# CITY OF LONG BEACH
# STORMWATER MONITORING REPORT 2006/2007
# NPDES Permit No. CAS004003 (CI 8052)

**City of Long Beach**
**July 2007**

KINNETIC LABORATORIES INCORPORATED

*Cover Photo:* View of Los Cerritos Creek during a site visitation on April 20, 2007 to change out the composite bottle sample.

# CITY OF LONG BEACH

## DEPARTMENT OF PUBLIC WORKS

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The City of Long Beach is pleased to submit their eighth annual "Stormwater Monitoring Report 2006/2007" in compliance with Order No. 99-060, for the Municipal National Pollutant Discharge Elimination System (NPDES) Permit No. CAS004003 (CI8052).

We have worked collaboratively with our contractor, Kinnetic Laboratories, Inc., and their subcontractors to produce a report that we believe contains extremely useful information for the City and the Regional Board. As required in our permit, all analyses were conducted at laboratories certified for such analyses by the Department of Health Services or approved by the Executive Officer and in accordance with current EPA guideline procedures or as specified in this Monitoring Program.

I certify under penalty of law that this document and all attachments were prepared under my directions or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted.

Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility, of a fine and imprisonment for knowing violations.

Executed on the 15th day of July, 2007
at Long Beach, California.

Mark Christoffels
City Engineer

7/13/07
Date


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**CITY OF LONG BEACH**
**STORMWATER MONITORING REPORT 2006/2007**

**NPDES Permit No. CAS004003 (CI 8052)**

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## ACRONYMNS AND ABBREVIATIONS LIST

ASTM - American Society for Testing and Materials
BMP - Best Management Practice
BOD- Biological Oxygen Demand
CCC – Criterion Continuous Concentration
CD - Compact Disk
CFU - Colony Forming Units
CMC – Criterion Maximum Concentration
COD - Chemical Oxygen Demand
CRWQCB – California Regional Water Quality Control Board
CTR - California Toxics Rule
DDD - dichloro (p-chlorophenyl)ethane
DDE - dichloro (p-chlorophenyl)ethylene
DDT - dichlorodiphenyl trichloroethane
DF - dilution factor
DI - Deionized
DL - Detection Limit (considered the same as RL)
DO - Dissolved Oxygen
$EC_{50}$ - Concentration causing effects to 50% of the test population
EDTA - ethylene diamine triacetic acid
EMC - Event mean concentration
GIS - Geographic Information System
$IC_{25}$ - Concentration causing 25% inhibition in growth or reproduction
$IC_{50}$ - Concentration causing 50% inhibition in growth or reproduction
ICP-MS - Inductively Coupled Plasma-Mass Spectrometry
Halocline – a locally steepened vertical gradient of salinity
KLASS - Kinnetic Laboratories Automated Sampling System
KLI - Kinnetic Laboratories, Inc.
$LC_{50}$ - Bioassay concentration that produces 50% lethality
LDPE - Low Density Polyethylene
LOEC - Lowest Observed Effect Concentration
MBAS - methylene-blue-active substances
ML – Minimum level as defined in State Implementation Plan
MPN- Most Probable Number
MS4 - Multiple Separate Storm Sewer System
NADP - National Atmospheric Deposition Program
NCDC - National Climate Data Center
NPDES – National Pollutant Discharge Elimination System
NOEC - No observed effect concentration
NTU - nephelometric turbidity units
PCB - Polychlorinated biphenyls
PDF - Portable Document Format
ppb - Parts per Billion
ppt – Parts per Thousand
Q - Flow
QA/QC - Quality Assurance/Quality Control
RL - Reporting Limit (considered the same as DL)
RPD - Relative Percent Difference

sf - Square Feet
SIP – State Implementation Plan
SM- Standard Methods for the Examination of Water and Wastewater
SOP - Standard Operating Procedure
SRM - Standard Reference Material
STS - sodium tetradecyl sulfate
SWRCB-State Water Resource Control Board
TDS – Total Dissolved Solids
TIE – Toxicity Identification Evaluation
TKN - Total Kjeldahl Nitrogen
TOC - Total Organic Carbons
TPH - total petroleum hydrocarbons
TSI - ToxScan, Inc.
TSS – Total Suspended Solids
TU - Toxicity Unit
$TU_a$ – Acute Toxicity Unit ($1/LC_{50}$ or $EC_{50}$)
$TU_c$ – Chronic Toxicity Unit (1/NOEC)
USEPA - U.S. Environmental Protection Agency
WQO - Water Quality Objective
WQS - Water Quality Standard

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**CITY OF LONG BEACH**
**STORMWATER MONITORING REPORT 2006/2007**

**NPDES Permit No. CAS004003 (CI 8052)**

# 1.0 EXECUTIVE SUMMARY

This report provides a summary of the results of the eighth year of monitoring conducted under the terms of Order No. 99-060 National Pollutant Discharge Elimination Systems Municipal Permit No. CAS004003 (CI 8052) for City of Long Beach. Included in this report is a synthesis of key elements of the data set as developed over the duration of this program. The following section provides a summary of the background and purpose of the monitoring program. This is followed by a summary of key findings based upon the full eight years of monitoring.

## 1.1 Background and Purpose

Under the terms of Order No. 99-060, the City of Long Beach was required to conduct a water quality monitoring program for stormwater and dry weather discharges through the City's municipal separate storm sewer system (MS4) beginning in the 1999/2000 wet weather season. The permit was initially issued for the term of five years. At the end of the initial five years the City was directed by the Regional Board to continue operating under the 1999 permit until further notice. Major elements of the current monitoring and reporting program include 1) mass emission monitoring during storm events, 2) monitoring of dry weather discharges at each mass emission site, 3) receiving water quality monitoring and 4) special studies.

Mass emission monitoring is conducted at four sites during four wet weather storm events each year. Monitoring sites specified in the permit are as follows:

- Basin 14: Dominguez Gap Pump Station Monitoring Site
- Basin 20: Bouton Creek Monitoring Site
- Basin 23: Belmont Pump Station Monitoring Site
- Portions of Basins 18, 19, 27 and 29: Los Cerritos Channel Monitoring Site

This element of the program is intended to characterize stormwater discharges, identify contaminants of concern and develop pollutant load estimates for each major watershed. Monitoring is required to be conducted during the first significant rainfall event of the season. Flow-rated, whole storm composite samples are obtained at each site and analyzed for major constituents of concern which included conventionals, total and dissolved metals, organophosphate pesticides and herbicides. Toxicity testing using sea urchin fertilization tests and water flea survival and reproduction is conducted on the composite storm samples from three of the four mass emission sites. Phase 1 Toxicity Identification Evaluations (TIEs) are performed on samples with toxicity in order to determine the likely contaminants causing the observed toxicity.

Dry weather monitoring consists of inspections at each mass emission site and the collection and analysis of dry weather discharges over two different separate 24-hour periods during each dry season. This element of the program is intended to identify pollutants of concern and associated toxicity at the mass emission sites during the dry season. Dry weather discharge samples are subjected to the same chemical analysis and toxicity testing used for the stormwater monitoring program.

A receiving water quality monitoring program is conducted in association with the first major storm event of the season. This past year was unique in that the first major storm event of the year did not occur until late in the season. The purpose of this program is to map the resulting stormwater plume in Alamitos Bay and assess water quality and toxicity within the plume at locations representing a range of stormwater dilutions. The results are used to determine the extent of impact of typical stormwater discharges to Alamitos Bay.

The purpose of this present report is to submit the results of the City of Long Beach's stormwater monitoring program for the seventh year (2006/2007) under the current permit.

## 1.2 Summary of Results

Extreme drought conditions have persisted in Long Beach for the past two years. Normal precipitation for October through April at the Long Beach Airport is 12.27 inches. During the 2005/2006 wet weather season, rainfall was measured at 7.76 inches. During the 2006/2007, just 2.38 inches of rain was measured at the Long Beach Airport making it one of the driest on record. This amounts to a staggering 9.89 inch deficit for the season or just 19% of the normal wet season rainfall.

A total of five storm events were monitored during the 2006/2007 season. Of these, only two storm events were monitored for the full set of analytical constituents at the Belmont Pump Station, Bouton Creek and Los Cerritos Channel site. One storm event was monitored for the full set of analytical constituents at the Dominguez Gap Pump Station site.

Rainfall and runoff were far below predicted levels during the first two events of the season (October 14, 2006 and January 30, 2007). This resulted in stormwater composite volumes that were insufficient and inappropriate for the full suite of tests. Only TSS was measured at sites with sufficient flow to trigger the storm monitoring sites.

This past year completes the fifth year of a receiving water study in Alamitos Bay designed to monitor the horizontal and vertical extent of the stormwater plume and to characterize key contaminants and toxicity within the plume. Although this study is intended to be conducted in association with the first significant storm of the season, drought conditions resulted in this receiving water study being conducted during the final storm event in the season which occurred a few days past the end of the wet season as defined in the City's NPDES permit. Due to the drought, the City opted to monitor this despite the fact that it occurred after April 15$^{th}$, the official end of the wet season. The stormwater plume investigation was conducted once most rainfall subsided on the evening of April 20$^{th}$, 2007. Sampling locations represented a range of salinities within the plume that ranged from 10 to 25‰. Water samples were tested for toxicity and a subset of water quality parameters which included selected trace metals, TSS and organophosphate pesticides.

Two dry weather inspections/monitoring events were conducted during the 2006/2007 monitoring year. These surveys are conducted during the summer dry weather period at each of the four mass emission stations. A total of 16 dry weather surveys have now been conducted since issuance of the permit in 1999. The first dry weather survey was conducted on September 6$^{th}$ and 7$^{th}$, 2006 prior to the winter rains. The second dry weather survey was conducted on May 16$^{th}$ and 17$^{th}$, 2007 once winter rains had subsided. Dry weather monitoring was conducted for the three mass emission sites that exhibited dry weather flows. These included Bouton Creek, the Belmont Pump Station, and the Los Cerritos Channel. Since this program started in early 2000, the Dominguez Pump Station has never been observed to have dry weather discharges due the large infiltration basin adjacent to the site.

Included in this year's report is the second phase of program designed to identify potential sources of contaminants of concern that contribute to elevated concentrations in sediments within the western arm of Colorado Lagoon. Details of this investigation are provided in Appendix B. The investigation was based upon an iterative process where storm drain sediments were first collected from the three main storm drains at locations near the western arm of Colorado Lagoon. Based upon the results of that survey, one of the storm drains was selected for further investigation. This followup survey was conducted in June 2007. Appendix B provides a complete summary of this effort.

The following provides a brief synopsis of the results of the City of Long Beach's 2006/2007 stormwater monitoring program:

**Wet Weather Chemical and Bacterial Results**

Numerical standards do not exist for stormwater discharges. However, water quality criteria or objectives may provide reference points for assessing the relative importance of various stormwater contaminants, though specific receiving water studies are necessary to quantify the presence and magnitude of any actual water quality impacts. The 2005 California Ocean Plan (SWRCB, 2006), the Los Angeles Region Basin Plan (CRWQCB, Los Angeles Region, 1994), California Department of Fish and Game (Siepmann and Finlayson, 2002) criteria for chlorpyrifos and diazinon, and both saltwater and freshwater criteria from the California Toxics Rule (USEPA, 2000) were used as benchmarks as requested by Regional Board staff. In addition, National Recommended Water Quality Criteria (USEPA, 2002) were used as benchmarks for compounds such as malathion that are not considered to be priority pollutants. Comparisons of stormwater concentrations with various water quality criteria are intended to provide a framework for evaluating constituents of concern and allow for identification of watersheds that could benefit from additional BMPs or source identification/reduction efforts.

Although only two storm events were monitored during the past year, the results were consistent with general trends reported over the life of the permit.

- Grab samples taken for bacteria during storm events typically exceed Basin Plan water quality criteria but this season two sites had bacteria concentrations below the single sample criteria during the first, small storm event. Enterococcus was below the single sample criteria at Bouton Creek and both total and fecal coliform were below the single sample criteria at the Los Cerritos Channel site. The criterion for the ratio of fecal to total coliform was exceeded in all samples except for the first event at the Los Cerritos Channel site.

- Benchmark reference values were commonly exceeded at least once for a total of four different total recoverable metals. These included aluminum, copper, lead, and zinc. The aluminum drinking water quality criteria of 1000 ug/L was exceeded in one of the two samples from both the Belmont Pump Station and Bouton Creek sites and all samples from the Los Cerritos Channel and Dominguez Pump Station. Concentrations of total recoverable copper and zinc in runoff from all mass emission sites exceeded Ocean Plan criteria during all storm events. Concentrations of total recoverable lead also exceeded Ocean Plan criteria during all storm events at all sites except for the first small event at the Los Cerritos Channel site.

- Total nickel exceeded Ocean Plan water quality criteria during the final event of the wet season in runoff from the Los Cerritos Channel. Exceedance of Ocean Plan nickel criteria at this site has always been associated with elevated TSS concentrations. The concentration of TSS reported in stormwater from the second monitored event in the Los Cerritos Channel was 280 mg/L.

- The near absence of measurable levels of diazinon and chlorpyrifos remains to be a significant trend. Diazinon was only detected in association with a single storm event at the Los Cerritos Channel monitoring station and concentrations did not exceed the available criterion of 0.08 ug/l proposed by the California Department of Fish and Game.

- With only two storm events during the past year, changes in loading rates among sites are difficult to assess although loading rates for copper, lead and zinc were among the lowest measured since 2001. Historical differences in loading rates for copper, lead, and zinc among the four sites have generally remained consistent. The Los Cerritos Channel site tends to have the highest loading rates of these metals and the Dominguez Pump Station consistently has the lowest loading rates. Loading rates for the metals are generally comparable at the Belmont Pump and Bouton Creek sites.

**Dry Weather Chemical and Bacterial Results**

- Water quality of dry weather discharges has been generally consistent over the past eight years. Dry season water quality has not tended to vary greatly between sites or sampling dates. In general, the concentrations of suspended particulates and total recoverable metal concentrations are low in dry weather runoff. Trace metals are predominantly in the dissolved form. Hardness is also consistently high which tends to mitigate the effects of the dissolved metals. As a result, most trace metals were below CTR freshwater criteria during both dry weather sampling events.

