445	< 0.001	< 0.001
Dibenzothiophene	< 0.001	< 0.001	< 0.001	0.0068	< 0.001	< 0.001
Diethyl phthalate	0.753	0.499	1.29	0.318 *	0.421	0.857
Dimethyl phthalate	0.153 *	0.135 *	0.254 *	0.0293	0.0326	0.126
Di-n-butylphthalate	0.0876 *	0.0419 *	0.116 *	0.0346 *	0.0771*	0.127
Fluoranthene	< 0.001	0.0051 *	< 0.001	0.023	< 0.001	< 0.001
Fluorene	< 0.001	< 0.001	< 0.001	0.0071	0.0018*	< 0.001
Naphthalene	0.138	0.0983	0.122	0.0338	0.0306	0.0165
Perylene	< 0.001	< 0.001	< 0.001	0.0286	< 0.001	< 0.001
Phenanthrene	0.0032 *	< 0.001	< 0.001	0.0898	0.001*	< 0.001
Phenol	11.9	6.48	13.5	< 0.1	3.17	2.97
Pyrene	0.0013 *	0.0038 *	< 0.001	0.0219	< 0.001	< 0.001
EPA 625m Pesticides ~ µg/L						
Malathion	0.0437	< 0.005	< 0.005	< 0.005	< 0.003	< 0.003
Results from remaining EPA Methods 8151A and 8260B are non-detect.						

*See Appendix F for a description of the data qualifier(s) associated with this sample result.
"<" – Constituent not detected above specified detection limit.

Table 48: Detected Trace Organic Results from Mass Emission Site ME-SCR

Event Type	**Wet**	**Wet**	**Wet**	**Wet**	**Dry**	**Dry**
Constituent	**Event 1 10/17/05**	**Event 2 11/9/05**	**Event 3 2/17/06**	**Event 4 2/27/06**	**Event 5 5/31/06**	**Event 6 6/13/06**
EPA 625m Organics ~ µg/L						
1-Methylnaphthalene	0.004	0.0057	0.0139	0.0854 *	0.0118	0.0062*
1-Methylphenanthrene	0.0143	0.0044 *	0.0052	0.0429 *	0.0114	< 0.001
2,3,5-Trimethylnaphthalene	0.0078	< 0.001*	< 0.001	0.0371 *	0.0061	< 0.001
2,4-Dichlorophenol	< 0.05	< 0.05	0.0555 *	< 0.05	< 0.05	< 0.05
2,6-Dimethylnaphthalene	0.016	0.0063 *	0.0115	0.0868 *	0.0255*	< 0.001
2-Methylnaphthalene	0.0075	0.0073	0.0087	0.107 *	0.0168	0.0058
Benzo(a)anthracene	0.0063	< 0.001	< 0.001	0.0151 *	0.0067*	< 0.001
Benzo(a)pyrene	0.0075	< 0.001	< 0.001	0.0133 *	< 0.001*	< 0.001
Benzo(b)fluoranthene	0.0094	< 0.001*	< 0.001	0.0233 *	0.0074	< 0.001
Benzo(e)pyrene	0.0143	< 0.001	< 0.001	0.0238 *	< 0.001*	< 0.001
Benzo(g,h,i)perylene	0.0108	0.004 *	< 0.001	0.0151 *	0.0118*	< 0.001
Benzo(k)fluoranthene	0.0052	< 0.001	< 0.001	0.0143 *	0.0088*	< 0.001
Biphenyl	< 0.001	0.0038 *	< 0.001	0.0358 *	0.0024*	< 0.001*
Bis(2-ethylhexyl)phthalate	0.865	0.747 *	2.21	4.95	0.239*	0.13*
Butyl benzyl phthalate	0.0204 *	0.018 *	0.0317 *	0.0426 *	0.0389*	0.0262*
Chrysene	0.0369	0.0074 *	< 0.001	0.0576 *	0.012	< 0.001
Dibenzothiophene	0.001	< 0.001	< 0.001	0.0214 *	< 0.001	< 0.001
Diethyl phthalate	0.36 *	0.105 *	0.346 *	0.182 *	0.25	0.469
Dimethyl phthalate	0.137 *	0.1 *	0.181 *	0.0185	0.0298	0.0827*
Di-n-butylphthalate	0.0741 *	0.0509 *	0.101 *	0.0464 *	0.12*	0.0575*
Fluoranthene	0.0113	0.0033 *	0.0047 *	0.0253 *	0.0091	< 0.001*
Fluorene	< 0.001	< 0.001	< 0.001	0.0129 *	0.0038*	< 0.001
Naphthalene	0.0189	0.0205	0.015	0.0716 *	0.0461	0.0172
Perylene	0.0922	0.0779*	0.0885	0.151 *	0.121*	0.0194
Phenanthrene	0.0168	0.0087*	0.0083	0.114 *	< 0.001*	< 0.001
Phenol	0.595	0.441	0.516	< 0.1	0.313*	< 0.1
Pyrene	0.0233	0.0044 *	0.0082	0.0376 *	0.0128	0.004*
EPA 625m Pesticides ~ µg/L						
Malathion	0.226	0.658	0.386	< 0.005	< 0.003	< 0.003
Results from remaining EPA Methods 8151A and 8260B are non-detect.						

*See Appendix F for a description of the data qualifier(s) associated with this sample result.
"<" – Constituent not detected above specified detection limit.

Table 49: Bacteriological Results from Mass Emission Site ME-CC

Event Type	Wet	Wet	Wet	Wet	Dry	Dry
Constituent ~ MPN/100 mL	Event 1 10/17/05	Event 2 11/9/05	Event 3 2/17/06	Event 4 2/27/06	Event 5 5/31/06	Event 6 6/13/06
E. coli	12033	9208	1313	10462	1000	235
Enterococcus	43300	16520	2005	19200	30	20
Fecal Coliform	50000	16000	1700	30000	300	1600
Total Coliform	5475000	770100	198630	344800	9804	19863

Table 50: Bacteriological Results from Mass Emission Site ME-VR2

	ME-VR2					
Event Type	Wet	Wet	Wet	Wet	Dry	Dry
Constituent ~ MPN/100 mL	Event 1 10/17/05	Event 2 11/9/05	Event 3 2/17/06	Event 4 2/27/06	Event 5 5/31/06	Event 6 6/13/06
E. coli	2613	327	74	11199	31	31
Enterococcus	12980	207	111	10910	< 10	< 10
Fecal Coliform	5000	130	50	17000	70	30
Total Coliform	104620	3076	3448	241920	1119	727

"<" – Constituent not detected above specified detection limit.

Table 51: Bacteriological Results from Mass Emission Site ME-SCR

Event Type	Wet	Wet	Wet	Wet	Dry	Dry
Constituent ~ MPN/100 mL	Event 1 10/17/05	Event 2 11/9/05	Event 3 2/17/06	Event 4 2/27/06	Event 5 5/31/06	Event 6 6/13/06
E. coli	256	1722	122	5794	52	31
Enterococcus	288	1298	453	14450	< 10	10
Fecal Coliform	900	9000	110	5000	30	470*
Total Coliform	34480	198630	12997	686700	3873	1450

*See Appendix F for a description of the data qualifier(s) associated with this sample result.
"<" – Constituent not detected above specified detection limit.

Aquatic Toxicity Results

The NPDES permit specifies that acute toxicity monitoring must occur during at least one storm per year at Land Use and Receiving Water sites until baseline information has been collected. The permit also requires that chronic toxicity tests be conducted at Mass Emission sites for two wet weather events and one dry weather event per monitoring season. In following these requirements, acute toxicity tests were performed on samples collected at Land Use and Receiving Water sites in October 2005 (Event 1), and chronic toxicity testing was conducted on samples collected at Mass Emission sites during two wet weather events in October and November 2005 (Events 1 and 2) and one dry weather event in May 2006 (Event 5). Results for acute and chronic toxicity tests are summarized in Table 52 and Table 53, respectively.

Acute Toxicity

Acute toxicity tests were performed using *Ceriodaphnia dubia* as the test organism; test results are summarized in Table 52. Results for acute toxicity are reported as the LC50, which is the lethal concentration of sample that produces death in 50% of test organisms exposed. The acute toxicity of an environmental sample is expressed as a dilution percentage of the original sample (e.g., with 100% indicating the absence of toxicity in the undiluted sample). An LC50 result, or dilution percentage, reported as less than 100% indicates that the undiluted sample caused >50% mortality to exposed test organisms and required dilution to achieve LC50. An LC50 result of greater than 100% indicates that the sample would have to be more concentrated than it was at the time of sample collection to achieve the

LC50. Results are also reported in units of TUa[3], which the analyzing laboratory calculated using the following equation from the California Ocean Plan[4]:

$$TUa = \frac{\log(100-S)}{1.7}$$

where: S = percent survival in 100% sample. If S > 99, TUa shall be reported as zero.

Acute toxicity (as demonstrated by a TUa >1.0) was observed at Receiving Water site W-3 for the sample collected during Event 1 (grab sample date – 10/18/05) as shown in Table 52. In accordance with permit requirements, a TIE was initiated for this sample. The toxicity testing laboratory, Aquatic Bioassay & Consulting Laboratories, Inc. (ABC), was unable to identify the toxicant(s) because the sample's toxicity dissipated by the time the TIE was initiated.

Table 52: Acute Toxicity Results from Land Use and Receiving Water Sites

Station	Event No. – Event Type	Sample Date	Percent Survival in 100% Sample	Acute Ceriodaphnia Survival	
				LC50 – Dilution %	TUa
A-1	Event 1 – Wet	10/18/05	90	>100%	0.59
I-2	Event 1 – Wet	10/18/05	100	>100%	0.00
R-1	Event 1 – Wet	10/18/05	85	>100%	0.69
W-3	Event 1 – Wet	10/18/05	10	55.56%	2.00
W-4	Event 1 – Wet	10/18/05	80	>100%	0.77

Chronic Toxicity

Chronic toxicity tests were conducted using the Purple Sea Urchin (*Strongylocentrotus purpuratus*) as the test species. Results are summarized in Table 53.

Table 53: Chronic Toxicity Results from Mass Emission Sites

Station	Event No. – Event Type	Sample Date	Chronic Purple Sea Urchin Fertilization Bioassay		
			IC50 Dilution	NOEC Dilution	TUc
ME-CC	Event 1 – Wet	10/18/05	>100%	100%	1.00
ME-CC	Event 2 – Wet	11/09/05	>100%	100%	1.00
ME-CC	Event 5 – Dry	5/31/06	>100%	100%	1.00
ME-SCR	Event 1 – Wet	10/18/05	>100%	100%	1.00
ME-SCR	Event 2 – Wet	11/09/05	>100%	100%	1.00
ME-SCR	Event 5 – Dry	5/31/06	>100%	100%	1.00
ME-VR2	Event 1 – Wet	10/18/05	>100%	100%	1.00
ME-VR2	Event 2 – Wet	11/09/05	>100%	100%	1.00
ME-VR2	Event 5 – Dry	5/31/06	>100%	100%	1.00

Chronic toxicity results are reported in several ways: the IC50 is the sample concentration, or dilution percentage, at which an inhibitory response (in this case, decreased fertilization relative to the control) is observed in 50% of the exposed test organisms. The NOEC is the concentration of sample at which there exists no observable effect on test organisms. An IC50 dilution or NOEC dilution reported as greater

[3] Historically, acute toxicity has been calculated using the following equation: TUa = 100/LC50

[4] California Ocean Plan. State Water Resources Control Board. 2005.

than 100% indicates that the sample would have to be more concentrated than it was at the time of sample collection to achieve the indicated effect. Results are also reported in units of TUc, which is calculated as 100 divided by the NOEC.

The NPDES permit specifies that a TIE must be initiated if two consecutive wet weather samples (or a single dry weather sample) exhibit toxicity; however, a numeric trigger for chronic toxicity is not specified in the permit. For the purposes of the Stormwater Monitoring Program, a numeric chronic toxicity trigger of >1.0 TUc was selected. Chronic toxicity (defined herein as a TUc >1.0) was not detected in any of the wet or dry weather samples collected at Mass Emission stations during the 2005/06 monitoring season. ABC Laboratory's toxicity testing reports from the current monitoring season are provided in Appendix N.

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9. Data Analysis and Discussion

This section summarizes the estimated mass loadings from the ME-CC, ME-VR2, and ME-SCR Mass Emission stations and provides a comparison of the Stormwater Monitoring Program's 2005/06 data to water quality objectives. The purpose of stormwater monitoring is to characterize water quality conditions that can be used to assess water quality improvements and to help direct the efforts of the Stormwater Management Program. Mass loadings were calculated to track conditions in the watershed. Analysis of the data is needed in order to provide a comparison with water quality objectives and assist in the identification of any pollutants or sources that may be problematic in the watershed. The applicability of relevant water quality objectives is discussed in detail later in this section.

Mass Loadings

Mass loadings were estimated for constituents detected at the ME-CC, ME-VR2, and ME-SCR Mass Emission sites during the 2005/06 monitoring season. Mass loadings could not be calculated at the ME-SCR station for wet weather monitoring events because total wet weather flow could not be accurately measured, as discussed in Section 4. To recap, the Santa Clara River flows through two possible routes during wet weather conditions. One route is through the river diversion gate structure where the majority of wet weather flow passes. The other route is over the diversion dam, a situation which occurs only during high flows generated by large storm events. At the moment, wet weather flow can only be measured at the diversion dam because there is no flow meter installed at the river diversion gate. There are technical challenges involved with measuring flow at the river diversion gate since floating debris and sediment can interfere with flow measurement. VCWPD is currently investigating flow meters capable of measuring flow in the diversion gate structure under these conditions.

Mass loads were calculated by using the average flow (measured in cubic feet per second, CFS) estimated over the duration of a monitoring event and the concentrations of detected constituents. Event duration is defined as the number of hours elapsed between the first aliquot distributed into the first sample bottle collected through the last aliquot distributed into the last sample bottle collected by a composite sampler. Wet weather events monitored during 2005/06 at the ME-CC and ME-VR2 stations lasted from less than 24 hours (Event 1 at ME-CC) to just under 88 hours (Event 3 at ME-CC). Dry weather events monitored during the current season lasted approximately 24 hours. Based on the average flow rate for an event, loadings were calculated in lbs/event to allow for comparisons between sites as well as between events (see example below). These mass loading estimates are presented in Table 54 through Table 56.

Example Mass Loading Calculation

A mass loading calculation is shown below for an Event 1 Total Copper concentration measured at ME-CC (Event Duration = 18 hours 1 minute = 18.02 hours).

Total Copper Concentration
13.6 µg/L or 0.0136 mg/L (Table 43)

Average Flow Rate for Monitoring Event
62.84 CFS (Table 6)

62.84 CFS x 7.48 gal/CF x 3.785 liters/gal = 1779 liters/sec

Load = Concentration x Volume
1779 liters/sec x 0.0136 mg/L = 24.19 mg/sec

24.19 mg/sec x 60 sec/min x 60 min/hr x 18.02 hr/event x 1 kg/10^6 mg = 1.57 kg/event