- As in all previous years, copper remains the primary constituent of concern in dry weather discharges. It is uncommon for dissolved copper to exceed the CTR freshwater criterion due to the elevated hardness of dry weather discharges. This year, none of the six dry weather samples exceeded the CTR freshwater criterion. The CTR saltwater criterion for dissolved copper, however, was exceeded in five out of the six samples. Highest concentrations (7.5 ug/L and 12 ug/L) were once again encountered in dry weather flows from the Los Cerritos Channel mass emission station. In addition, both measured concentrations of total copper in the Los Cerritos Channel dry weather samples exceeded Ocean Plan criteria.

- As in all previous years, no dry weather discharges were observed from the Dominguez Gap Pump Station.

**Alamitos Bay Receiving Water Program**

- A total of five stormwater plume tracking studies have been conducted in Alamitos Bay receiving waters since the initial pilot program in 2002. These studies are typically conducted in association with an early season storm event. Since the first study, monitored events have ranged from relatively small events (0.3 to 0.5 inches of rain) where the stormwater plume was limited mostly to the Los Cerritos Channel to very large events (1.6 to 1.8 inches) that impacted all of Alamitos Bay and extended out into San Pablo Bay. In contrast to similar studies conducted to monitor stormwater plumes in Santa Monica Bay and San Diego Bay, none of these surveys, including the most recent, has shown evidence of wide-spread toxicity within Alamitos Bay as a result of the stormwater plumes.

- Based upon the plume characteristics, the Los Cerritos Channel was the major source of stormwater entering Alamitos Bay. Measured surface salinity within Alamitos Bay ranged from 3.88 to 35.3 ppt. The lowest salinities were found within the lower reaches of the Los Cerritos Channel near the Pacific Coast Highway Bridge. The higher surface salinities occurred nearer the

Bay entrance and the western half of Alamitos Bay. The upper reaches of Marine Stadium had near open coast salinities indicating that there was no significant plume from this portion of the watershed during this moderate event.

- Total metal concentrations, for the most part, increased with decreasing salinity (or increasing stormwater influence) for each of the metals tested. Total zinc concentrations exceeded the California Ocean Plan 2002 daily maximum concentration of 80 µg/L at stations RW1 and RW2, the two stations most influenced by the stormwater plume.

- With the exception of cadmium, dissolved metals also showed a clear pattern of stormwater influence. Dissolved metal concentrations increased as the salinity decreased. Dissolved copper concentrations exceeded the California Toxics Rule for Saltwater Criterion Maximum Concentration (CMC) of 4.8 µg/L at stations RW1 and RW2 and the Criterion Continuous Concentration (CCC) of 3.1 µg/L at all receiving water stations.

- The sea urchin fertilization test was used to evaluate potential toxic effects of the stormwater plume. Tests conducted on plume samples from each of the four receiving water stations showed no evidence of a toxic response.

**Temporal Trends in Constituents of Concern**

Each year, long term trends have been examined for selected trace metals and organic compounds, TSS, and bacteria. With only two storm events during the 2006/2007 monitoring season, there is limited new information as to long term trends. Nevertheless, data from the two 2006/2007 storm events continue to confirm patterns identified since the beginning of the monitoring effort in early 2000. These include the following:

- Dissolved concentrations of cadmium, copper, and nickel do not vary substantially between wet and dry weather periods.

- Concentrations of dissolved zinc and lead are often higher during storm events than during dry weather sampling events. Elevation in dissolved zinc has often been associated with increasing toxicity in the sea urchin fertilization tests, although no toxicity effects were observed during the current year of monitoring.

- Concentrations of total copper, lead and zinc are consistently higher in association with storm flows.

- The decline in concentrations of chlorpyrifos and diazinon in stormwater at all sites remains one of the most significant temporal trends. These compounds are now rarely detected and, when detected, are now present at lower concentrations that tend not to exhibit toxicity in the more sensitive bioassay tests.

- Based upon all eight years of monitoring, stormwater discharges from the Dominguez Gap Pump Station continue to have the lowest concentrations of total metals.

- Fecal indicator bacteria typically exceed Basin Plan water quality criteria during both wet and dry weather monitoring. Dry weather concentrations of indicator bacteria are often slightly less than those observed during wet weather conditions. This is most apparent in Bouton Creek where the

dry weather concentrations of both total and fecal coliform bacteria are below Basin Plan criteria about 75% of the time.

**Toxicity Results**

- Water flea toxicity was not seen during either storm at any station. It is noteworthy that the disappearance of toxicity to *Ceriodaphnia* is correlated with the absence of detectable concentrations of the organophosphate pesticides diazinon and chlorpyrifos. Toxicity to sea urchin fertilization was detected at all three of the stations during both of the wet weather storm events. The frequency of stormwater toxicity from the Long Beach stations to sea urchins during this monitoring period was slightly increased over that reported for the previous three monitoring periods. The magnitude of stormwater toxicity to sea urchins was similar to that seen in previous years. Frequency and magnitude of 2006/2007 stormwater toxicity to urchins were similar to those observed in the 2005/2006 program when compared with stormwater samples from other southern California watersheds in that both were elevated over data from the previous three years. The Chollas Creek (San Diego) and Ballona Creek (Santa Monica) were most similar to the Long Beach study, as these samples were obtained from smaller highly urbanized watersheds relative to the Los Angeles and San Gabriel Rivers.

- Toxicity to *Ceriodaphnia* was measured in the fall dry weather sample from Bouton Creek. The slightly elevated salinity of that sample probably contributed to the observed toxicity. The spring dry weather sample from Bouton Creek was not tested with water fleas because of its much higher salinity. There was also very minor reproductive toxicity to *Ceriodaphnia* in the fall dry weather sample from the Los Cerritos Channel. The virtual lack of toxicity to water fleas at any station and in either wet or dry weather samples during this monitoring program did not support a hypothesis of differing composition of stormwater and dry weather discharge at Long Beach. In contrast, wet weather runoff appeared to consistently produce more sea urchin toxicity of higher magnitude than dry weather discharge, supporting the wet/dry difference in composition.

- Neither of the wet weather sea urchin TIEs were completed successfully due to the unexplained loss of acute baseline toxicity. There was a general lack of useful correlations of chemical with toxicity data. The relative dryness of the storm season (only two collectable storm events) may have contributed to the paucity of useful information resulting from this 2006/2007 monitoring program.

**Pilot Watershed Source Identification Program (Appendix B)**

- This investigation was designed to identify possible sources of contaminants of concern within the storm drain system by analyzing sediments from areas that effectively isolate segments of the storm drain system. During the field investigation it was discovered that all three major storm drain systems contributing runoff to the western arm of Colorado Lagoon are interconnected at a number of locations in the upper portion of the watershed.

- Soils from the former Pacific Electric Train right-of-way were initially tested to determine if this area could have contributed to the elevated levels of contaminants of concern in Colorado Lagoon. Analysis of these soils indicated relatively low concentrations of persistent, biaccumulative, and toxic (PBT) compounds of concern. The only 303(d) list contaminant of concern at this site was zinc.

- Relatively low concentrations of PBTs were also present in storm drain sediments collected in the upper portion of the watershed (areas north of Tenth Street) that contributes flow to two of the three storm drains that discharge to Colorado Lagoon. This suggests that upper portions of the watershed do not serve as significant sources of the primary constituents of concern in Colorado Lagoon.

- Sediment sampled from Site E in 2005 and Site E1 (the original Site E) in 2007 exhibited elevated levels of lead. Lead concentrations at Site E1 were nearly five times those found in the contaminated sediments of Colorado Lagoon. Concentrations of lead were over nine times those found in Colorado Lagoon when all results were normalized to the fine-grained sediment.

- Concentrations of copper, silver, zinc, DDT and chlordane in storm drain sediments from throughout most of the watershed are typically 1-3 times the concentrations measured in sediments from Colorado Lagoon. Concentrations of these contaminants in storm drain sediments indicate that sources of these contaminants are likely sufficient to maintain the current elevated levels of these contaminants in Colorado Lagoon if measures are not taken to decrease sediment loads.

### 1.3 Recommended Programmatic Changes

Two primary adjustments are recommended for the 2007/2008 monitoring period. It is recommended that monitoring of the stormwater plume in Alamitos Bay receiving waters be discontinued and that the triazine pesticides be eliminated from the analytical suite.

Over the past five years, the Long Beach stormwater monitoring program has clearly demonstrated a lack of substantial toxicity in the stormwater plume over a wide range of storm events. This program was implemented based upon toxicity observed in stormwater plumes emanating from Ballona Creek and extending well out into Santa Monica Bay as well as toxicity observed in stormwater plumes in San Diego Bay from the Chollas Creek watershed. Having demonstrated that the general lack of toxicity in the stormwater plumes within Alamitos Bay, we believe that monitoring funds could be better expended on other activities.

The only triazine pesticides detected in stormwater or dry weather discharges have been prometon, simazine and cyanazine. All three typically occur at levels of less than 10 times the detection limit. The infrequent presence of these compounds in stormwater runoff and the low concentrations when they are detected suggests that this group of organic compounds should be considered for elimination from the analytical suite.

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## 2.0 INTRODUCTION

The City of Long Beach received an NPDES Permit issued by the California Regional Water Quality Control Board, Los Angeles Region on 30 June 1999 (Order No 99-060, NPDES No. CAS004003, [CI 8052]). This order defined Waste Discharge Requirements for Municipal Stormwater and Urban Runoff discharges within the City of Long Beach. Specifically, the permit regulates discharges of stormwater and urban runoff from municipal separate storm sewer systems (MS4s), also called storm drain systems, into receiving waters of the Los Angeles Basin.

Since issuance of the 1999 NPDES permit, the population served by City of Long Beach has increased by nearly 9 percent. When the permit was first issued, the population was estimated at 452,000. Current estimates place the City's population at 492,912[1] people in an area of approximately 50 square miles. This makes the City of Long Beach the fifth most populated city in the California. The discharges from the MS4 system consist of surface runoff (non-stormwater and stormwater) from various land uses in the hydrologic drainage basins within the City. Approximately 44% of the land area discharges to the Los Angeles River, 7% to the San Gabriel River, and the remaining 49% drains directly to Long Beach Harbor and San Pedro Bay (City of Long Beach Municipal Stormwater Permit, 1999). The quality and quantity of these discharges vary considerably and are affected by the hydrology, geology, and land use characteristics of the watersheds; seasonal weather patterns; and frequency and duration of storm events. Impairments or threatened impairments of beneficial uses of water bodies in Long Beach include Alamitos Bay, Los Angeles River, El Dorado Lake, Los Angeles River Reach 1 and Reach 2, San Gabriel River Estuary, San Gabriel River Reach 1, Colorado Lagoon, and Los Cerritos Channel. These areas also include coastal shorelines, including Alamitos Bay Beaches, Belmont Shore Beach, Bluff Park Beach, and Long Beach Shore[2].

### 2.1 Annual Program Adjustments

The 1999 NPDES permit requires the City of Long Beach to prepare, maintain, and update if necessary a monitoring plan. The original monitoring plan required the City to monitor three (Year 1) and four (Years 2 through 5) discharge sites draining representative urban watersheds (mass emission sites) during the program. Flow, chemical analysis of water quality, and toxicity were to be monitored at each of these sites for four representative storm events each year. During the dry season, inspections and monitoring of these same discharge sites were to be carried out, with the same water quality characterization and toxicity tests to be run. In addition, one receiving water body (Alamitos Bay) was to be monitored during the first two years of the program for bacteria and toxicity. Monitoring at the Alamitos Bay site was to be conducted during both the wet and the dry seasons and was to be used to document the effect of a dry weather diversion. Each year the program is reviewed and adjustments are made as a result of discussions with Regional Board staff. No adjustments were made to the 2005/2006 monitoring program. Evolution of the program is summarized in Table 2.1.

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[1] State of California, Department of Finance, *E-4 Population Estimates for Cities, Counties and the State, 2001-2007, with 2000 Benchmark. Sacramento, California, May 2007*

[2] Los Angeles Regional Water Quality Control Board, 2002 303(d) list

**Table 2.1 Summary of the City of Long Beach Stormwater NPDES Monitoring and Reporting Program with Annual Adjustments.**

| 1999 Monitoring and Reporting Program |
|---|
| ***Mass Emission Site Monitoring*** |
| • Monitor 3 mass emission sites (Belmont Pump Station, Bouton Creek and Dominguez Gap Pump Station) during the 1st year of the permit. Add a 4th mass emission site (Los Cerritos Channel) during the 2nd and subsequent years. Flow-rated composites to be obtained during 4 storm events at each site and analyzed for:<br>✓ conventionals, total and dissolved metals, semivolatile organic compounds, organochlorine pesticides, organophosphate pesticides, herbicides and MBTE.<br>✓ toxicity testing using mysids, sea urchin and water flea.<br>✓ Phase 1 Toxicity Identification Evaluations (TIEs) to be conducted when 3 consecutive wet weather or 2 consecutive dry weather samples from the same monitoring station show toxicity.<br>✓ Grab samples for indicator bacteria and oil and grease.<br>Dry season inspections and monitoring to be conducted at each mass emission site 2 times per year. Sampling of dry weather flows to be conducted over 24-hour periods to provide representative samples. Samples from each site to be tested consistent with stormwater monitoring. |
| ***Receiving Waters*** |
| • Conduct receiving water quality monitoring in Alamitos Bay for the first two years of the program to document effects of a dry weather diversion. Testing to consist of indicator bacteria and toxicity. |
| ***Special Studies*** |
| • Conduct a special study to examine characteristics of stormwater runoff from parking lots (one year only). |
| **2001 - M&R Program Modifications** |
| • List of constituents and reporting limits modified for consistency with minimum levels (MLs) listed in the State's *Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays and Estuaries of California* (SIP).<br>• TIE triggers altered to enhance opportunities for defining toxicity whenever it occurs.<br>• Use of the mysid toxicity test reduced to include only the first event of the season. |
| **2002 - M&R Program Modifications** |
| • Suspend toxicity monitoring at the Dominguez Pump Station monitoring site.<br>• Suspend monitoring of semivolatile organic compound.<br>• Conduct a pilot plume monitoring program in Alamitos Bay to document the horizontal and vertical extent of the stormwater plume in the receiving waters, measure the concentration of selected metals and organophosphate pesticides at four points in the plume and conduct sea urchin bioassay tests to document potential toxicity in the plume.<br>• Immediate upstream investigations were to be conducted if elevated pH was detected during dry weather surveys at mass emission monitoring sites in order to document the source or cause. |
| **2003 - M&R Program Modifications** |
| • Suspend analyses of parameters infrequently detected and/or typically detected at low levels.<br>• Continue the pilot plume monitoring program targeting the first storm of the season.<br>• Adjust TIE triggers – TIEs to be conducted using water flea when toxicity exceeds 2 toxicity units (TUs). TIEs to be conducted using sea urchins when toxicity exceeds 3 TUs.<br>• Change monitoring strategy to emphasize sampling during early season events.<br>• Monitor TSS and stormwater flow for all storm events at all four mass emission sites. |
| **2004 - M&R Program Modifications** |
| • Recommended setting minimum of 7 days between monitored events.<br>• Include daily records of rainfall for current and previous seasons in report.<br>• Submit draft work plan for identification of PBT sources to Stormwater Monitoring Coalition (SMC) for input and participation. |
| **2005 – 2006 M&R Program Modifications** |
| • No changes; continue with current program. |

# 3.0 STUDY AREA DESCRIPTION

The four sites for mass emissions monitoring were originally selected by the City of Long Beach with the assistance of the Southern California Coastal Water Research Project (SCCWRP), with input from the Los Angeles Department of Public Works, the environmental community, and with the approval of the Regional Water Quality Control Board. These sites were then specified in the NPDES permit after an analysis of the drainage basins and receiving waters. They were selected to be representative of the stormwater discharges from the City's storm drain system, as well as to be practical sites to carry out stormwater and dry weather monitoring.