1.57 kg/event x 2.2 lb/kg = **3.5 lbs/event**

Table 54: ME-CC Estimated Mass Loadings

	ME-CC					
Event Type	**Wet**	**Wet**	**Wet**	**Wet**	**Dry**	**Dry**
Date	**10/17/05**	**11/9/05**	**2/17/06**	**2/27/06**	**5/31/06**	**6/13/06**
Event Duration (Hours)	**18.02**	**33.68**	**87.90**	**43.47**	**26.20**	**23.63**
Constituent – Fraction	***All results reported in lbs/event***					
Anions						
Bromide	107	614	712	3260	39.9	61.7
Chloride	15900	83400	148000	448000	18800	15700
Conventionals						
BOD	355	8070	35600	1.09E+07	12700	4340
Total Dissolved Solids	136000	549000	900000	4560000	102000	83600
Total Organic Carbon	3550	10500	22600	4240000	12700	2790
Total Suspended Solids	74400	175000	45700	2.11E+07	22400	1900
Hydrocarbons						
Oil and Grease	355	ND	ND	22800	ND	ND
TRPH	ND	1130	ND	ND	17.9	32.8
Metals						
Aluminum – Total	376	3770	6790	133000	335	54.0
Arsenic – Total	1.1	5.3	5.5	70.5	0.33	0.28
Cadmium – Total	0.22	4.0	1.9	46.9	0.10	0.07
Chromium – Total	1.1	12.1	28.3	285	1.7	0.38
Chromium VI – Total	1.3	ND	ND	65.2	ND	ND
Copper – Total	3.5	19.6	26	642	1.0	0.44
Lead – Total	3.0	5.8	6.8	175	0.11	0.04
Mercury – Total	0.006	0.03	0.04	0.87	0.001	4.84E-04
Nickel – Total	3.4	24.4	33.7	614	2.2	0.77
Selenium – Total	0.55	3.4	3.9	13.9	0.34	0.28
Zinc – Total	16.3	57.1	85.5	1830	2.8	1.8
Nutrients						
Ammonia as N	107	140	332	1090	4.2	10.7
Nitrate as N	1709	6918	9080	30000	362	594
Nitrite as N	53.1	105	546	3260	8.4	13.1
Orthophosphate as P (Diss)	247	1061	1800	5980	97.2	139
TKN	711	1841	689	15800	33.8	55.7
Total Phosphorus – Total	269	1491	1750	20600	205.9	135
Organics						
1-Methylnaphthalene	5.00E-04	0.01	0.005	0.08	0.001	0.001
1-Methylphenanthrene	0.002	ND	ND	0.10	ND	ND
2,3,5-Trimethylnaphthalene	0.001	ND	ND	ND	ND	ND
2,6-Dimethylnaphthalene	0.003	0.009	0.007	0.12	3.17E-04	ND
2,4,6-Trichlorophenol	ND	ND	ND	ND	ND	0.005
2-Methylnaphthalene	0.003	0.03	0.02	0.13	0.003	0.002
Acenaphthene	ND	ND	ND	0.03	4.75E-04	ND
Anthracene	0.002	ND	ND	0.13	ND	3.97E-4
Benzo(a)anthracene	0.004	0.01	ND	0.54	ND	ND
Benzo(a)pyrene	0.006	0.02	ND	0.72	ND	ND
Benzo(b)fluoranthene	0.01	0.04	ND	0.77	ND	ND
Benzo(e)pyrene	0.01	0.04	0.007	6.9	ND	ND
Benzo(g,h,i)perylene	0.01	0.03	ND	0.58	3.17E-04	ND
Benzo(k)fluoranthene	0.01	0.02	ND	0.79	ND	ND
Biphenyl	9.00E-04	0.005	0.003	0.09	0.001	2.38E-04

ND – Constituent not detected, and therefore no estimated mass loading was calculated.

Table 54 (Continued): ME-CC Estimated Mass Loadings

	ME-CC					
Event Type	**Wet**	**Wet**	**Wet**	**Wet**	**Dry**	**Dry**
Date	**10/17/05**	**11/9/05**	**2/17/06**	**2/27/06**	**5/31/06**	**6/13/06**
Event Duration (Hours)	**18.02**	**33.68**	**87.90**	**43.47**	**26.20**	**23.63**
Constituent – Fraction	***All results reported in lbs/event***					
Organics						
Bis(2-ethylhexyl)phthalate	2.8	4.2	1.3	561	0.01	0.006
Butyl benzyl phthalate	0.14	0.49	0.02	20.1	0.003	0.002
Chrysene	0.02	0.06	0.003	0.97	2.96E-04	ND
Dibenz(a,h)anthracene	ND	ND	ND	0.10	2.85E-04	ND
Dibenzothiophene	0.01	0.01	ND	0.15	ND	ND
Diethyl phthalate	0.15	0.14	3.1	18.8	0.02	0.07
Dimethyl phthalate	0.03	0.13	0.37	1.4	0.002	0.01
Di-n-butylphthalate	0.03	0.08	0.17	2.0	0.006	0.005
Di-n-octylphthalate	0.01	0.05	ND	2.6	ND	ND
Fluoranthene	0.02	0.03	0.007	1.1	4.86E-04	ND
Fluorene	0.002	ND	ND	0.06	2.43E-04	ND
Indeno(1,2,3-cd)pyrene	0.01	0.02	ND	0.53	4.12E-04	ND
Naphthalene	0.002	0.15	0.04	0.42	0.01	0.004
Pentachlorophenol	0.03	ND	ND	ND	ND	ND
Perylene	0.002	0.04	ND	0.41	ND	ND
Phenanthrene	0.01	0.02	0.008	0.52	2.01E-04	ND
Phenol	0.19	0.52	0.14	ND	0.06	0.02
Pyrene	0.01	0.03	0.004	1.1	3.06E-04	ND
Pesticides						
4,4'-DDD	0.01	ND	ND	0.22	2.32E-04	ND
4,4'-DDE	0.03	0.06	ND	0.97	0.003	ND
4,4'-DDT	ND	ND	ND	0.12	0.002	ND
Chlordane-alpha	ND	ND	ND	0.03	ND	ND
Chlordane-gamma	ND	ND	ND	0.03	ND	ND
Chlorpyrifos	0.003	0.04	ND	2.5	0.006	ND
Diazinon	0.01	0.04	ND	1.3	ND	0.002
Glyphosate	4.8	ND	ND	ND	ND	ND
Malathion	0.06	0.23	ND	ND	ND	ND
trans-Nonachlor	ND	ND	ND	0.06	ND	ND

ND – Constituent not detected, and therefore no estimated mass loading was calculated.

Table 55: ME-VR2 Estimated Mass Loadings

	ME-VR2					
Event Type	**Wet**	**Wet**	**Wet**	**Wet**	**Dry**	**Dry**
Date	**10/17/05**	**11/9/05**	**2/17/06**	**2/27/06**	**5/31/06**	**6/13/06**
Event Duration (Hours)	**58.97**	**34.50**	**44.20**	**49.28**	**27.92**	**23.58**
Constituent – Fraction	***All results reported in lbs/event***					
Anions						
Bromide	54.4	128	189	1750	24.6	37.2
Chloride	6737	9020	14000	119000	8790	7550
Conventionals						
BOD	511	7120	6520	10500	37600	5090
Total Dissolved Solids	108000	153000	211000	1890000	142000	115000
Total Organic Carbon	1040	7120	3360	28300	14400	2550
Total Suspended Solids	ND	2720	3580	3000000	731	2550
Hydrocarbons						
Oil and Grease	ND	ND	ND	4960	ND	ND
TRPH	ND	92.5	ND	4960	20.9	ND
Metals						
Aluminum – Total	3.1	26.9	360	29400	30	0.85
Arsenic – Total	0.18	0.65	0.47	6.9	0.16	0.14
Cadmium – Total	ND	0.1	0.23	6.9	0.11	0.09
Chromium – Total	0.04	0.12	0.91	46.3	0.21	0.09
Chromium VI – Total	ND	ND	ND	155	ND	ND
Copper – Total	0.26	1.5	1.6	78.1	0.31	0.22
Lead – Total	0.02	0.05	0.58	28.5	0.04	0.04
Mercury – Total	0.001	0.003	0.006	0.19	0.001	3.90E-04
Nickel – Total	0.42	1.0	2.3	128	0.56	0.44
Selenium – Total	0.49	0.99	1.3	6.7	0.46	0.41
Zinc – Total	0.89	1.3	6.7	231	0.98	0.36
Nutrients						
Ammonia as N	4.1	1.8	ND	437	ND	ND
Nitrate as N	62.3	151	282	2830	50.1	1.7
Nitrite as N	19.9	7.1	503	816	4.2	73.0
Orthophosphate as P (Diss)	25.1	52.7	ND	237	2.3	8.5
TKN	96.6	1070	177	3290	100	3.4
Total Phosphorus – Total	21.8	155	33.6	1600	12.3	123.9
Organics						
1-Methylnaphthalene	0.001	0.002	0.002	0.14	0.001	0.001
1-Methylphenanthrene	ND	ND	ND	0.12	ND	ND
2,3,5-Trimethylnaphthalene	ND	ND	ND	0.08	ND	ND
2,6-Dimethylnaphthalene	ND	ND	0.01	0.15	ND	0.002
2-Methylnaphthalene	0.003	0.004	0.005	0.18	0.002	0.003
Benzo(a)anthracene	ND	ND	ND	0.02	ND	ND
Benzo(a)pyrene	ND	ND	ND	0.02	ND	ND
Benzo(b)fluoranthene	ND	ND	ND	0.05	ND	ND
Benzo(e)pyrene	ND	ND	ND	0.06	ND	ND
Benzo(g,h,i)perylene	ND	ND	ND	0.02	ND	ND
Benzo(k)fluoranthene	ND	ND	ND	0.02	ND	ND
Biphenyl	ND	4.00E-04	9.00E-04	0.05	0.001	3.22E-04
Bis(2-ethylhexyl)phthalate	0.12	0.55	0.35	18.9	0.01	0.01
Butyl benzyl phthalate	0.002	ND	0.009	ND	0.004	0.004
Chrysene	ND	ND	ND	ND	ND	ND

ND – Constituent not detected, and therefore no estimated mass loading was calculated.