## 3.1 Regional Setting

### 3.1.1 Geography

The City of Long Beach is located in the center and southern part of the Los Angeles Basin (Figure 3.1) and is part of the highly urbanized Los Angeles region. In addition to residential and other uses, the City also encompasses heavy industrial and commercial areas and includes a major port facility, one of the largest in the United States. The City's waterfront is protected from the open Pacific Ocean by the extensive rock dikes encircling the outer harbor area of the Port of Los Angeles/Port of Long Beach complex. The waterfront includes port facilities along with a downtown commercial/residential area that includes small boat marinas, recreational areas, and convention facilities. Topography within the City boundaries can be generally characterized as low relief, with Signal Hill being the most prominent topographic feature (Figure 3.2).

### 3.1.2 Major Watersheds

Major water bodies receiving stormwater discharges from the City of Long Beach include the Los Angeles River located near the western boundary of the City, the San Gabriel River located near the eastern boundary, and the outer Harbor of the Los Angeles/Long Beach area. The City of Long Beach has fifteen pump stations that discharge into the Los Angeles River, and one pump station that discharges into the San Gabriel River. Receiving water sub-areas of importance include the extensive Alamitos Bay, heavily developed for marina and recreational uses, and the inner harbor areas of the City, heavily developed as port facilities. Other receiving water sub-areas include the Los Angeles River, El Dorado Lake, Los Angeles River Reach 1 and Reach 2, San Gabriel River Estuary, San Gabriel River Reach 1, Colorado Lagoon, and Los Cerritos Channel. These areas also include coastal shorelines, including Alamitos Bay Beaches, Belmont Shore Beach, Bluff Park Beach, and Long Beach Shore. The drainage from the City is characterized by major creeks or storm channels, usually diked and/or concrete lined such as the Los Cerritos Channel that originates in Long Beach, flows near the eastern City boundary, and discharges into the Marine Stadium and then into Alamitos Bay. Other such regional drains include:

- Coyote Creek, which passes through a small portion of Long Beach before it discharges to the San Gabriel River;
- Heather Channel and Los Cerritos Line E that both enter Long Beach from the City of Lakewood and discharge into the Los Cerritos Channel; and the
- Artesia-Norwalk Drain that enters Long Beach from Hawaiian Gardens and discharges into Coyote Creek.

The City of Long Beach, including the City of Signal Hill, is divided into 30 watersheds as shown in Figure 3.3. Data presently in the City of Long Beach GIS database on total areas and specific land use categories for each basin are given in Table 3.1 (City of Long Beach, 2000). Specific watersheds selected

by the City of Long Beach for this present stormwater monitoring program are described in more detail in the section 4.0.

### 3.1.3 Annual Rainfall and Climate

The City of Long Beach is located in the semi-arid Southern California coastal area and receives significant rainfall on a seasonal basis. The rain season generally extends from October through April, with the heavier rains more likely in the months of November through March (see Figure 5.2 for average rainfall by month and seasonal total rainfall as measured at the Long Beach Airport). The long-term average (1971-2000) rainfall for October through April (wet season) at the Long Beach Airport is 12.27 inches per year. Average annual rainfall for the entire year is 12.94 inches.

The City lies in the Los Angeles Plain, which is south of the Santa Monica and San Gabriel Mountains and west of the San Jose and the Puente Hills. The Los Angeles River is the largest stream on the Plain and it drains the San Fernando Valley and much of the San Gabriel Mountains. Most of the streams are dry during the summer and there are no lakes or ponds, other than temporary ponding behind dunes (Miles & Goudy, 1998). The climate is mild, with a 30-year average temperature of 23.4 °C (74.1°F) at the Long Beach Daugherty Airport (NCDC, 2000).

### 3.1.4 Population and Land Use Characteristics

The population of the City of Long Beach totaled 492,912 residents in January 2007 (California Department of Finance Demographic Research Unit, 2007). The total population of the County of Los Angeles, in which it resides, was 10,331,939. The independent city of Signal Hill, located on a promontory, is surrounded by the City of Long Beach. Signal Hill's population was recently estimated to be 11,229. Signal Hill contributes runoff to drainage basins 6, 7, 8, 9 and 18. Drainage basin 18 discharges through the Los Cerritos Channel.

The City of Long Beach has a total area of 26,616 acres. Of that total 16,926 acres (64%) are classified as residential, 4,784 acres (18%) as commercial, 2,269 acres (8.5%) as industrial, 1,846 (7%) as institutional, and 786 acres (3%) as open space (City of Long Beach, 2000). The drainage basins sampled for the stormwater monitoring study follow this general pattern of land use.

**Figure 3.1 Los Angeles Basin. (Source: 3-D TopoQuads Copyright 1999 DelLorme, Yarmouth, ME 04096).**

**Figure 3.2 City of Long Beach. (Source: Google Earth Pro, 2006).**

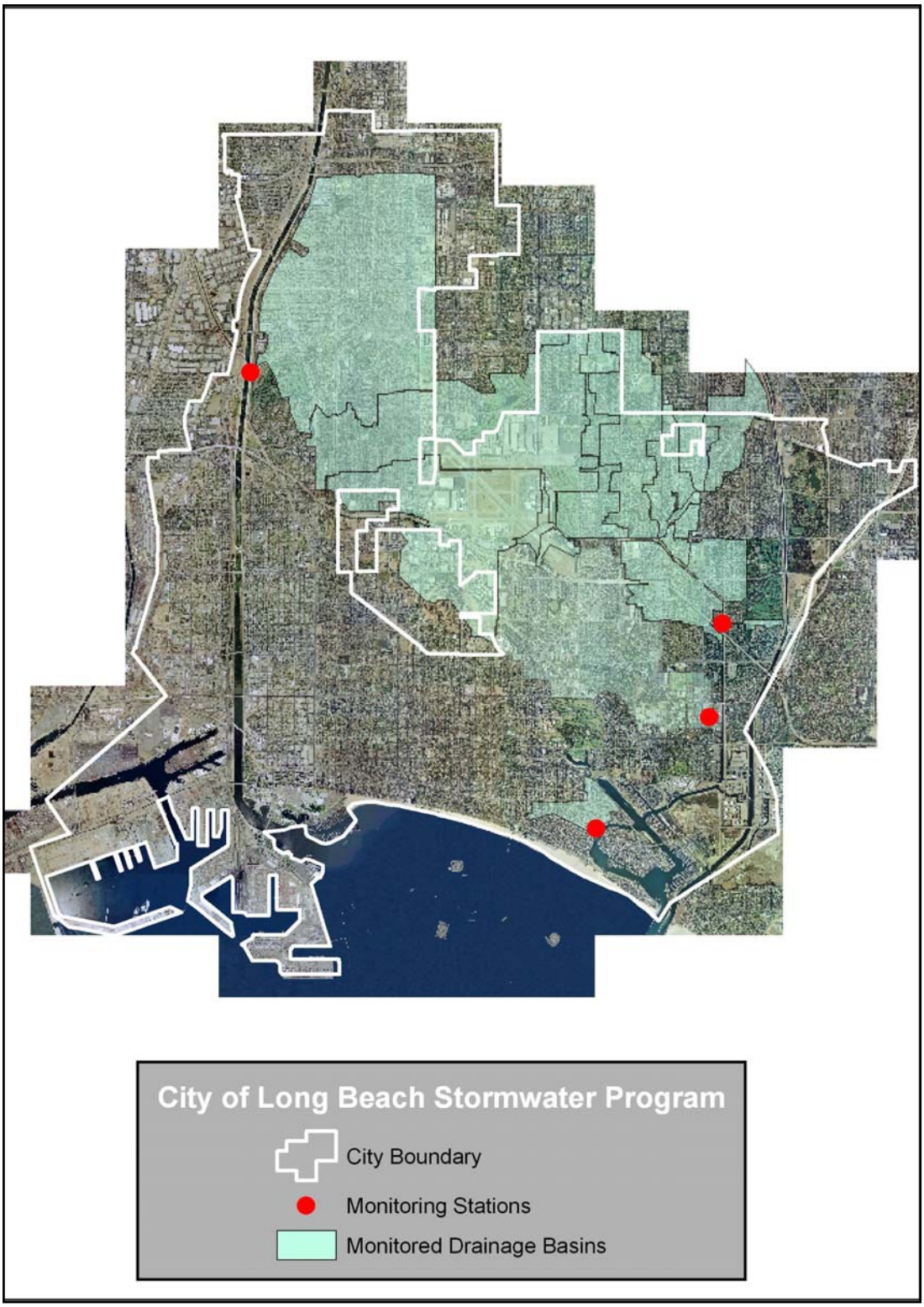


**Figure 3.3 City of Long Beach, Major Drainage Basins (Source: City of Long Beach, Department of Technology Services, last update 2000) and City of Long Beach Stormwater Monitoring Sites.**

**Table 3.1 Total Area and Land Use for City of Long Beach Watersheds.**

| Drainage Basin | Drainage Pattern | Sub-basins | Total Acres | Residential Acres | Commercial Acres | Industrial Acres | Institutional Acres | Open Space Acres |
|---|---|---|---|---|---|---|---|---|
| 1 | N to S | 4 | 456 | 393 | 44 | 0 | 7 | 12 |
| 2 | E to W | 1 | 1,276 | 905 | 287 | 22 | 59 | 3 |
| 3 | E to W | 3 | 1,083 | 367 | 642 | 7 | 58 | 9 |
| 4 | E to W | 2 | 810 | 426 | 176 | 140 | 56 | 12 |
| 5 | E to W | 1 | 546 | 434 | 97 | 0 | 13 | 2 |
| 6 | S & SE | 1 | 695 | 475 | 125 | 0 | 73 | 17 |
| 7 | to center | 1 | 1,029 | 858 | 89 | 11 | 53 | 18 |
| 8 | E to W | 1 | 248 | 163 | 27 | 58 | 0 | 0 |
| 9 | SW & NW | 1 | 399 | 295 | 91 | 0 | 12 | 1 |
| 10 | S & E | 3 | 416 | 16 | 49 | 351 | 0 | 0 |
| 11 | S & E | 1 | 424 | 338 | 64 | 3 | 18 | 1 |
| 12 | S & E | 1 | 719 | 556 | 98 | 9 | 41 | 15 |
| 13 | S & E | 1 | 84 | 0 | 7 | 77 | 0 | 0 |
| 14 | S & W | 2 | 3,374 | 2,445 | 392 | 148 | 273 | 116 |
| 15 | S & W | 1 | 958 | 569 | 167 | 197 | 25 | 0 |
| 16 | N to S | 1 | 194 | 113 | 61 | 8 | 5 | 7 |
| 17 | S & E | 1 | 317 | 244 | 68 | 0 | 5 | 0 |
| 18 | E | 1 | 1,814 | 804 | 262 | 729 | 19 | 0 |
| 19 | E | 20 | 3,898 | 2,475 | 610 | 439 | 228 | 146 |
| 20 | S & E | 1 | 2,259 | 1,215 | 412 | 70 | 492 | 70 |
| 21 | S & E | 3 | 1,172 | 773 | 125 | 0 | 55 | 219 |
| 22 | variable | 9 | 520 | 38 | 428 | 0 | 54 | 0 |
| 23 | S | 1 | 213 | 110 | 85 | 0 | 14 | 4 |
| 24 | SE & NW | 1 | 281 | 188 | 30 | 0 | 0 | 63 |
| 25 | W & E | 2 | 90 | 70 | 9 | 0 | 4 | 7 |
| 26 | S & W | 3 | 355 | 304 | 22 | 0 | 29 | 0 |
| 27 | E & S | 9 | 1,083 | 825 | 109 | 0 | 143 | 6 |
| 28 | S & E | 1 | 630 | 386 | 179 | 0 | 65 | 0 |
| 29 | S | 8 | 727 | 633 | 10 | 0 | 26 | 58 |
| 30 | SW(6) & SE(1) | 7 | 546 | 508 | 19 | 0 | 19 | 0 |
| | **Total Acres** | | 26,616 | 16,926 | 4,784 | 2,269 | 1,846 | 786 |

**Monitored Watersheds**

- **Dominguez Gap**
- **Belmont Pump Station**
- **Bouton Creek**
- **Los Cerritos Channel**

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# 4.0 MONITORING PROGRAM

## 4.1 Monitoring Program Objectives

The stated long-term objectives of the stormwater monitoring program are as follows:

1. Estimate annual mass emissions of pollutants discharged to surface waters through the MS4;
2. Evaluate water column and sediment toxicity in receiving waters;
3. Evaluate impact of stormwater/urban runoff on marine life in receiving waters;
4. Determine and prioritize pollutants of concern in stormwater;
5. Identify pollutant sources on the basis of flow sampling, facility inspections, and ICID investigations; and
6. Evaluate BMP effectiveness.