Table 55 (Continued): ME-VR2 Estimated Mass Loadings

	ME-VR2					
Event Type	**Wet**	**Wet**	**Wet**	**Wet**	**Dry**	**Dry**
Date	**10/17/05**	**11/9/05**	**2/17/06**	**2/27/06**	**5/31/06**	**6/13/06**
Event Duration (Hours)	**58.97**	**34.50**	**44.20**	**49.28**	**27.92**	**23.58**
Constituent – Fraction	***All results reported in lbs/event***					
Organics						
Dibenzothiophene	ND	ND	ND	0.02	ND	ND
Diethyl phthalate	0.10	0.09	0.27	0.93	0.09	0.15
Dimethyl phthalate	0.02	0.02	0.05	0.09	0.007	0.02
Di-n-butylphthalate	0.01	0.007	0.02	0.10	0.02	0.02
Fluoranthene	ND	9.00E-04	ND	0.07	ND	ND
Fluorene	ND	ND	ND	0.02	3.76E-04	ND
Naphthalene	0.02	0.02	0.03	0.10	0.006	0.003
Perylene	ND	ND	ND	0.08	ND	ND
Phenanthrene	4.00E-04	ND	ND	0.26	2.09E-04	ND
Phenol	1.6	1.2	2.8	ND	0.66	0.50
Pyrene	2.00E-04	7.00E-04	ND	0.06	ND	ND
Pesticides						
Malathion	0.006	ND	ND	ND	ND	ND

ND – Constituent not detected, and therefore no estimated mass loading was calculated.

Table 56: ME-SCR Estimated Mass Loadings

	ME-SCR					
Event Type	**Wet**	**Wet**	**Wet**	**Wet**	**Dry**	**Dry**
Date	**10/17/05**	**11/9/05**	**2/17/06**	**2/27/06**	**5/31/06**	**6/13/06**
Event Duration (Hours)	**38.42**	**24.00**	**47.50**	**51.75**	**23.73**	**23.73**
Constituent – Fraction	***All results reported in lbs/event***					
Anions						
Bromide	—	—	—	—	5.5	11.3
Chloride	—	—	—	—	2050	2190
Conventionals						
BOD	—	—	—	—	7000	5830
Total Dissolved Solids	—	—	—	—	41200	40000
Total Organic Carbon	—	—	—	—	6220	3340
Total Suspended Solids	—	—	—	—	15800	2560
Hydrocarbons						
TRPH	—	—	—	—	15.9	ND
Metals						
Aluminum – Total	—	—	—	—	148	42.1
Arsenic – Total	—	—	—	—	0.13	0.06
Cadmium – Total	—	—	—	—	0.05	0.05
Chromium – Total	—	—	—	—	0.29	0.22
Copper – Total	—	—	—	—	0.42	0.19
Lead – Total	—	—	—	—	0.12	0.04
Mercury – Total	—	—	—	—	3.03E-04	2.14E-04
Nickel – Total	—	—	—	—	0.44	0.19
Selenium – Total	—	—	—	—	0.21	0.24
Zinc – Total	—	—	—	—	1.2	0.49
Nutrients						
Ammonia as N	—	—	—	—	1.2	1.6
Nitrate as N	—	—	—	—	32.7	78.9
Nitrite as N	—	—	—	—	1.2	3.1
Orthophosphate as P (Diss)	—	—	—	—	0.81	1.2
TKN	—	—	—	—	6.2	6.6
Total Phosphorus – Total	—	—	—	—	8.5	1.7
Organics						
1-Methylnaphthalene	—	—	—	—	4.59E-04	2.41E-04
1-Methylphenanthrene	—	—	—	—	4.43E-04	2.25E-04
2,3,5-Trimethylnaphthalene	—	—	—	—	2.37E-04	ND
2,6-Dimethylnaphthalene	—	—	—	—	0.001	ND
2-Methylnaphthalene	—	—	—	—	0.001	ND
Acenaphthene	—	—	—	—	1.71E-04	ND
Benzo(a)anthracene	—	—	—	—	2.61E-04	ND
Benzo(b)fluoranthene	—	—	—	—	2.88E-04	ND
Benzo(g,h,i)perylene	—	—	—	—	4.59E-04	ND
Benzo(k)fluoranthene	—	—	—	—	3.42E-04	ND
Biphenyl	—	—	—	—	9.34E-05	ND
Bis(2-ethylhexyl)phthalate	—	—	—	—	0.009	0.005
Butyl benzyl phthalate	—	—	—	—	0.002	0.001
Chrysene	—	—	—	—	4.67E-04	ND
Diethyl phthalate	—	—	—	—	0.01	0.02
Dimethyl phthalate	—	—	—	—	0.001	0.003
Di-n-butylphthalate	—	—	—	—	0.005	0.002

"—" Total flow at Mass Emission site ME-SCR is incalculable during wet weather events, and therefore no mass loadings are calculated.
ND – Constituent not detected, and therefore no estimated mass loading was calculated.

Table 56 (Continued): ME-SCR Estimated Mass Loadings

	ME-SCR					
Event Type	**Wet**	**Wet**	**Wet**	**Wet**	**Dry**	**Dry**
Date	**10/17/05**	**11/9/05**	**2/17/06**	**2/27/06**	**5/31/06**	**6/13/06**
Event Duration (Hours)	**38.42**	**24.00**	**47.50**	**51.75**	**23.73**	**23.73**
Constituent – Fraction	***All results reported in lbs/event***					
Organics						
Fluoranthene	—	—	—	—	3.54E-04	ND
Fluorene	—	—	—	—	1.48E-04	ND
Indeno(1,2,3-cd)pyrene	—	—	—	—	2.57E-04	ND
Naphthalene	—	—	—	—	0.05	ND
Perylene	—	—	—	—	0.005	0.001
Phenanthrene	—	—	—	—	3.89E-05	ND
Phenol	—	—	—	—	0.01	ND
Pyrene	—	—	—	—	4.98E-04	1.55E-04

"—" Total flow at Mass Emission site ME-SCR is incalculable during wet weather events, and therefore no mass loadings are calculated.
ND – Constituent not detected, and therefore no estimated mass loading was calculated.

Water Quality Objective Comparisons

Pursuant to Part 2.C of the Countywide NPDES Permit the co-permittees are required to determine whether discharges from their municipal separate storm sewer system are causing or contributing to an exceedance of water quality standards. This determination is impacted by a number of factors including: duration of the storm event, averaging periods, mixing zones, representative samples, impacted beneficial uses, etc. Currently, neither USEPA nor the State has established procedures for making this type of determination. In spite of these limitations the co-permittees have conducted a preliminary assessment of receiving water and discharge monitoring data to identify potential water quality issues. Correspondence between the Stormwater Management Program and the Regional Board on the topic of water quality objective comparisons, as well as several other issues, is presented in Appendix P.

There are several steps involved in analyzing data to assess water quality improvements. The first step involves comparing analytical results from Mass Emission and Receiving Water stations to the applicable surface water quality objectives established in the Los Angeles Region 4 Basin Plan (Basin Plan) and the California Toxics Rule (CTR). Each plan includes a discussion of the applicability of their objectives based on the type of water (freshwater or saltwater) and the beneficial uses that are being protected. For the purposes of this analysis, all of the water quality objectives were evaluated.

Since the Stormwater Monitoring Program's monitoring sites are representative of larger drainage areas, the comparison of water quality data from Mass Emission and Receiving Water stations to water quality objectives will identify pollutants that may pose a problem to the overall watershed. More specifically, water quality data from the three Mass Emission sites are representative of water quality conditions in the three major watersheds (Calleguas Creek, Santa Clara River, and Ventura River) in Ventura County. The second step in analyzing data to assess water quality in Ventura County includes comparing Land Use data to these same objectives. The third step involves comparing Land Use water quality objective exceedances to Receiving Water and Mass Emission exceedances. Land Use sites are representative of drainage areas that are specific to either one of three land use types: residential, agricultural or industrial. These sites also allow the Stormwater Monitoring Program to identify the possible sources of problematic constituents based on the land use (i.e. agriculture, residential, industrial sources).

Based on the analysis, a list of potentially problematic constituents, or pollutants of concern (POCs), can be identified. The beneficial uses potentially impacted by the receiving water exceedances of these POCs can be identified and the impacts of stormwater discharges can be assessed. In summary, the water quality objective comparison is composed of the following four steps:

- Compare Mass Emission and Receiving Water data with water quality objectives
- Compare Land Use discharge data with water quality objectives
- Compare Land Use water quality objective exceedances to Receiving Water and Mass Emission exceedances
- Identify potentially problematic constituents

Mass Emission and Receiving Water Analysis

The 2005/06 monitoring data from the Mass Emission and Receiving Water stations were analyzed and compared to the water quality objectives to determine the frequency of exceedances of objectives and identify potential pollutants of concern.