Monitoring efforts during the initial term of the permit have focused on developing accurate assessments of pollutant loads from mass emission sites and determining the chemical and toxicological characteristics of discharges from the City's MS4 during both storm events and dry weather periods. During the first full year of monitoring a special Parking Lot Study was implemented to assist in identification of potential pollutant sources and to evaluate application of BMPs in parking lots. Specific objectives of this year's work included the following:

1. Obtain monitoring data from four (4) storm events for each mass emission station during the 2006/2007 storm season.
2. Conduct a field study to document the extent of stormwater plumes in Alamitos Bay and measure associated toxicity and water chemistry at four different dilutions.
3. Carry out dry weather inspections and obtain samples of dry weather flow at each of the four mass emission stations. Perform this dry weather work twice during the dry season that extends from May through October.
4. Perform chemical analyses for the specified suite of analytes at the appropriate detection limits for all stormwater samples collected.
5. Perform toxicity testing of the stormwater samples collected, and Toxicity Identification Evaluations (TIEs) if warranted by the toxicity results at a given site. No toxicity testing was required for water from the Dominguez Gap Pump Station monitoring site.
6. Continue the pilot investigation of sediments in storm drains to determine the efficacy of this method in identifying significant sources of Persistent Bioaccumulative and Toxic Compounds (PBTs) not readily measured in typical stormwater monitoring programs.
7. Report the above results and evaluate the monitoring data with respect to receiving water quality criteria.

## 4.2 Monitoring Site Descriptions

Four mass emission monitoring sites are routinely monitored as part of the City's stormwater program. The general locations of the drainage basins sampled by each of these sites and each monitoring location are shown in Figure 3.3. The latitude and longitude of each site are shown in Table 4.1. Brief descriptions of each drainage basin and land use are provided in the following sections.

### 4.2.1 Basin 23: Belmont Pump Station Monitoring Site

This site collects water from Basin 23 that covers 213 acres. Land use in the basin is 52% residential, 40% commercial, 0% industrial, 6% institutional, and 2% open space (Figure 4.1, Table 3.1). This basin is located in the southeastern portion of the City and is bounded on the north, south, east, and west by Colorado Street, Division Street, Ultimo Avenue and Belmont Avenue respectively. The Belmont Pump Station is located at 222 Claremont Avenue.

**Changing Out Sample Bottles at the Belmont Pump Station**

Water enters the forebay of the facility via a nine-foot diameter underground storm pipe. A trash rack catches debris before water drops four feet into the sump area. A small summer pump typically comes on and discharges about two feet of water from the sump area every evening at around 2300 hours. Four main pumps are available to remove water during storm events. Water from these pumps is discharged into Alamitos Bay.

The storm monitoring equipment is interfaced with all five pumps to determine when each pump is activated. Water depth and pump discharge curves are then used to calculate discharges from this site for use in pacing the sampling equipment.

### 4.2.2 Basin 20: Bouton Creek Monitoring Site

This site collects water from Basin 20 covering 2,259 acres. Basin 20 is 54% residential, 22% institutional, 18% commercial, 3% industrial, and 3% open space (Figure 4.2). This basin is located in the east central portion of the City and is bounded on the north, south, east, and west by Spring Street, 8th Avenue, the Los Cerritos Channel and Redondo Avenue, respectively. The sampling station is located a short way upstream from the point of discharge into Los Cerritos Channel, along side of the Alamitos Maintenance Yard of the Los Angeles County Public Works Department.

**Stormwater Runoff at the Bouton Creek Monitoring Station**

At the sampling station, Bouton Creek is a 35 ft wide, 8.5 ft deep open concrete box channel. The elevation of the channel bed is approximately one inch lower at the side than the center. About a quarter of a mile to the southeast, Bouton Creek flows into Los Cerritos Channel. Based on numerous observations of conductivity at various tides, this site has saltwater influence at tide levels above three feet. The automatic sampling equipment was therefore configured and programmed to measure discharge flow and to obtain flow-composited samples of the freshwater discharge down the creek, avoiding the tidal

contributions by using real-time conductivity sensors. A velocity sensor was mounted on the invert of the box channel near the center of flow. Two conductivity sensors were mounted on the wall of the channel near the bottom and 2 feet above the bottom. A third conductivity sensor and the sample intake were mounted on a floating arm that kept them near the surface.

The velocity sensor at this site was destroyed on two separate occasions this year due to debris present in the Creek. Blocks of broken pavement, concrete and rebar were removed from the creek to prevent further damage.

### 4.2.3 Portions of Basins 18, 19, 27 and 29: Los Cerritos Channel Monitoring Site

The Los Cerritos Channel Monitoring Site receives runoff from all or portions of four different basins. Small portions of the watershed are located outside of the City of Long Beach. This includes roughly 577 acres of the City of Lakewood and 581 acres of the City of Signal Hill.

**Stormwater Runoff at the Los Cerritos Channel Monitoring Station**

The total area of watershed above the sampling site is approximately 7,685 acres. Land use within the watershed consists of 65% residential, 12% commercial, 12% institutional and 5% open space (Figure 4.3).

The stormwater monitoring station was installed in a steel utility box located on the west side of the channel south of Stearns Street. Flow sensors and sampling tubing were installed on the bottom of the large concrete lined channel. Flow rates based upon flow velocity and channel dimensions are used to control the composite sampler, and to calculate total flow at the end of the storm event.

This sampling site is normally above tidewater on Los Cerritos Channel. During extreme tides required for the dry weather surveys, this site can be impacted by backwater conditions.

### 4.2.4 Basin 14: Dominguez Gap Monitoring Site

The sampling station located at the Dominguez Gap Pump Station is intended to monitor Basin 14 that covers 3,374 acres. Land use in this basin is 72% residential, 12% commercial, 8% institutional, 4% industrial, and 4% open space (Figure 4.4). The basin is located in the northwestern portion of Long Beach just east of the Los Angeles River and is bounded on the north, south, east, and west by Artesia Boulevard, Roosevelt Road, the railroad, and the Los Angeles River respectively (City of Long Beach, 2000).

**View of the Dominguez Gap Pump Station during Construction Activities related to Creation of Wetland Habitat in the Infiltration Basin**

The Dominguez Gap Pump Station and adjacent infiltration/detention basin have been undergoing major renovations during the summer of 2006 and through most of the past winter. At the start of the storm season, the sump had been pumped dry to enable removal and replacement of the diesel engine and pumps with new gas engines and pumps. The infiltration/detention basin located adjacent to the pump station was in the process of being cleared of vegetation and regraded when the 2006/2007 storm season started. In November, coffer dams were installed just to the north and south sides of the pump station. These were intended to prevent stormwater from entering the areas of the infiltration basin being prepared as constructed wetlands. Installation of the coffer dams severely constrained the capacity for temporary storage of stormwater and infiltration by reducing the infiltration area to small area in front of the pump station.

**View of Trash Racks from within the Sump of the Dominguez Gap Pump Station**

By the beginning of the 2007/2008 storm season, most of the capacity of the infiltration basis is expected to be available. The downstream coffer dam will be removed and trash booms will be placed on either side of the pump station to contain most trash and debris from the storm drain entering near the pump station. During dry weather periods, water will be diverted from the Los Angeles River at the upper end of the wetlands. Water will then be siphoned across to the other side of the River to another wetland infiltration area. From there it will come back to the Dominguez Gap Pump Station where the summer pump will be discharging at a rate of about five cubic feet per second (cfs) around the clock. When storms are expected, Los Angeles County Public Works will shut down the diversion that directs water from the Los Angeles River into the new Dominguez Gap wetlands.

The stormwater monitoring equipment at this site is located within the Dominguez Gap Pump Station. The automatic sampler utilized a peristaltic pump to collect water from the pump station's sump. The configuration of monitoring equipment was updated two years ago to improve measurement of flow particularly during periods when the basin was being manually pumped down. All five pumps have been individually instrumented to detect when each pump is activated. In the past, equipment constraints prevented instrumentation of the final pump that comes on line during extreme high flows. Although this was not an issue with automatic operations, it became an issue when the basin was manually pumped down since all pumps are normally operated at such times to "exercise" all the equipment.

**Dominguez Gap Pump Station Discharging Stormwater Runoff to the Los Angeles River**

Flow is calculated based upon pump curves and water elevations in the sump as measured with a pressure transducer to determine instantaneous head. Flow from each pump is summed to determine discharge rates at any one point in time. Under normal operation, it is highly unusual for the complement of pumps to be activated.

Due to replacement of the pumps, the software for this site required modification. The new pump curves were obtained from Los Angeles County Public Works. Equations were developed for the new pumps and incorporated into the monitoring software.

## 4.3 Monitoring Station Design and Configuration

Each of the four land use stations monitored in Long Beach is equipped with Kinnetic Laboratories Automatic Sampling System (KLASS). Figure 4.5 illustrates the configuration of a typical KLASS. This system consists of several commercially available components that Kinnetic Laboratories has integrated and programmed into an efficient flow-based stormwater compositing sampler.

The integral components of this system consist of an acoustic Doppler flow meter or a pressure transducer, a datalogger/controller module, cellular or landline telecommunications equipment, a rain gauge, and a peristaltic sampler. The system installed at Bouton Creek also incorporated several conductivity cells for distinguishing tidal flow from fresh water runoff. Pump station sites also incorporate a variety of sensors to monitor individual pump activity.

The equipment was installed with intakes and sensors securely mounted, tubing and wires in conduits, and all above ground instruments protected within a security enclosure. Section 4.2 described how the equipment was placed at each station.

All materials used in the collection of stormwater samples and in contact with the samples meet strict criteria in order to prevent any form of contamination of the sample. These materials allow both inorganic and organic trace toxicant analyses from the same sampler and composite bottle. Only the highest grade of borosilicate glass is suitable for both trace metal and organic analyses from the same composite sample bottle. Sample hoses were Teflon®.

All bottles and hoses were cleaned according to EPA-approved protocols consistent with approved methodology for analysis of stormwater samples (USEPA, 1983). These bottles and hoses were then evaluated through a blanking process to verify that the hoses and composite bottles were contamination-free and appropriately cleaned for analyses of both inorganic and organic constituents.

## 4.4 Field Monitoring Procedures

The following sections provide a summary of the field methods and procedures used to collect and process data for both the wet and dry weather surveys.

### 4.4.1 Wet Weather Monitoring

Stormwater runoff was collected using two primary methods. Composite sampling was conducted to collect water for both chemical analysis and toxicity testing. A few analytes such as bacteria must be sampled using grab sampling methods and thus reflect conditions only at the time of sampling. For the past three years, wet weather monitoring has also included a second study designed to investigate the spatial extent of the stormwater plume in the receiving waters of Alamitos Bay. The following sections provide details of methods used for composite sampling, grab sampling and for the receiving water study in Alamitos Bay.

#### 4.4.1.1 Composite Sample Collection

A priority objective of the storm monitoring was to maximize the percent storm capture of the composite sample, while ensuring that the composite bottle collects enough water to support all the required analyses. This study required volumes of 20 to 30 liters of sample from each of the four land use sites to meet these analytical needs.

All aspects of the sampling events were continuously tracked from an office command and control center (Storm Control) located at our Santa Cruz laboratory. The status of each station was monitored through telecommunication links to each site. Station data were downloaded, and the stations were controlled and reprogrammed remotely. Weather information, including Doppler displays of rainfall for each area being monitored were also available on screen at the Storm Control center. In addition, Storm Control was in contact by cellular phone with the field crews.

When a storm was likely, all stations were made ready to sample. This preparation included entering the correct volume of runoff required for each sample aliquot ("Volume to Sample"), setting the automatic sampler and the data logger to sampling mode, pre-icing the composite sample bottle, and performing a general equipment inspection. A brief physical inspection of the equipment was made if possible to make certain that there were no obvious problems such as broken conduit, a kinked hose, or debris.

Once a storm event ended, the stations were shut down either on site or remotely by Storm Control. The station was left ready for the next storm event in case there was insufficient time for a maintenance visit between storms. Data were retrieved remotely via telecommunications from the data logger on a daily basis throughout the wet weather season.

All water samples were kept chilled (4ºC) and were transferred to the analytical laboratories within holding times. Prior to sample shipping, sub-sampling from the composite container into sample containers was accomplished using protocol cleaned Teflon and silicone sub-sampling hoses and a peristaltic pump. Using a large magnetic stirrer, all composite water was first mixed together thoroughly and then continuously mixed while the sub-sampling took place. All sub-sampling took place at a staging area near Long Beach. Documentation accompanying samples to the laboratories included Chain of Custody forms, and Analysis Request forms (complete with detection limits).

#### 4.4.1.2 Grab Sampling

During each storm event, grab samples for oil and grease, total and fecal coliform, and enterococcus were collected. The timing of grab sampling efforts was often driven by the short holding times for the bacterial analyses. The ability to deliver samples to the microbiological laboratory within the 6-hour holding time was always a major consideration.

Except at the pump stations, all grab samples were taken near the center of flow as possible or at least in an area of sufficient velocity to ensure good mixing. At both the Dominguez Gap and Belmont Pump stations, grabs were taken from the sump. A specially constructed sampling pole was required to obtain samples at most sites. Poles used were fitted with special bottle holders to secure the sampling containers. Care was taken not to overfill the sample containers for some of the containers contained preservative.

#### 4.4.1.3 Alamitos Bay Receiving Water Study

This element of the stormwater monitoring program was initiated during the 2001/2002 annual program review with Regional Board staff. A pilot receiving water program was first conducted during the 2002/2003 season. Since the initial pilot program, receiving water study in Alamitos Bay has been included as a part of the stormwater monitoring program. The primary objectives of the receiving water program are to:

- Define the general vertical and horizontal extent of stormwater in Alamitos Bay, Marine Stadium and Los Cerritos Channel.
- Evaluate toxicity and associated water quality characteristics of the stormwater plume.

Alamitos Bay, located approximately 10 miles southeast of Long Beach Harbor, is a 1 by ¾ mile, multi-use harbor. The opening of the harbor is at the southeast corner. The center of the harbor is occupied by Naples Island, which effectively gives it the structure of a ring. The bay receives freshwater from a variety of sources, the largest being Cerritos Creek, which drains the Long Beach Area and regions further inland. The upper end of Marine Stadium also can receive significant stormwater discharge volumes from Colorado Lagoon.

**The YSI Sonde Deployed to Track the Horizontal Extent of the Plume in Alamitos Bay.**

This program was intended to be conducted once during the early portion of the wet-weather season. The study area included all of Alamitos Bay, Marine Stadium and the Los Cerritos Channel up to the first upstream bridge. Initiation of field sampling is intended to occur 12 to 24 hours following the end of rainfall.

The first task of this field program was to roughly define the horizontal and vertical extent of the stormwater plume. This required rapid characterization of the plume by use of a towed YSI Multiparameter Sonde deployed from a boom off the side of KLI's research vessel, the *D.W. Hood*. For establishing the horizontal extent of the plume, the sonde was towed at a depth of approximately 0.5 feet. Data from the Sonde was recorded on a portable computer. Sonde parameters included time, salinity, temperature, turbidity, pH and dissolved oxygen. A Garmin differential global

positioning system (DGPS) unit was linked to a separate portable computer to record location and time and provide a real-time display of position. The Sonde and DGPS unit were synchronized to the nearest second to ensure concurrent locational data for all water quality data.

Occasional depth profiles were conducted in the plume to determine the depth of freshwater influence. Profiles were made to a depth of 10 feet with near surface data being recorded at six-inch depth intervals. After defining the halocline, recording depth intervals were increased to 1-foot. After establishing the general distribution of stormwater in receiving waters, sites were selected for collection of water samples based upon salinity. Four sites were selected to be representative of four different stormwater dilutions. To the extent practical, sites were intended to be selected from locations within the defined study area where receiving water salinities ranged from approximately 15 to 30 ppt.

The following table summarizes the target ranges of conditions to be sampled in the field. The target ranges were to provide a general framework and strategy for selection of sampling locations. This was intended to provide stormwater concentrations ranging from 12 to 56 percent. As anticipated, the actual ranges varied due to specific field conditions during the survey such as the general extent of the stormwater plume and characteristics of the vertical profiles of the plume.

| Receiving Water Station Designation | Salinity (ppt) | Est. % Stormwater |
|---|---|---|
| RW-1 | 15 | 56 |
| RW-2 | 20 | 41 |
| RW-3 | 25 | 26 |
| RW-4 | 30 | 12 |

Each receiving water sample was subjected to the sea urchin fertilization test. This is the only test that has been found to suggest potential for toxicity in the marine/estuarine receiving waters of Alamitos Bay. These samples were also analyzed for a subset of the analytes required for the stormwater monitoring program. Analytes were selected based upon previous results of toxicity testing and Toxicity Identification Evaluations (TIEs) conducted on the stormwater samples as well as general potential for toxicity. Chemical analyses of receiving water samples included total and dissolved trace metals (Cd, Cu, Ni, Pb and Zn), TSS, ammonia-N, pH, conductivity, and salinity.

The data files from the YSI Sonde containing time and water quality measurements and from the Garmin DGPS containing time and position data were merged by the time field. This combined data was entered into ArcView GIS and maps of surface salinity were generated. These maps provide a synoptic look at surface salinity throughout the bay a few hours after the end of the rainfall.

### 4.4.2 Dry Weather Monitoring

The NPDES Permit calls for two dry weather inspections and sampling events to be carried out during the summer dry season. Inspections at each site included whether water was present and whether this water was flowing or just ponded. When flowing water was present at one of these mass emission sites, then water quality measurements, flow estimates, and water samples were taken along with observations of site conditions. Flowing water was present and all measurements were taken at Bouton Creek, the Belmont Pump Station, and at Los Cerritos Channel. As in previous years, no dry weather discharge was observed at the Dominguez Gap Pump Station. Temperature, conductivity, and pH were measured with a YSI Model 63 Handheld pH, Conductivity, Salinity, and Temperature Meter. Oxygen was measured a YSI Model 58 Dissolved Oxygen Meter.

The water samples were collected at the Los Cerritos Channel Station by use of an automatic peristaltic pump sampler that collected aliquots every half hour for a 24-hour period. For dry weather sampling, intake hoses are extended to reach the low-flow channel.

Dry weather flow into the Belmont Pump Station occurs continually at rates that vary throughout the day. The accumulated flow is discharged via a maintenance pump and usually occurs once a day. The maintenance pump is installed in a well in the floor of the sump. The pump is controlled by a depth switch and a timer. The pump turns on when the depth of the water in the sump is at or above 1.75 feet and turns off when the depth is zero feet, but the timer is intended to restrict the time of operation of the pump to the hours from 10:00 p.m. to 6:00 a.m. PDT. During the dry weather season the pump runs only once each day. It turns on promptly at 10:00 p.m. and runs for 20 to 35 minutes. If the maintenance pump is allowed to operate during the 24 hour dry weather sample collection period, the level of the water in the sump will drop below the level from which the sampler can draw water. Thus, a number of the 30 minute sample aliquots are not collected. The samples at this site are intended to be collected as a grab sample during the period that the maintenance pump was running in order to provide a well mixed sample of the dry weather discharge. Due to malfunctions of the pump control, the pump did not come on during the September, 2006 dry weather event. Problems with the erratic operation of the control unit for the maintenance pump were no longer evident during the May, 2007 event.

For the Bouton Creek Station where tidal influences are present, the method is to collect a composite grab sample over a 30 minute period of low tide in order to isolate sampling to just the freshwater discharge down the creek. This method minimizes the influence of saltwater that slowly drains from the channel and mixes with the dry weather discharge. Additional grab samples for TPH and bacteria are taken just after the time-composited samples. All samples are cooled to 4ºC and transported to the appropriate laboratory for analysis.

## 4.5 Laboratory Analyses

The water quality constituents selected for this program were established based upon the requirements of the City of Long Beach NPDES permit for stormwater discharges as modified through the annual review process. All analyses were conducted at laboratories certified for such analyses by the Department of Health Services or approved by the Executive Officer and in accordance with current EPA guideline procedures or as specified in this Monitoring Program. Analytical methods are based upon approved USEPA methodology. The following sections detail laboratory methods for chemical and biological testing.

### 4.5.1 Analytical Suite and Methods

Conventional, bacteriological, and chemical constituents selected for inclusion in this stormwater quality program are presented in Table 4.2. Analytical method numbers, holding times, and reporting limits are also indicated for each analysis.

### 4.5.2 Laboratory QA/QC

Quality Assurance/Quality Control (QA/QC) activities associated with laboratory analyses are detailed in Appendix A.

The laboratory QA/QC activities provide information needed to assess potential laboratory contamination, analytical precision and accuracy, and representativeness. Analytical quality assurance for this program included the following:

- Employing analytical chemists trained in the procedures to be followed.
- Adherence to documented procedures, USEPA methods and written SOPs.
- Calibration of analytical instruments.
- Use of quality control samples, internal standards, surrogates and SRMs.
- Complete documentation of sample tracking and analysis.

Internal laboratory quality control checks included the use of internal standards, method blanks, matrix spike/spike duplicates, duplicates, laboratory control spikes and Standard Reference Materials (SRMs).

Data validation was performed in accordance with the USEPA Functional Guidelines for Low Level Concentration Organic Data Review (USEPA, 2001), USEPA Functional Guidelines for Inorganic Data Review (USEPA, 2002), and Guidance on the Documentation and Evaluation of Trace Metals Data Collected for the Clean Water Act Compliance Monitoring (USEPA, 1995a).

### 4.5.3 Toxicity Testing Procedures

Upon receipt in the laboratory, stormwater discharge and receiving water samples were stored at 4°C, in the dark until used in toxicity testing. Toxicity testing commenced within 72 hours of sample collection for most samples. The relative toxicity of each discharge sample was evaluated using two chronic test methods: the water flea (*Ceriodaphnia dubia*) reproduction and survival test (freshwater) and the purple sea urchin (*Strongylocentrotus purpuratus*) fertilization test (marine). Each of the methods is recommended by the USEPA for the measurement of effluent and receiving water toxicity. Samples of marine receiving water from Alamitos Bay were tested with the marine species only. Water samples were diluted with laboratory water to produce a concentration series using procedures specific to each test method.

#### 4.5.3.1 Water Flea Reproduction and Survival Test

Toxicity tests using the water flea, *Ceriodaphnia dubia*, were conducted in accordance with methods recommended by USEPA (1994). The test procedure consisted of exposing 10 *C. dubia* neonates (less than 24 hours old) to the samples for six or seven days. One animal was placed in each of 10 individual polystyrene cups containing approximately 20 mL of test solution. The test temperature was 25 ± 1°C and the photoperiod was 16 hours light: 8 hours dark. Daily water changes were accomplished by transferring each individual to a fresh cup of test solution; water quality measurements and observations of survival and reproduction (number of offspring) were made at this time also. Prior to transfer, each cup was inoculated with food (100 µL of a 3:1 mixture of *Selenastrum* culture, density approximately 3.5 x 108 cells/mL and *Ceriodaphnia* chow).

The test organisms were obtained from in-house cultures that were established from broodstock obtained from Aquatic Biosystems (Fort Collins, CO). The laboratory water used for cultures, controls, and preparation of sample dilutions was synthetic moderately hard freshwater, prepared with deionized water and reagent chemicals. Test samples were poured through a 60 µm Nitex screen in order to remove indigenous organisms prior to preparation of the test concentrations. Serial dilutions of the test sample were prepared, resulting in test concentrations of 100, 50, 25, 12, and 6 %.

The quality assurance program for this test consisted of three components. First, a control sample (laboratory water) was included in all tests in order to document the health of the test organisms. Second, a reference toxicant test consisting of a concentration series of potassium chloride (KCl) was conducted with each batch of samples to evaluate test sensitivity and precision. Third, the results were compared to established performance criteria for control survival, reproduction, reference toxicant sensitivity, sample storage, and test conditions. Any deviations from the performance criteria were noted in the laboratory

records and prompted corrective action, ranging from a repeat of the test to adjustment of laboratory equipment.

#### 4.5.3.2 Sea Urchin Fertilization Test

All discharge and receiving water samples of stormwater were also evaluated for toxicity using the purple sea urchin fertilization test (USEPA, 1995b). This test measures toxic effects on sea urchin sperm, which are expressed as a reduction in their ability to fertilize eggs. The test consisted of a 20-minute exposure of sperm to the samples. Eggs were then added and given 20 minutes for fertilization to occur. The eggs were then preserved and examined later with a microscope to assess the percentage of successful fertilization. Toxic effects are expressed as a reduction in fertilization percentage. Purple sea urchins (*Strongylocentrotus purpuratus*) used in the tests were supplied by U.C. Davis – Granite Canyon. The tests were conducted in glass shell vials containing 10 mL of solution at a temperature of 15 ± 1°C. Five replicates were tested at each sample concentration.

All samples were adjusted to a salinity of 33.5 g/kg for the fertilization test. Previous experience has determined that many sea salt mixes are toxic to sea urchin sperm. Therefore, the salinity for the urchin test was adjusted by the addition of hypersaline brine. The brine was prepared by freezing and partially thawing seawater. Since the addition of brine dilutes the sample, the highest stormwater concentration that could be tested for the sperm cell test was 50%. The adjusted samples were diluted with seawater to produce test concentrations of 50, 25, 12, 6, and 3%.

Seawater control (1.0 µm filtered natural seawater from ToxScan's Long Marine Laboratory facility) and brine control samples (50% deionized water and 50% brine) were included in each test series for quality control purposes. Water quality parameters (temperature, dissolved oxygen, pH, ammonia, and salinity) were measured on the test samples to ensure that the experimental conditions were within desired ranges and did not create unintended stress on the test organisms. In addition, a reference toxicant test was included with each stormwater test series in order to document intralaboratory variability. Each reference toxicant test consisted of a concentration series of copper sulfate with four replicates tested per concentration. The median effective concentration ($EC_{50}$) was estimated from the data and compared to control limits based upon the cumulative mean and two standard deviations of recent experiments.

#### 4.5.3.3 Toxicity Identification Evaluations (TIEs)

Phase I TIEs were conducted on selected runoff samples from stations that exhibited substantial ($\geq 3\ TU_a$) toxicity, in order to determine the characteristics of the toxicants present. Substantial toxicity was defined as $\geq 2\ TU_a$ in the case of waterfleas and $\geq 3\ TU_a$ for sea urchins. Each sample was subjected to treatments designed to selectively remove or neutralize classes of compounds (e.g., metals, nonpolar organics) and thus the toxicity that may be associated with them. Treated samples were then tested to determine the change in toxicity using the sea urchin fertilization test.

Prior to evaluation of toxicity changes, an untreated aliquot of sample was tested to confirm persistence of the originally-noted toxicity. If toxicity in this "baseline" sample had decreased to <2 TU, further toxicity tests were not performed and the TIE was abandoned.

Four or five treatments were applied to each sample. These treatments were: particle removal, trace metal chelation, nonpolar organic extraction, organophosphate (OP) deactivation (except urchins) and chemical reduction. With the exception of the organics extraction, each treatment was applied independently on a salinity-adjusted sample. A control sample (lab dilution water) was included with each type of treatment to verify that the manipulation itself was not causing toxicity. If the TIE was not conducted concurrently with the initial testing of a sample, then a reduced set of concentrations of untreated sample was tested at

the time of the TIE to determine the baseline toxicity and control for changes in toxicity due to sample storage.

Ethylene diamine tetraacetic acid (EDTA), a chelator of metals, was added to a concentration of 60 mg/L to the marine test samples. EDTA additions to the *Ceriodaphnia* samples were based upon sample hardness (USEPA, 1991). Sodium thiosulfate (STS), a treatment that reduces oxidants such as chlorine and also decreases the toxicity of some metals, was added to a concentration of 50 mg/L to separate portions of each marine sample. STS additions to the *Ceriodaphnia* samples were at 500, 250 and 125 mg/L. The EDTA and sodium thiosulfate treatments were given at least one hour to interact with the sample prior to the start of toxicity testing. Pipernyl butoxide, which inhibits activation of OP pesticides, was added at three concentrations (125, 250 and 500 mg/L) for *Ceriodaphnia*.

Samples were centrifuged for 30 minutes at a centrifugal force of 3000G to remove particle-borne contaminants and tested for toxicity. A portion of the centrifuged sample was also passed through a 360 mg Sep-Pak™ C-18 solid phase extraction column in order to remove nonpolar organic compounds. C-18 columns have also been found to remove some metals from aqueous solutions.

#### 4.5.3.4 Statistical Analysis

The toxicity test results were normalized to the control response in order to facilitate comparisons of toxicity between experiments. Normalization was accomplished by expressing the test responses as a percentage of the control value. Four statistical parameters (NOEC, LOEC, median effect, and $TU_c$) were calculated to describe the magnitude of stormwater toxicity. The NOEC (highest test concentration not producing a statistically significant reduction in fertilization or survival) and LOEC (lowest test concentration producing a statistically significant reduction in fertilization or survival) were calculated by comparing the response at each concentration to the dilution water control. Various statistical tests were used to make this comparison, depending upon the characteristics of the data. Water flea survival and reproduction data were usually tested against the control using Fisher's Exact and Steel's Many-One Rank test, respectively. Sea urchin fertilization data were evaluated for significant differences using Dunnett's multiple comparison test, provided that the data met criteria for homogeneity of variance and normal distribution. Data that did not meet these criteria were analyzed by the non-parametric Steel's Many-One Rank or Wilcoxon's tests.