The most appropriate standards for comparison to stormwater (i.e., wet weather) discharges are short-term acute freshwater objectives. Stormwater events usually occur over the span of a few hours to a day. As a result, exposure to the concentrations above the objectives only occurs for a short period of time. For this reason, longer term objectives (i.e., chronic exposure objectives) may not be as applicable for wet events. Acute criteria better reflect the short-term event exposure experienced by organisms during precipitation runoff events. Additionally, freshwater objectives are the most appropriate because the monitoring stations discharge to inland, freshwater receiving waters.

For the analysis of wet weather (storm) data (Events 1 – 4), the Basin Plan objectives and the acute, freshwater objectives in the California Toxics Rule (CTR) were used. For some constituents, the California Toxics Rule does not contain acute objectives. In these cases, the California Toxics Rule Human Health (Organisms Only) objectives were used in the wet weather comparisons. The CTR Human Health (Organisms Only) objectives were used here because these constituents have no other objectives for comparison. These objectives were used even though they are based on long-term risks to human health that cannot be directly correlated to stormwater discharges. CTR chronic criteria were not used for wet weather analyses because acute criteria better reflect the short-term storm event exposure experienced by organisms, as compared to the long-term exposure considered by chronic criteria.

For the analysis of dry weather data (Events 5 and 6), the Basin Plan objectives and the chronic, freshwater objectives in the CTR were used. For some constituents, the CTR does not contain chronic objectives. In these cases, the CTR Human Health (Organisms Only) objectives were used in the dry weather comparisons. The CTR Human Health (Organisms Only) objectives were used here because these constituents have no other objectives for comparison.

Objectives in the CTR for metals are calculated based on the hardness of the water in which metals concentrations are being evaluated. As specified by the CTR, certain metals comparisons were made by using the hardness value measured at a particular site during a particular monitoring event for calculating a specific metals objective, except when the measured hardness was greater than 400 mg/L. The CTR sets a hardness cap of 400 mg/L for calculating the objectives, so any measured hardness value above 400 mg/L was set equal to 400 mg/L for the purposes of the calculation.

The elevated mass loadings calculated for Mass Emission stations ME-CC (see Table 54) and ME-VR2 (see Table 55) during Event 4 are the result of (1) large average flows (see Table 6) calculated for this event, relative to those calculated for Events 1 – 3, and (2) the elevated concentration of most constituents (especially total suspended solids, metals, organics, and pesticides) measured in the water quality samples collected at these sites during Event 4. The elevated constituent concentrations were likely produced by a flushing of watersheds and the scouring of streambeds and adjacent riparian habitat that occurred as a result of the higher flows observed during Event 4. The net result of these flushing and scouring effects can be seen in the increased number of water quality objective exceedances observed during Event 4 at the Mass Emission sites as compared to the exceedances reported during Events 1–3 at these stations. Table 57 through Table 59 present water quality objective exceedances at Mass Emission stations based on an analysis of the 2005/06 wet weather stormwater monitoring data. Table 60 and Table 61 show water quality objective exceedances observed at the ME-CC and ME-SCR stations, respectively, during dry weather monitoring events. It should be noted that no water quality objective exceedances were observed at Mass Emission site ME-VR2 during this season's dry weather monitoring events. Table 62 and Table 63 present water quality objective exceedances detected at Receiving Water sites W-3 and W-4, respectively, based on an analysis of the Event 1 wet weather monitoring data collected at these locations.

Table 57: Water Quality Objective Exceedances at Mass Emission Site ME-CC observed during Wet Weather Monitoring Events

Classification	Constituent (in μg/L except where noted)	Event 1 10/17/05 Result	Event 2 11/9/05 Result	Event 3 2/17/06 Result	Event 4 2/27/06 Result	Basin Plan Objective	CTR FW Acute Objective
Bacteriological	E. coli (MPN/100 mL)	12033	9208	1313	10462	235	
Bacteriological	Fecal Coliform (MPN/100 mL)	50000	16000	1700	30000	400	
Metal	Aluminum – Total	1480	4300	5720	12200	1000	
Metal	Mercury – Total				0.0796		0.051^
Organic	Benzo(a)-anthracene				0.0495		0.049^
Organic	Benzo(a)pyrene				0.0665		0.049^
Organic	Benzo(b)-fluoranthene				0.0708		0.049^
Organic	Benzo(k)-fluoranthene				0.0724		0.049^
Organic	Bis(2-ethyl-hexyl)phthalate				6.3	4	5.9^
Organic	Chrysene	0.0607	0.0652		0.0894		0.049^
Pesticide	4,4'-DDD	0.0328			0.0205		0.00084^
Pesticide	4,4'-DDE	0.136	0.069		0.0891		0.00059^

Blank cells denote no exceedance of a water quality objective.
"^" – CTR Human Health objective for consumption of organisms only.

Table 58: Water Quality Objectives Exceedances at Mass Emission Site ME-VR2 observed during Wet Weather Monitoring Events

Classification	Constituent (in μg/L except where noted)	Event 1 10/17/05 Result	Event 2 11/9/05 Result	Event 3 2/17/06 Result	Event 4 2/27/06 Result	Basin Plan Objective	CTR FW Acute Objective
Anion	Chloride (mg/L)			66.5		60	
Bacteriological	E. coli (MPN/100 mL)	2613	327		11199	235	
Bacteriological	Fecal Coliform (MPN/100 mL)	5000			17000	400	
Conventional	Total Dissolved Solids (mg/L)			1004		1000	
Metal	Aluminum – Total			1713	10100	1000	
Metal	Mercury – Total				0.0649		0.051^
Organic	Bis(2-ethyl-hexyl)phthalate				6.48	4	5.9^

Blank cells denote no exceedance of a water quality objective.
"^" – CTR Human Health objective for consumption of organisms only.

Table 59: Water Quality Objective Exceedances at Mass Emission Site ME-SCR observed during Wet Weather Monitoring Events

Classifi-cation	Constituent (in μg/L except where noted)	Event 1 10/17/05 Result	Event 2 11/9/05 Result	Event 3 2/17/06 Result	Event 4 2/27/06 Result	Basin Plan Objective	CTR FW Acute Objective
Bacterio-logical	E. coli (MPN/100 mL)	256	1722		5794	235	
Bacterio-logical	Fecal Coliform (MPN/100 mL)	900	9000		5000	400	
Metal	Aluminum – Total	8580	12060	8390	43600	1000	
Metal	Cadmium – Total				14.8	5	
Metal	Mercury – Total	0.0545	0.0875		0.174		0.051^
Metal	Nickel – Total				161	100	
Organic	Bis(2-ethyl-hexyl)phthalate				4.95	4	
Organic	Chrysene				0.0576		0.049^

Blank cells denote no exceedance of a water quality objective.
"^" – CTR Human Health objective for consumption of organisms only.

Table 60: Water Quality Objective Exceedances at Mass Emission Site ME-CC observed during Dry Weather Monitoring Events

Classification	Constituent (in μg/L except where noted)	Event 5 5/31/06 Result	Event 6 6/13/06 Result	Basin Plan Objective	CTR FW Chronic Objective
Anion	Chloride (mg/L)	178	191	150	
Bacteriological	E. coli (MPN/100 mL)	1000		235	
Bacteriological	Fecal Coliform (MPN/100 mL)		1600	400	
Conventional	Total Dissolved Solids (mg/L)	972	1020	850	
Metal	Aluminum – Total	3170		1000	
Pesticide	4,4'-DDD	0.0022			0.00084
Pesticide	4,4'-DDE	0.0299			0.00059
Pesticide	4,4'-DDT	0.0187			0.001

Blank cells denote no exceedance of a water quality objective.
"^" – CTR Human Health objective for consumption of organisms only.

Table 61: Water Quality Objective Exceedances at Mass Emission Site ME-SCR observed during Dry Weather Monitoring Events

Classification	Constituent (in μg/L except where noted)	Event 5 5/31/06 Result	Event 6 6/13/06 Result	Basin Plan Objective	CTR FW Chronic Objective
Bacteriological	Fecal Coliform (MPN/100 mL)		470	400	
Metal	Aluminum – Total	3800	1085	1000	
Metal	Selenium – Total	5.47	6.1		5

Blank cells denote no exceedance of a water quality objective.
"^" – CTR Human Health objective for consumption of organisms only.