Measures of median effect for each test were calculated as the $LC_{50}$ (concentration producing a 50% reduction in survival) for water flea survival, the $EC_{50}$ (concentration effective on 50% of eggs) for sea urchin fertilization, or the $IC_{50}$ (concentration inhibitory to 50% of individuals) for water flea reproduction and $IC_{25}$. The $LC_{50}$ or $EC_{50}$ was calculated using either probit analysis or the trimmed Spearman-Karber method. The $IC_{25}$ and $IC_{50}$ were calculated using linear interpolation analysis. All procedures for calculation of median effects followed USEPA guidelines.

The toxicity results were also expressed as chronic Toxic Units ($TU_c$). This statistic was calculated as: 100/NOEC. Increased values of toxic units indicate relatively greater toxicity, whereas greater toxicity for the NOEC, LOEC, and median effect statistics is indicated by a lower value.

Comparisons of chemical or physical parameters with toxicity results were made using the non-parametric Spearman rank order correlation.

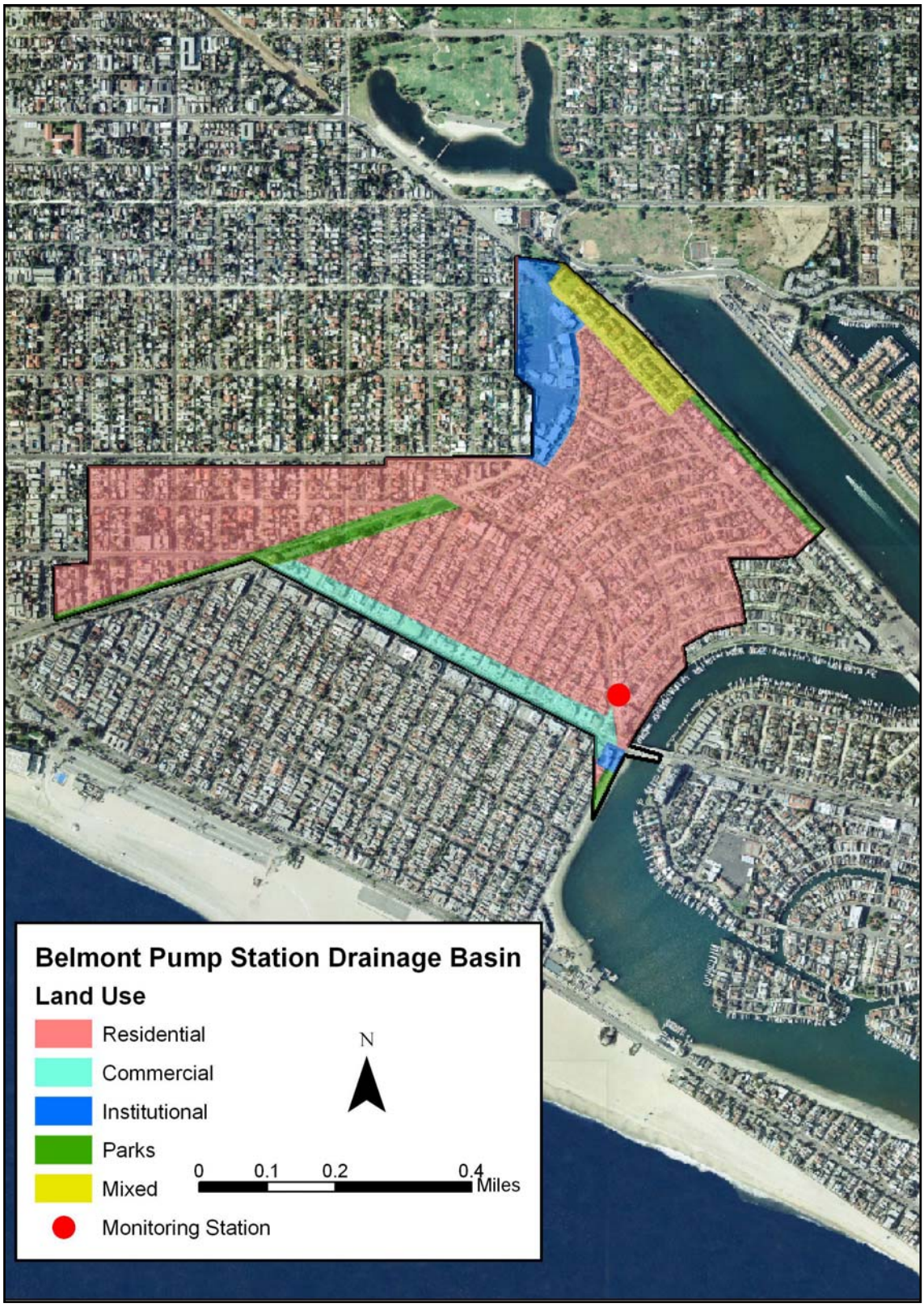



**Figure 4.1 Land Use of Drainage Basin #23 which Drains to the Belmont Pump Station Mass Emission Site.** (Source: City of Long Beach, Department of Technology Services, last updated 2000)

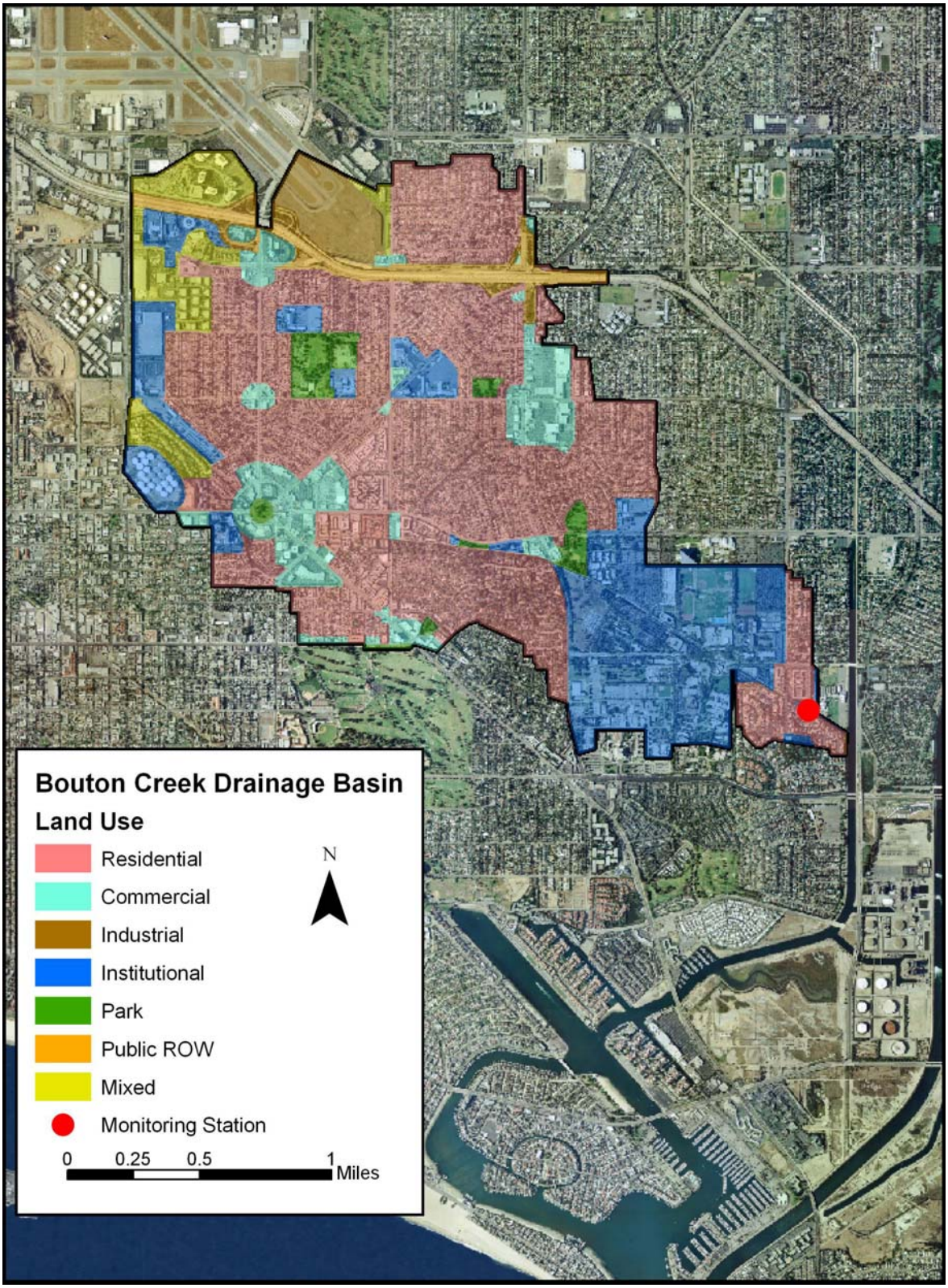



**Figure 4.2 Land Use of Drainage Basin #20 which drains to the Bouton Creek Mass Emission Site.** (Source: City of Long Beach, Department of Technology Services, last updated 2000).

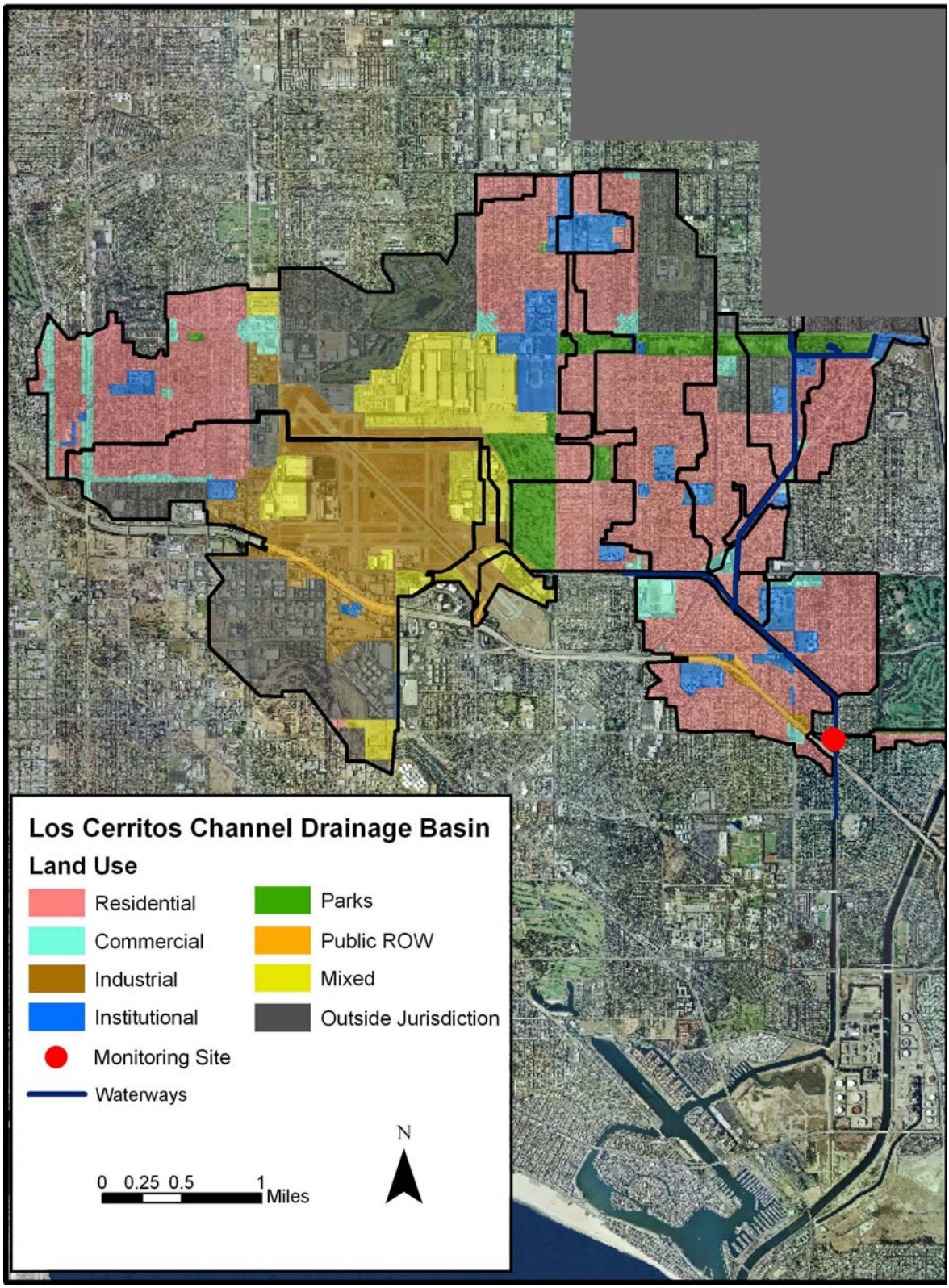



**Figure 4.3 Land Use of Drainage Basins which Drain to the Los Cerritos Channel Monitoring Site.** (Source: City of Long Beach, Department of Technology Services, last update 2000).

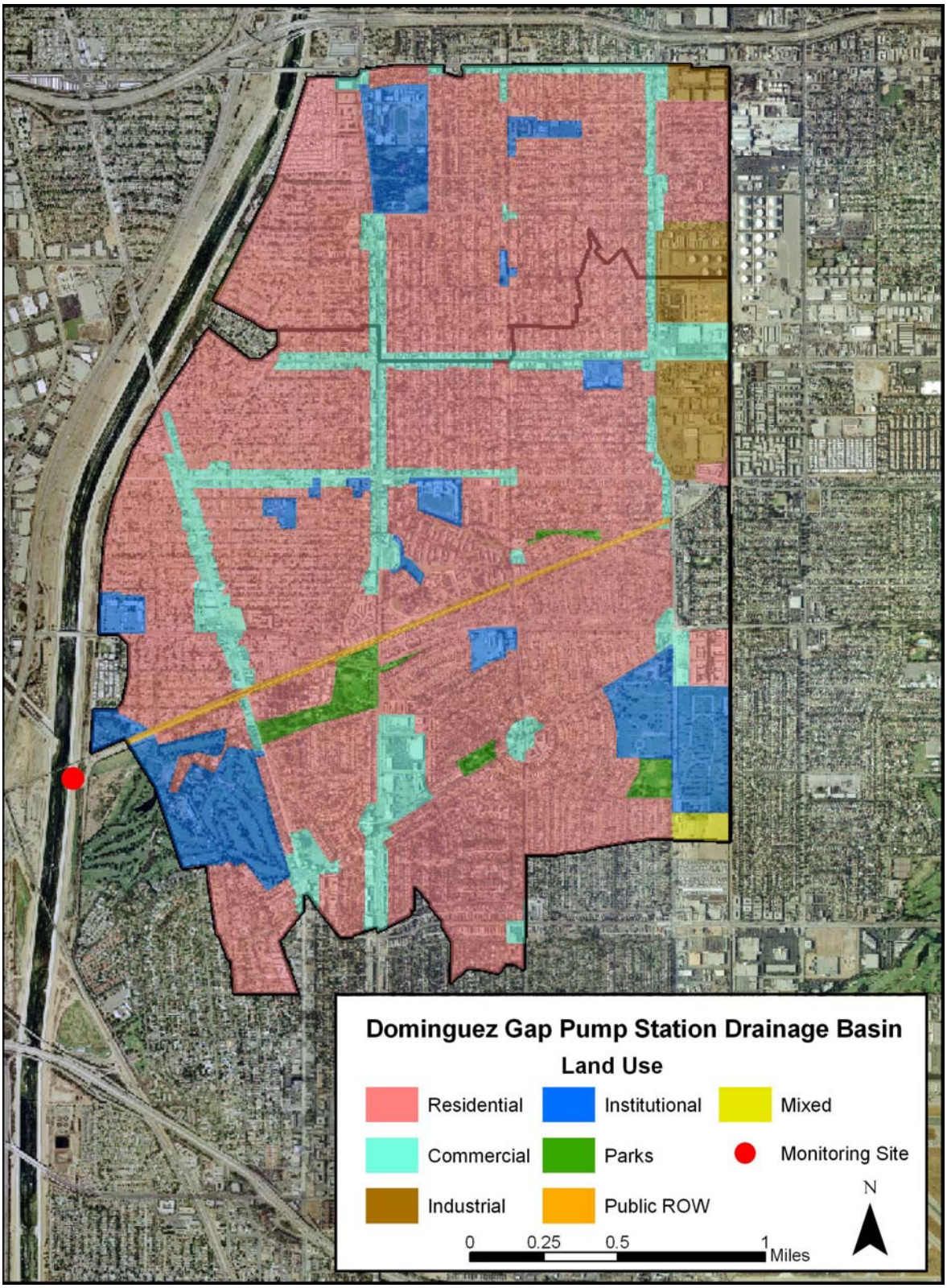



**Figure 4.4 Land Use of Drainage Basin #14 which Drains to the Dominguez Gap Mass Emission Site.** (Source: City of Long Beach Department of Technology Services, last update 2000)**.**

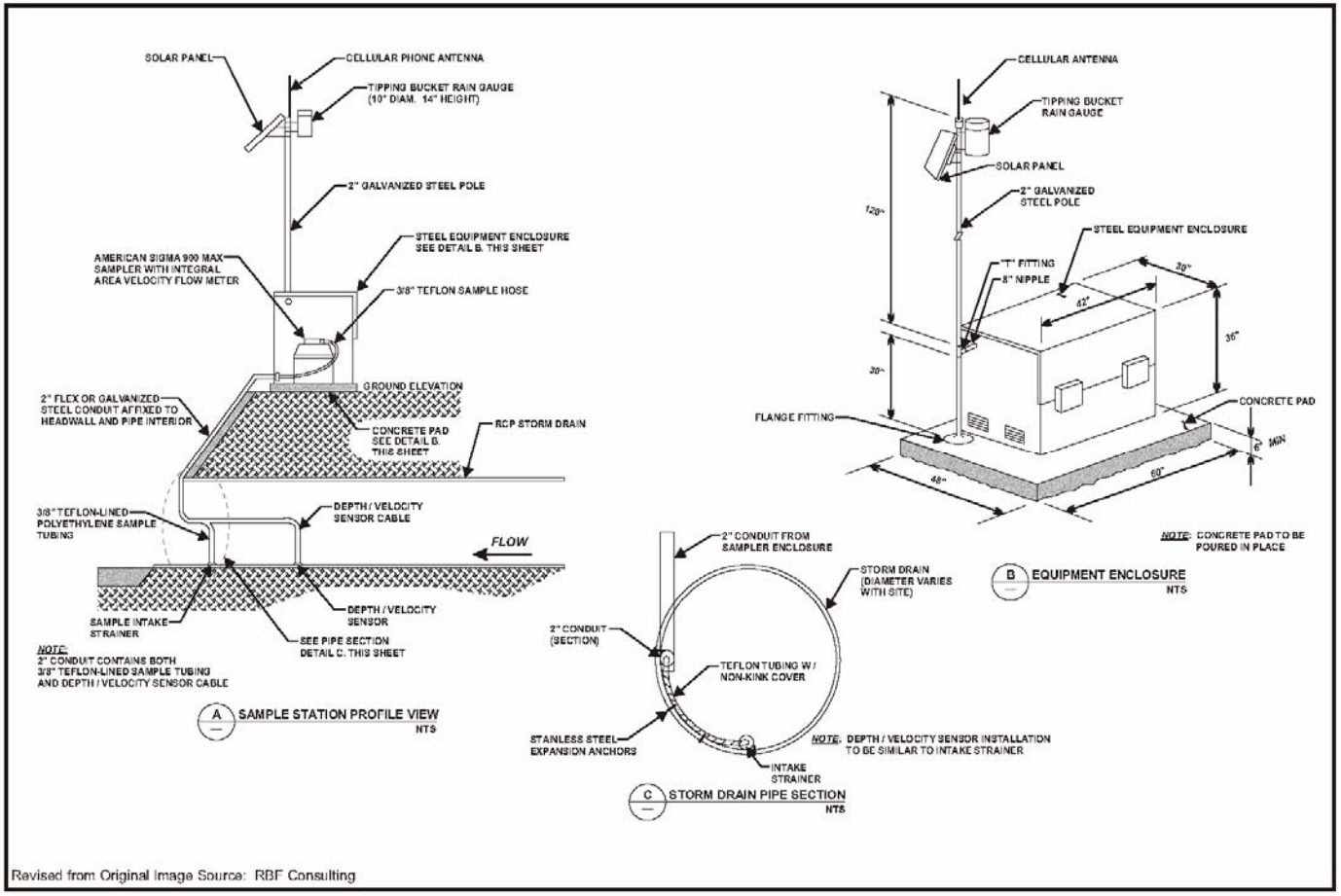



**Figure 4.5 Typical KLASS Stormwater Monitoring Station.**

**Table 4.1 Location Coordinates of Monitoring Stations for the City of Long Beach Stormwater Monitoring Program.**

| Station Name | State Plane Coordinates: Zone 5 | | North American Datum (NAD) 83 | |
|---|---|---|---|---|
| | Northing (ft) | Easting (ft) | Latitude | Longitude |
| Belmont Pump | 1734834.9 | 6522091.2 | 33° 45’ 36.6”N | 118° 07’ 48.7”W |
| Bouton Creek | 1741960.5 | 6529305.2 | 33° 46’ 44.3”N | 118° 06’ 23.4”W |
| Los Cerritos Channel | 1747935.9 | 6530153.2 | 33° 47’ 43.3”N | 118° 06’ 13.4”W |
| Dominguez Gap Pump | 1764025.0 | 6500042.5 | 33° 50’ 22.1”N | 118° 12’ 10.5”W |

**Table 4.2 Analytical Methods, Holding Times, and Reporting Limits.**

| Analyte and Reporting Unit | EPA Method Number | Holding Time | Target Reporting Limit or ML |
|---|---|---|---|
| **CONVENTIONAL PARAMETERS** | | | |
| Oil and Grease (mg/L) | 1664 | 28 days | 5.0 |
| Total Phenols (mg/L) | 420.1 | 28 days | 0.1 |
| pH (units) | 150.1 | ASAP | 0 – 14 |
| Orthophosphate-P (mg/L) | 365.3 | 48 hours | 0.01 |
| Total Phosphorus (mg/L) | 365.3 | 28 days | 0.05 |
| Turbidity (NTU) | 180.1 | 48 hours | 1.0 |
| Total Suspended Solids (mg/L) | 160.2 | 7 days | 1.0 |
| Total Dissolved Solids (mg/L) | 160.1 | 7 days | 1.0 |
| Volatile Suspended Solids (mg/L) | 160.4 | 7 days | 1.0 |
| Total Organic Carbon (mg/L) | 415.1 | 28 days | 1.0 |
| Biochemical Oxygen Demand (mg/L) | 405.1 | 48 hours | 4.0 |
| Chemical Oxygen Demand (mg/L) | 410.1 | 28 days | 4.0 |
| Total Ammonia-Nitrogen (mg/L) | 350.2 | 28 days | 0.1 |
| Total Kjeldahl Nitrogen (mg/L) | 351.3 | 28 days | 0.1 |
| Nitrite Nitrogen (mg/L) | 300.0 | 48 hours | 0.1 |
| Nitrate Nitrogen (mg/L) | 300.0 | 48 hours | 0.1 |
| Alkalinity, as CaCO3 (mg/L) | 310.1 | 48 hours | 5.0 |
| Specific Conductance (umhos/cm) | 120.1 | 48 hours | 1.0 |
| Total Hardness (mg/L) | 130.2 | 180 days | 1.0 |
| MBAS (mg/L) | 425.1 | 48 hours | 0.02 |
| Chloride (mg/L) | 300.0 | 48 hours | 1.0 |
| Fluoride (mg/L) | 300.0 | 48 hours | 0.1 |
| **BACTERIA (MPN/100ml)** | | | |
| Total Coliform | SM 9221B | 6 hours | <20 |
| Fecal Coliform | SM 9221B | 6 hours | <20 |
| Enterococcus | SM 9230C | 6 hours | <20 |
| **TOTAL AND DISSOLVED METALS (µg/L)[1]** | | | |
| Aluminum | 200.8 | 180 days | 100 |
| Arsenic | 200.8 | 180 days | 0.5 |
| Cadmium | 200.8 | 180 days | 0.25 |
| Chromium | 200.8 | 180 days | 0.5 |
| Copper | 200.8 | 180 days | 0.5 |
| Iron | 236.1 | 180 days | 25 |
| Lead | 200.8 | 180 days | 0.5 |
| Nickel | 200.8 | 180 days | 1.0 |
| Selenium | 200.8 | 180 days | 1.0 |
| Silver | 200.8 | 180 days | 0.25 |
| Zinc | 200.8 | 180 days | 1.0 |

1. Samples to be analyzed for dissolved metals are to be filtered within 48 hours.

**Table 4.2 Analytical Methods, Holding Times, and Reporting Limits. (continued)**

| Analyte and Reporting Unit | EPA Method Number | Holding Time | Target Reporting Limit |
|---|---|---|---|
| **CHLORINATED PESTICIDES (µg/L)** | | | |
| Aldrin | 8081A | 7 days | 0.005 |
| alpha-BHC | 8081A | 7 days | 0.01 |
| beta-BHC | 8081A | 7 days | 0.005 |
| delta-BHC | 8081A | 7 days | 0.005 |
| gamma-BHC (lindane) | 8081A | 7 days | 0.02 |
| alpha-Chlordane | 8081A | 7 days | 0.1 |
| gamma-Chlordane | 8081A | 7 days | 0.1 |
| 4,4'-DDD | 8081A | 7 days | 0.05 |
| 4,4'-DDE | 8081A | 7 days | 0.05 |
| 4,4'-DDT | 8081A | 7 days | 0.01 |
| Dieldrin | 8081A | 7 days | 0.01 |
| Endosulfan I | 8081A | 7 days | 0.02 |
| Endosulfan II | 8081A | 7 days | 0.01 |
| Endosulfan sulfate | 8081A | 7 days | 0.05 |
| Endrin | 8081A | 7 days | 0.01 |
| Endrin Aldehyde | 8081A | 7 days | 0.01 |
| Heptachlor | 8081A | 7 days | 0.01 |
| Heptachlor Epoxide | 8081A | 7 days | 0.01 |
| Toxaphene | 8081A | 7 days | 0.5 |
| **PCBs (µg/L)** | | | |
| Aroclor-1016 | 8081A | 7 days | 0.5 |
| Aroclor-1221 | 8081A | 7 days | 0.5 |
| Aroclor-1232 | 8081A | 7 days | 0.5 |
| Aroclor-1242 | 8081A | 7 days | 0.5 |
| Aroclor-1248 | 8081A | 7 days | 0.5 |
| Aroclor-1254 | 8081A | 7 days | 0.5 |
| Aroclor-1260 | 8081A | 7 days | 0.5 |
| Total PCBs | 8081A | 7 days | 0.5 |
| **ORGANOPHOSPHATE PESTICIDES (µg/L)** | | | |
| Diazinon | 8141A | 7 days | 0.01 |
| Chlorpyrifos (Dursban) | 8141A | 7 days | 0.05 |
| Malathion | 8141A | 7 days | 1.0 |
| Prometryn | 8141A | 7 days | 1.0 |
| Atrazine | 8141A | 7 days | 1.0 |
| Simazine | 8141A | 7 days | 1.0 |
| Cyanazine | 8141A | 7 days | 1.0 |

# 5.0 RAINFALL AND HYDROLOGY

The four Long Beach stormwater runoff monitoring stations were fully operational at the end of September 2006 prior to the start of the 2006/2007 wet weather season. Precipitation and discharge were continuously monitored throughout the season.

Although an attempt was made to collect samples for a complete suite of water quality analytes during the first significant rains of the season, this was not realized due to very lower than anticipated rainfall and runoff. Therefore, the first monitored event, October 13 and 14, 2006, resulted in the analysis of total suspended solids (TSS) at two stations, Bouton Creek and Los Cerritos Channel, since insufficient sample volume existed to perform the remaining analyses. There was no discharge from the Belmont and Dominguez Gap Pump Stations. The subsequent event occurred on January 30, 2007. This event resulted in low discharge at both the Belmont Pump Station and Bouton Creek monitoring stations and no discharge at either Los Cerritos Channel or the Dominguez Gap Pump Station. This low discharge event also did not allow for enough volume for the full suite of analytes, so TSS was analyzed only for this event. The first fully monitored storm at the Belmont Pump Station, Los Cerritos Channel and Bouton Creek monitoring stations occurred on February 11 and 12, 2007. Although this event may not represent the "first flush" of the season, the events prior to this one consisted of low rainfall and relatively low amounts of runoff. The next event (February 19-20, 2007) also resulted in TSS analysis only for the same three monitoring stations. Discharge did not occur at the Dominguez Gap Pump Station until a 0.65-inch rain event that began on April 20, 2007. This was the only event where all stations were successfully sampled. Alamitos Bay receiving waters were successfully sampled during the April 20$^{th}$ event as well.