Table 62: Water Quality Objective Exceedances for Receiving Water Site W-3

Classification	Constituent (in µg/L except where noted)	Event 1 10/17/05 Result	Basin Plan Objective	CTR FW Acute Objective
Bacteriological	E. coli (MPN/100 mL)	32550	235	
Bacteriological	Fecal Coliform (MPN/100 mL)	50000	400	
Conventional	Total Dissolved Solids (mg/L)	881	500	
Metal	Aluminum – Total	28600	1000	
Metal	Mercury – Total	0.129		0.051^
Pesticide	4,4'-DDD	0.114		0.00084^
Pesticide	4,4'-DDE	0.742		0.00059^

Blank cells denote no exceedance of a water quality objective.
"^" – CTR Human Health objective for consumption of organisms only.

Table 63: Water Quality Objective Exceedances for Receiving Water Site W-4

Classification	Constituent (in µg/L except where noted)	Event 1 10/17/05 Result	Basin Plan Objective	CTR FW Acute Objective
Bacteriological	E. coli (MPN/100 mL)	3873	235	
Bacteriological	Fecal Coliform (MPN/100 mL)	2400	400	
Conventional	Total Dissolved Solids (mg/L)	16240	500	
Metal	Aluminum – Total	8850	1000	
Nutrient	Nitrate as N (mg/L)	22.4	10	
Organic	Benzo(a)pyrene	0.056		0.049^
Organic	Benzo(b)fluoranthene	0.115		0.049^
Organic	Benzo(k)fluoranthene	0.0713		0.049^
Organic	Chrysene	0.162		0.049^
Organic	Indeno(1,2,3-cd)pyrene	0.0673		0.049^
Pesticide	4,4'-DDD	0.3		0.00084^
Pesticide	4,4'-DDE	1.45		0.00059^

Blank cells denote no exceedance of a water quality objective.
"^" – CTR Human Health objective for consumption of organisms only.

Land Use Discharge Analysis

In order to assess whether or not discharges from the stormwater system are contributing to the exceedances of objectives identified in the receiving waters, Land User discharge data were analyzed in the same manner as the Mass Emission and Receiving Water data.

The 2005/06 monitoring data from the Agricultural Land Use station A-1 were compared to the Basin Plan and CTR objectives previously described. Although the Stormwater Monitoring Program's Land Use stations are not always located in each of the watersheds for which Receiving Water samples are collected, the sites were chosen to provide representative data to be used to describe the water quality of discharges from urban and agricultural areas in Ventura County. As a result, for this analysis, the Land Use objective exceedances are compared to the receiving water objectives exceedances in all watersheds even if they are not specifically located in that watershed. This comparison allows the Stormwater Monitoring Program to determine whether certain land use types may be contributing to the objectives exceedances in receiving waters.

Table 64 presents water quality objective exceedances at agricultural Land Use site A-1 based on an analysis of the wet weather stormwater monitoring data collected there during Event 1.

Table 64: Water Quality Objective Exceedances at Agricultural Land Use Site A-1

Classification	Constituent (in μg/L except where noted)	Event 1 10/17/05 Result	Basin Plan Objective	CTR FW Acute Objective
Bacteriological	E. coli (MPN/100 mL)	4611	235	
Bacteriological	Fecal Coliform (MPN/100 mL)	5000	400	
Conventional	Total Dissolved Solids (mg/L)	3158	500	
Nutrient	Nitrate as N (mg/L)	48.7	10	
Pesticide	4,4'-DDD	0.049		0.00084^
Pesticide	4,4'-DDE	0.197		0.00059^

Blank cells denote no exceedance of a water quality objective.
"^" – CTR Human Health objective for consumption of organisms only.

Potential Problematic Constituents

A review of Table 57 through Table 64 provides the following observations with respect to potential problematic constituents measured in wet weather runoff.

Anions

Chloride concentrations above Basin Plan objectives were observed at Mass Emission sites ME-CC and ME-VR2 during both wet and dry monitoring events. The two exceedances at the ME-CC station occurred during dry weather Events 5 and 6, while the one exceedance at the ME-VR2 site occurred during wet weather Event 3. Chloride was not observed at concentrations greater than site-specific Basin Plan objectives for most monitoring events of the 2005/06 season. Chloride was included in the Stormwater Monitoring Program's 2002/03 Pollutant of Concern (POC) Prioritization List, but was not ultimately included in the top-ranked POC list presented in the 2002/03 Annual Monitoring Report. The Stormwater Monitoring Program will continue to evaluate chloride at Mass Emission and Receiving Water monitoring sites as a means of assessing any future trends exhibited by this pollutant.

Bacteriological

All Receiving Water and Mass Emission sites recorded concentrations greater than water quality objectives for *E. coli* and fecal coliform during wet weather events. Likewise, runoff from the A-1 agricultural Land Use site exceeded bacteriological objectives for these same two bacteria during wet weather Event 1. Dry weather monitoring at the three Mass Emission sites revealed fecal coliform concentrations above the Basin Plan objective at ME-CC and ME-SCR during Event 6, along with an E. coli exceedance recorded at ME-CC during Event 5. Consistent with previous pollutant of concern identification efforts by the Management Program (presented most recently in the 2002/03 Annual Monitoring Report) bacteria pose a potential problem for water quality protection and warrant special consideration by the Program (see Pollutant of Concern Assessment below).

Conventionals

Mass Emission station ME-VR2, Receiving Water sites W-3 and W-4, and the agricultural Land Use site A-1 showed total dissolved solids concentrations during wet weather events above Basin Plan objectives. A single dry weather exceedance above the Basin Plan site-specific objective for total dissolved solids was observed at Mass Emission site ME-CC. Total dissolved solids was included in the Stormwater Monitoring Program's 2002/03 Pollutant of Concern (POC) Prioritization List, but was not ultimately included in the top-ranked POC list contained in the 2002/-3 Annual Monitoring Report. The Stormwater Monitoring Program will continue to evaluate total dissolved solids at its monitoring sites as a means of augmenting its database and tracking site-specific and seasonal trends in observed Basin Plan exceedances for this water quality parameter.

Metals

All Mass Emission and Receiving Water sites monitored during wet weather events showed concentrations of total aluminum in excess of Basin Plan water quality objectives on one or more occasions. The one Land Use site monitoring this season, A-1, did not show any such exceedance. This season's dry weather monitoring revealed similar Basin Plan exceedances for total aluminum at the ME-CC and ME-SCR Mass Emission stations. This is the third year that aluminum has been monitored by the Stormwater Monitoring Program, and the third time that a comparison to Basin Plan objectives has revealed exceedances for total aluminum. It should be noted that aluminum is found as a ubiquitous natural element in sediments throughout Ventura County geology. All Mass Emission stations recorded concentrations of total mercury above CTR Human Health objectives during wet weather Event 4, while the ME-SCR site posted additional total mercury exceedances during wet Events 1 and 2. Mass Emission station ME-SCR also recorded concentrations of cadmium and nickel (both total fractions) above water quality objectives during wet weather Event 4. Additionally, dry weather monitoring at ME-SCR revealed exceedances of the CTR chronic objective for total selenium during Event 5 and 6. The La Vista (W-3) Receiving Water site posted a CTR exceedance for total mercury during Event 1, while the agricultural Land Use site A-1 showed no exceedances of metals objectives during that wet weather event.

The Basin Plan total aluminum exceedances notwithstanding, it should be noted that most metals exceedances observed during 2005/06 wet weather events were for metals concentrations above CTR mercury objectives and a handful of Basin Plan metals objectives observed at Mass Emission stations during the elevated flows of Event 4 in February 2006. It is reasonable to posit that the higher flows generated by the larger February 27, 2006, rainfall event were responsible for streambed and riparian habitat scouring that produced elevated concentrations of metals in water quality samples collected from Mass Emission sites during Event 4. Consistent with the most recent POC analysis (see 2002/03 Annual Monitoring Report), the runoff contributions of various metals will need to be analyzed by the Stormwater Management Program in more detail via trend analyses, source identification, and potential source control measures (see Pollutant of Concern Assessment below).

Nutrients

Water quality objective exceedances were recorded for nitrate at one Receiving Water site, W-4, and the Agricultural Land Use station, A-1. Given that these Basin Plan exceedances appear to be an issue more pertinent to agriculture, the Stormwater Monitoring Program will continue to monitor for nutrients at these sites to augment the database. Consistent with the most recent POC analysis (see 2002/03 Annual Monitoring Report), the runoff contributions of nitrogen compounds will need to be analyzed by the Stormwater Management Program in more detail via trend analyses, source identification, and potential source control measures (see Pollutant of Concern Assessment below).

Organics

Organic compound exceedances observed during 2005/06 wet weather events were limited to the phthalate compound, Bis(2-ethylhexyl)phthalate, and various polynuclear aromatic hydrocarbons (PAHs). The Mass Emission monitoring stations ME-CC and ME-VR2 recorded exceedances of the Basin Plan (4 µg/L) and CTR Human Health objectives (5.9 µg/L) for Bis(2-ethylhexyl)phthalate during wet weather Event 4, while the concentration measured at the ME-SCR station only exceeded the Basin Plan objective during the same event. No exceedances of Bis(2-ethylhexyl)phthalate were observed at either Receiving Water site (W-3 and W-4) or the agricultural Land Use site, A-1. No dry weather Bis(2-ethylhexyl)phthalate exceedances were observed at any of the three Mass Emission sites. As mentioned in Section 7, phthalate compounds originating from plastics are present in the environment at relatively high concentrations. The use of low detection limits achieved by the analytical laboratory employed by the Stormwater Monitoring Program to analyze for trace organics has resulted in the measurement of phthalate compounds at all monitoring stations in recent years.

Mass Emission stations ME-CC and ME-SCR and the Receiving Water site W-4 exhibited one or more PAH compound concentrations in excess of CTR Human Health water quality objectives. The presence of individual PAH compounds above CTR objectives at particular monitoring sites are listed as follows:

- Benzo(a)anthracene: ME-CC
- Benzo(a)pyrene: ME-CC, W-4
- Benzo(b)fluoranthene: ME-CC, W-4
- Benzo(k)fluoranthene: ME-CC, W-4
- Chrysene: ME-CC, ME-SCR, W-4
- Indeno(1,2,3-cd)pyrene: W-4

PAHs are found in the combustion products of wood, coal, and internal combustion engines, and are ubiquitous in the environment. Wildfires that burned in the region in recent years could also have served as a source of PAH compounds that were measured in water quality samples. With reference to both phthalates and PAHs, the CTR Human Health criteria for which these exceedances were observed were based on long-term exposure human health protection. Comparing short-term, stormwater discharges with the human health criterion is only useful as a screening tool and not for assessing the impact of the stormwater discharge on the waterbody and compliance with water quality standards. No dry weather PAH exceedances were observed at any of the three Mass Emission sites.

Pesticides

Pesticide exceedances observed during 2005/06 wet weather events were limited to two DDT-related compounds: 4,4'-DDD and 4,4'-DDE. These two DDT-related compounds for which CTR Human Health exceedances were recorded at Mass Emission site ME-CC, Receiving Water sites W-3 and W-4, and the agricultural Land Use site A-1 are legacy pesticides associated with Ventura County's extensive farming history. Additionally, the pesticide 4,4'-DDT was observed to exceed its CTR Human Health objective at Mass Emission site ME-CC, along with 4,4'-DDD and 4,4'-DDE, during dry weather Event 5. These pesticides are currently being addressed in the Calleguas Creek watershed through the implementation of the Calleguas Creek Watershed OC Pesticides and PCBs Total Maximum Daily Load (TMDL), adopted by the Los Angeles Regional Water Quality Control Board in July 2005. The Ventura Countywide co-permittees located in the Calleguas Creek watershed were actively involved in the TMDL development and are participating in its implementation. Legacy pesticides, such as DDT, will be further monitored over the course of the TMDL's implementation phase, and if high concentration areas (i.e., "hotspots") of these pesticides are identified, special studies will be implemented to address these hotspots.

Pollutant of Concern Assessment

On an annual basis it is important for the co-permittees to review the monitoring data generated by the Stormwater Monitoring Program (described in Section 8) as a means to evaluate the effectiveness of the existing Stormwater Management Program and to help direct future efforts and resources to the appropriate problematic water quality issues. During August 2005 the co-permittees conducted a limited review of the Stormwater Monitoring Program's historic data set (1993 – 2004) at Receiving Water sites W-3 and W-4 and Land Use sites I-2 and R-1 to determine whether discernable trends in the concentrations of the constituents contained in the 2003 POC list (see Table 65) could be identified. What follows is a brief summary of the findings of the trend analysis of POCs.

Table 65: 2003 Pollutant of Concern List

Rank	*Pollutant of Concern*
1	Total Nitrogen
2	Total DDT
3	Chlorpyrifos
4	Copper*
5	Total Coliforms
6	Ammonia
7	Zinc*
8	Lead*

*Includes both total and dissolved fractions.

The trend analysis used statistical summary results to identify POCs with sufficient data to ascertain potential trends in concentrations measured at Receiving Water and Land Use sites. Trend analysis was conducted on POCs when the following criteria were met:

- Pollutant was sampled at least 10 times, and
- Pollutant concentration was detected in at least 65% of the samples

Based on these criteria, the following pollutants were selected for trend analysis:

- Nutrients: Ammonia as N, Nitrate as N, and TKN
- Metals: Copper, Lead, and Zinc (total and dissolved fractions)
- Pesticides: 2,4'-DDD, 2.4'-DDT, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, Total Detectable DDTs, and Chlorpyrifos
- Bacteria: Total Coliform

Trend Analysis Using Simple Linear Regression Analysis – The principal statistical method used to address the objectives of this analysis consisted of a simple linear regression (SLR). Unless specified, thresholds for statistical significance were set at a confidence level of 95% ($p < 0.05$) for all analyses.

Fitness Analysis – Distribution fitness tests were conducted first (using the statistical software program JMP 5.1) to evaluate how well the data fit a lognormal or normal distribution. The statistical tests used were the Shapiro-Wilk test for normal distribution and the KSL (Kolmogorov-Smirnov-Lilliefors) goodness-of-fit test for lognormal distribution, respectively. A reasonable fit to a particular distribution was assumed if the p-value for the test statistic was > 0.05. A review of the fitness analysis results indicated that in nearly every case a lognormal distribution clearly provided a better distribution representation than a normal distribution for the data under consideration. The only exceptions were 2,4'-DDD data at site W-4, ammonia-N data at site W-4, nitrate-N data at site I-2, and total detectable DDT data at site W-4, where either distribution was shown to be acceptable. Based on these results and the distribution pattern for all parameters and sites, lognormal distribution was assumed for all POCs in the statistical analysis.

<u>Results by POC</u>

A review of the results reveals eight pollutants having either increasing or decreasing trends that were found to be statistically significant. Furthermore, the low R^2 values for 9 of the 11 significant trends indicate that these trends are statistically weak and therefore should be regarded with caution. Dissolved lead and dissolved zinc at monitoring site W-3 show the most significant decreasing trend with R^2 values of 0.851 and 0.792, respectively. However, the observed decrease for these two metals is relatively minor. Using the slope and y-intercept to calculate a rate of change in concentration (as % change/year) for each site-POC pair, it was shown that the greatest positive change (increase in concentration) over the period of study occurred for total coliform at the industrial land use site I-2 (24.36%), while the greatest negative change (decrease in concentration) was observed for dissolved lead at site W-3 (53.70%). These percent change/year results should not be extrapolated beyond the period of study in the absence of identifying specific causes for the observed increasing or decreasing trends.

DDT Pesticides – Analysis of DDT pesticides monitoring data did not reveal a significant trend in concentration (either increase or decrease) at any of the four monitoring sites analyzed. The lack of a discernible trend can be attributed to the limited time period of data available for the analysis. DDT-related pesticides are legacy pollutants that are persistent in the environment and very slow at degrading. Therefore, it is unlikely to observe a significant concentration change in the monitoring data that were collected over relatively brief time periods (R-1 and I-2: 1993-2004; W-3 and W-4: 1997-2004).

Metals – The most consistent trend observed was the decrease in dissolved lead at sites I-2, W-3, and W-4. Although no statistically significant trend was observed for dissolved lead at site R-1, a decrease was observed at site R-1 for total lead.

A statistically significant increasing trend in total copper concentrations was found at site I-2, while a decrease in total copper was observed at site W-4.

Statistically significant decreasing trends in dissolved and total zinc concentrations were observed in the receiving water sites W-3 and W-4, respectively.

Nutrients – A statistically significant increasing trend in ammonia-N concentrations was observed at site I-2, while a decrease in TKN was found at site W-4. No statistically significant trends were observed for nitrate-N at any of the sites.

Bacteria – The only statistically significant trend observed for total coliform was an increase at site I-2.

<u>Results by Site</u>

Site R-1 – The only statistically significant trend observed at site R-1 is a decrease in total lead concentrations. Over the time period analyzed (1993-2004), the total lead concentration at the site exhibited an 18.37% reduction per year. All other POCs evaluated at this site did not exhibit any discernible trends.

Site I-2 – The trend analysis revealed increasing concentrations of ammonia, total copper, and total coliform, and a decreasing trend in dissolved lead concentrations at this industrial land use monitoring site. The greatest rate of increase in pollutant concentration during the study period (1994-2004) was observed for total coliform bacteria, with a calculated percent change/year of 24.36. Ammonia-N and total copper showed lower rates of change in the increase of their concentrations, while dissolved lead exhibited a 24.36% reduction from 1993-2004.

Site W-3 – Statistically significant trends were identified for the dissolved fractions of lead and zinc. Concentrations for both metals appear to be decreasing at the rates of 53.70% (dissolved lead) and 33.30 (dissolved zinc), respectively, over the monitoring period studied (1997-2004).

Site W-4 – Statistically significant trends were identified for dissolved lead, total copper, total zinc, and TKN. All four POCs concentrations appear to be decreasing over the monitoring period studied (1997-2004), with dissolved lead showing the greatest reduction at 41.84%/year.

<u>List of Potential Sources of POCs</u>

Information on the geologic structure and specific land use practices that may contribute to POC loading in the four sub-watersheds under consideration is limited. To this end, general observations were made in identifying and listing potential sources for the POCs that were detected at the four monitoring sites.

Nitrogen Compounds – Sources of nitrite, nitrate, and ammonia are generally provided by agricultural activities (including nitrogenous-based fertilizers), animal fecal matter, human fecal matter (from homeless encampments), natural environmental concentrations, automobile emissions, and unregulated home use and disposal of fertilizers.

DDT Pesticides – Prior to 1972 when its use was banned, DDT was a commonly used pesticide in both commercial agriculture and home gardening. Although it is no longer used or produced in the United States, DDT persists in the environment. DDT, and its break-down products DDE and DDD, are persistent, bioaccumulative, and toxic. Sources of DDT include atmospheric deposition and soil and sediment runoff.

Total Coliform Bacteria – Sources of total coliform are human waste (from homeless encampments and diapers), domestic animals, livestock production, and natural occurring sources from wildlife and soil organisms.

Metals (Copper, Lead, Zinc) – Sources for metals found in stormwater runoff include industries, commercial businesses, residential activities, and ambient concentrations in the soil and water supply. Industries, such as electroplating or metal finishing operations, and commercial businesses, such as vehicle services (fueling, auto repair, and painting), machine shops, printers, and car washes are most likely to contribute metals into runoff without preventative source control measures in place. In residential areas, painting activities are likely sources of metal contribution in drainage and runoff. Brake pad dust from roadways is a likely significant source of copper as well.

POC Assessment Summary and Conclusions

Of the 20 individual POC constituents considered in this analysis at each of the four monitoring sites, only 17 pollutants possessed sufficient detected data for statistical analysis at one or more of the sites. Of the 17 pollutants that underwent trend analysis for one or more sites (for a total of 53 individual site-POC trend analyses), data from 11 site-POC pairs were observed to possess either a significant increasing or decreasing trend in pollutant concentration. Three of the 11 significant trends revealed increasing concentrations; these for ammonia, total copper, and total coliform at industrial land use site I-2. The other eight significant trend analyses revealed decreasing POC concentrations for total copper (W-4), dissolved lead (I-2, W-3, W-4), total lead (R-1), dissolved zinc (W-3), total zinc (W-4), and TKN (W-4).

As noted earlier, the low R^2 values associated with all significant trends, except dissolved lead and dissolved zinc at receiving water site W-3, indicate that these trends are weak and should be regarded with caution. Furthermore, the two statistically stronger decreasing trends observed at site W-3 possess slopes of small magnitude, meaning that the decrease in concentrations of these metals at this site is relatively minor. Using the slope and y-intercept to calculate a rate of change in concentration (as % change/year) for each site-POC pair, it was shown that the greatest positive change (increase in concentration) over the period of study occurred for total coliform at the industrial land use site I-2 (24.36%), while the greatest negative change (decrease in concentration) was observed for dissolved lead at site W-3 (53.70%). These percent change/year results should not be extrapolated beyond the period of study in the absence of identifying specific causes for the observed increasing or decreasing trends. Generally speaking, where statistically significant trends in data could be identified, both receiving water sites exhibited decreases in POC concentrations, the industrial land use site I-2 exhibited three increases and one decrease in POC concentrations, and site R-1, representing residential land use, showed a single decreasing trend. With regard to the three identified increasing POC trends (ammonia, total copper, and total coliform at site I-2), the Stormwater Management Program needs to consider how to incorporate this information into its next POC update and what affect it might have on the prioritization of individual POCs.

A review of the current BMP program and the results of the trend analysis generally supports that the Stormwater Management Program is adequately addressing its self-identified list of pollutants of concern and potential pollutants (e.g. trash and sediment). The trend analysis indicated that the one site that showed potential increases in pollutant concentrations was the industrial land use site I-2, and the pollutants showing concentration increases were ammonia, total copper, and total coliform. The Stormwater Management Program should consider implementing an enhanced pollutant source identification and control effort in this area. In contrast, the most common decreasing trend observed was for dissolved lead at sites I-2, W-3, W-4, indicating some reduction in the loading of this pollutant in three of the four sub-watersheds studied.

Overall Conclusions for 2005/06 Stormwater Monitoring Season

This report summarizes the events of the 2005/06 monitoring season in which the Stormwater Monitoring Program successfully collected and analyzed water quality samples from four wet weather storm events and two dry weather events. The Stormwater Monitoring Program subsequently conducted a thorough QA/QC evaluation of the environmental and QA/QC results generated from its analysis of water quality samples and found the resultant data set to have achieved a 94.2% success rate in meeting program data quality objectives. Overall, the four wet weather and two dry weather events monitored during the current season produced a high quality data set in terms of the low percentage of qualified data, as well as the low reporting levels achieved by all laboratories analyzing the Stormwater Monitoring Program's water quality samples.

Aquatic toxicity bioassays detected acute toxicity (defined in the NPDES permit as TUa > 1.0) in a water quality sample collected during wet weather Event 1 (October 17, 2005) at the Receiving Water site W-3.

This exceedance of an established toxicity threshold value required the Stormwater Monitoring Program to request that the toxicity testing laboratory initiate a toxicity identification evaluation (TIE) of the W-3 water quality sample. However, the laboratory was unable to identify the toxicant(s) because the sample's toxicity dissipated by the time the TIE was initiated. Chronic toxicity (defined by the Stormwater Monitoring Program as a TUc >1.0) was not detected in any of the wet or dry weather samples collected at Mass Emission stations during the 2005/06 monitoring season.

The September 2005 benthic macroinvertebrate (BMI) survey of the Ventura River Watershed was preceded by winter storms in December 2004, and January and February 2005 that dropped a combined total of 44.5 inches of rain (23.3 inches above normal) and represented the greatest amount of rain measured during the last five years since BMI sampling began. These storms produced widespread flooding, erosion, and sedimentation throughout the Ventura River Watershed. As a result of the unusually large amount of rain, 14 of the 15 BMI sampling locations had sufficient flow for sample collection (as compared to nine sites during the 2004 BMI survey possessing sufficient flow to allow sample collection). Physical habitat conditions at the 14 BMI sampling sites ranged from marginal to optimal. The best habitat scores were at the locations on the upper main stem of the Ventura River, upper San Antonio Creek, and Matilija Creek. The lowest scores were at locations on the lower Ventura River and Canada Larga Creek. Based on the Southern California Index of Biological Integrity (So CA IBI), the aquatic health of the Ventura River Watershed during 2005 ranged from poor to fair. One site each on the Ventura River and San Antonio Creek ranked in the poor range and the other twelve sites in the watershed ranked in the fair range. The sites that ranked in the poor range were located in areas of the watershed that were impacted by either a large human transient population on the Ventura River or were located downstream of an erosion control project in the vicinity of grazing and stables. Based on the findings of the 2005 BMI monitoring, it is recommended that the Ventura County Watershed Protection District continue to work with the Southern California Coastal Water Research Project (SCCWRP) to assist in the development of improved BMI sampling design, sampling protocols, taxonomic identification, and analysis techniques.