## 5.1 Precipitation during the 2006/2007 Wet Weather Season

The 2005/2006 season saw below normal precipitation, returning Southern California back to drought conditions. This carried over to the current 2006/2007 season in which seasonal rainfall was among the lowest ever recorded for Southern California. Normal precipitation for October through April at the Long Beach Airport is 12.27 inches. This season, a total of 2.38 inches of rainfall was recorded at the airport during the same period (Figure 5.1). This resulted in a staggering 9.89 inch deficit for the season or 19% of normal.

A direct comparison of daily rainfall measured at each site during the 2005/2006 and 2006/2007 wet weather seasons (Tables 5.1 through 5.3) clearly illustrates the large differences in rainfall over the past two seasons during both drought years. Large differences are evident in terms of the number of days of precipitation, the daily precipitation totals, and monthly precipitation totals.

Rainfall was relatively uniform at all four of the monitoring stations. Belmont Pump Station had a season total of 2.74 inches. Los Cerritos Channel had a season total of 2.54 inches. Although the Bouton Creek data has a reasonable season total, a close review of the data provided evidence that the screen on the rain gauge was slightly clogged throughout the season as the rain gauge has steady, incremental increases not realistic of true rainfall. Field visits to the site indicated that spiders had infested the equipment. The fact that the slow, steady rise is unlikely is also shown in rainfall data from two nearby sites, Los Cerritos Channel and the Belmont Pump Station. Therefore with respect to the hydrographs, Los Cerritos Channel data will be used in place of the Bouton Creek rain data. The cumulative and monthly graphs will also use the Los Cerritos Channel rainfall data. The Dominguez Gap Pump Station rain gauge suffered from malfunction during the early part of the season. Rainfall data from the Los Angeles County Department of Public Works LA River at West Wardlow Road rain gauge station was substituted for the time period of October 1, 2006 through February 13, 2007. Station data for the remainder of the season was valid. The season total for the Dominguez Gap Pump Station was 2.0 inches (Figure 5.1).

### 5.1.1 Monthly Precipitation

Below normal precipitation was recorded for most months during the 2006/2007 wet weather season (Figure 5.2). Similar to the 2005/2006 season, the monthly totals for all station were generally below normal rainfall totals. However, the 2006/2007 season totals are significantly less than both the normal totals as well as last year's totals (Tables 5.1 through 5.3). Only October and April had relatively normal precipitation. Below normal precipitation was especially evident in November, January and March, which had less than 20% of normal.

### 5.1.2 Precipitation during Monitored Events

Precipitation during each storm event has been characterized by total rainfall, duration of rainfall, maximum intensity, days since last rainfall, and the magnitude of the event immediately preceding the monitored storm event (antecedent rainfall). Precipitation characteristics for each monitored event are summarized in Table 5.4. Cumulative descriptive statistics between all monitored events, including TSS events, for each monitoring station are presented in Table 5.5. Cumulative rainfall and intensity are summarized graphically for each monitored event at each station in Figures 5.3 through 5.16.

For the 2006/2007 wet weather season, rainfall during all monitored events varied between 0.12 and 0.46 inches at the Belmont Pump Station, 0.12 and 0.38 inches at Los Cerritos Channel/Bouton Creek, and only one event totaling 0.65 inches at the Dominguez Gap Pump Station.

The mean rainfall total for all monitored events during the 2006/2007 wet weather station ranged from 0.24 inches at the Belmont Pump Station to 0.65 inches at the Dominguez Gap Pump Station. This is roughly half the mean rainfall totals for the 2005/2006 monitored events.

Mean maximum rainfall intensities among monitored events (based on five minutes of data) ranged from 0.42 inches per hour at the Belmont Pump Station to 0.84 inches per hour at the Dominguez Gap Pump Station, although there was only the single event at that station, skewing the statistics to some degree. Like mean total rainfall, mean maximum rainfall intensities during monitored events were generally less than those that occurred during the 2005/2006 monitored events. Rainfall intensities briefly peaked at 1.32 inches per hour at the Los Cerritos Channel during the October 13 through 14, 2006 event.

All storm events were spaced by weeks of no rainfall. Overall, the mean period of dry conditions prior to monitored events ranged from 26.14 days at the Belmont Pump Station to 67.9 days at the Dominguez Gap Pump Station. With very little rain in the whole month of March, the period prior to the event starting on April 20, 2007 was the driest for a fully monitored event.

## 5.2 Stormwater Runoff during Monitored Events

In order to properly estimate Event Mean Concentrations (EMCs) and constituent loadings, monitoring was designed to quantify rainfall events in their entirety and the majority of runoff created by those events. Table 5.6 summarizes flow characteristics among monitored events at each station including the duration of discharge/flow, total discharge volume, and peak discharge/flow. Table 5.5 provides descriptive statistics for all monitored events during the 2006/2007 season. This information complements the calculated EMCs for each monitored analyte at these sites. Figures 5.3 through 5.16 graphically depict flow during each monitored event at each station in response to rainfall. These figures also show how the aliquoting of each composite sample was conducted.

Flow duration or the period of discharge varied between stations and events. Flow duration was typically greatest at Bouton Creek due to tidal effects and Los Cerritos Channel due to the large drainage area. During incoming tides at Bouton Creek, low flows are backed up and held back by the tide. As the tide recedes, stormwater is detected at the station using the conductivity sensors and sampling continues. In contrast, the period of discharge at the Dominguez Gap Pump Station is usually the smallest since most of the runoff from this drainage must fill a reservoir prior to discharge.

The duration of discharge reported in Tables 5.5 and 5.6 for the Belmont and Dominguez Gap pump stations are often overestimated because of the on and off cycling of the pumps. The discharge durations reported in these tables represent the period between the first time a pump came on to the time all pumps became silent. One should refer to the hydrographs developed for the pump stations for a better estimate of the duration of discharge.

For the 2006/2007 wet weather season, mean total flow or discharge for monitored events ranged from 64,250 cf at the Belmont Pump Station to 3,316,000 cf at Los Cerritos Channel. These volumes were less than half the mean total flow volumes recorded the previous wet weather season

The percent storm captures (percentage of the total storm event volume effectively represented by the flow-weighted composite sample) were acceptable (>90%) in most cases. Loss of percent capture usually occurred toward the end of an event when flow levels were lower than the level of the sample intake or when time lapsed after a composite bottle was filled.

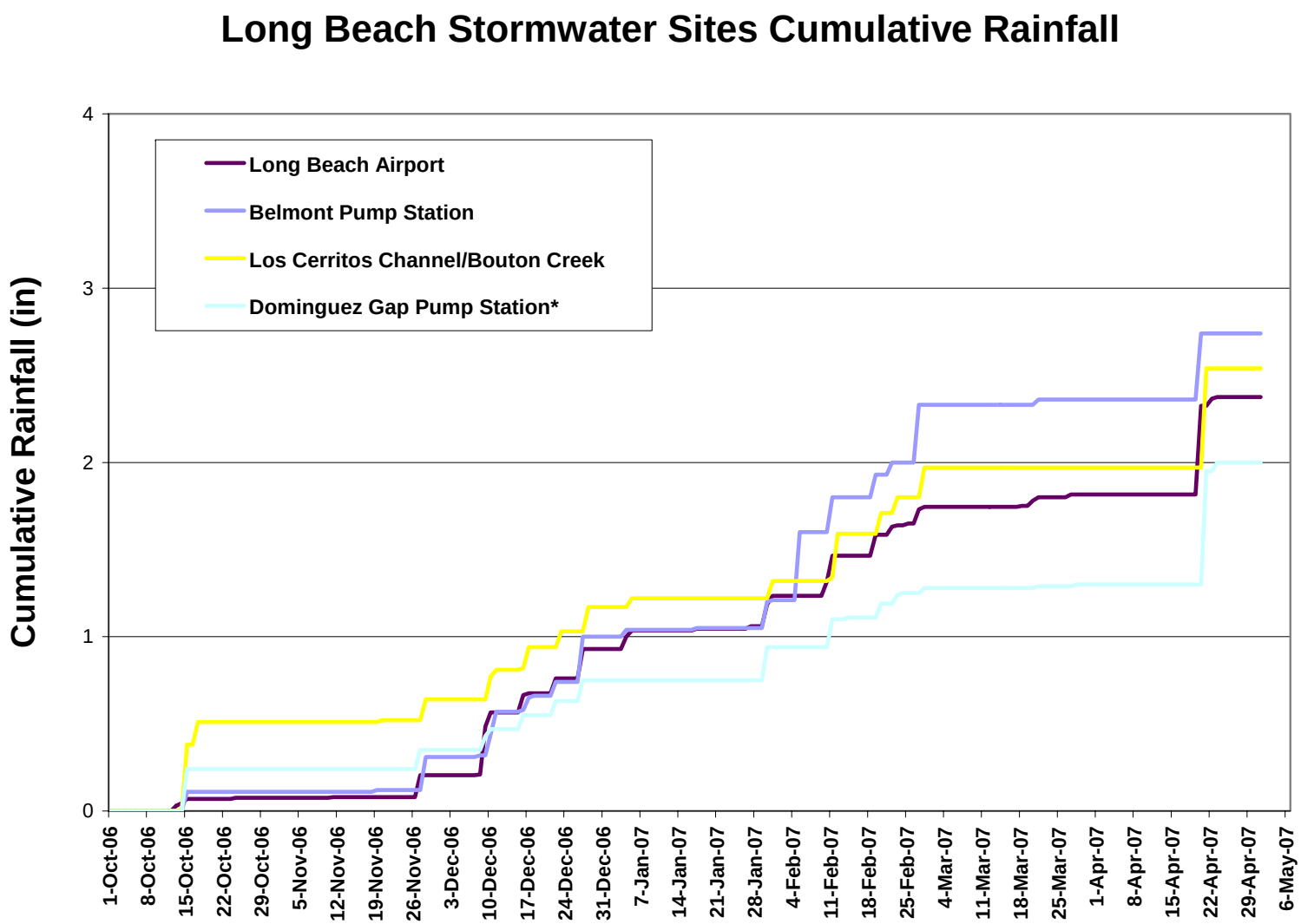
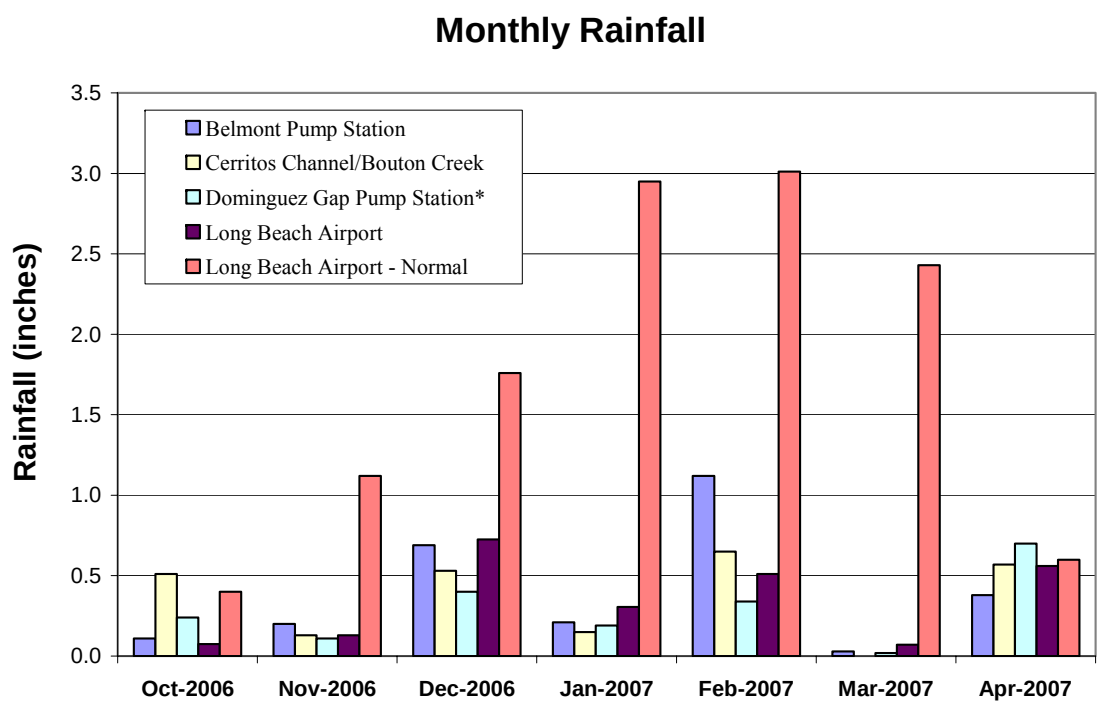



**Figure 5. 1** **Cumulative Rainfall for the 2006/2007 Wet Weather Season** (*Rainfall data from the Los Angeles County Department of Public Works LA River at West Wardlow Road rain gauge station substituted for October 1, 2006 through February 13, 2007 due to equipment malfunction)




| | Oct-06 | Nov-06 | Dec-06 | Jan-07 | Feb-07 | Mar-07 | Apr-07 |
|---|---|---|---|---|---|---|---|
| Belmont Pump Station | 0.11 | 0.20 | 0.69 | 0.21 | 1.12 | 0.03 | 0.38 |
| Cerritos Channel/Bouton Creek | 0.51 | 0.13 | 0.53 | 0.15 | 0.65 | 0.00 | 0.57 |
| Dominguez Gap Pump Station* | 0.24 | 0.11 | 0.40 | 0.19 | 0.34 | 0.02 | 0.70 |
| Long Beach Airport | 0.08 | 0.13 | 0.73 | 0.31 | 0.51 | 0.07 | 0.56 |
| Long Beach Airport - Normal | 0.40 | 1.12 | 1.76 | 2.95 | 3.01 | 2.43 | 0.60 |

**Figure 5.2** **Monthly Rainfall Totals for the 2006/2007 Wet Weather Season and Normal Rainfall at Long Beach Daugherty Air Field.** (*Rainfall data from the Los Angeles County Department of Public Works LA River at West Wardlow Road rain gauge station substituted for October 1, 2006 through February 13, 2007 due to equipment malfunction)

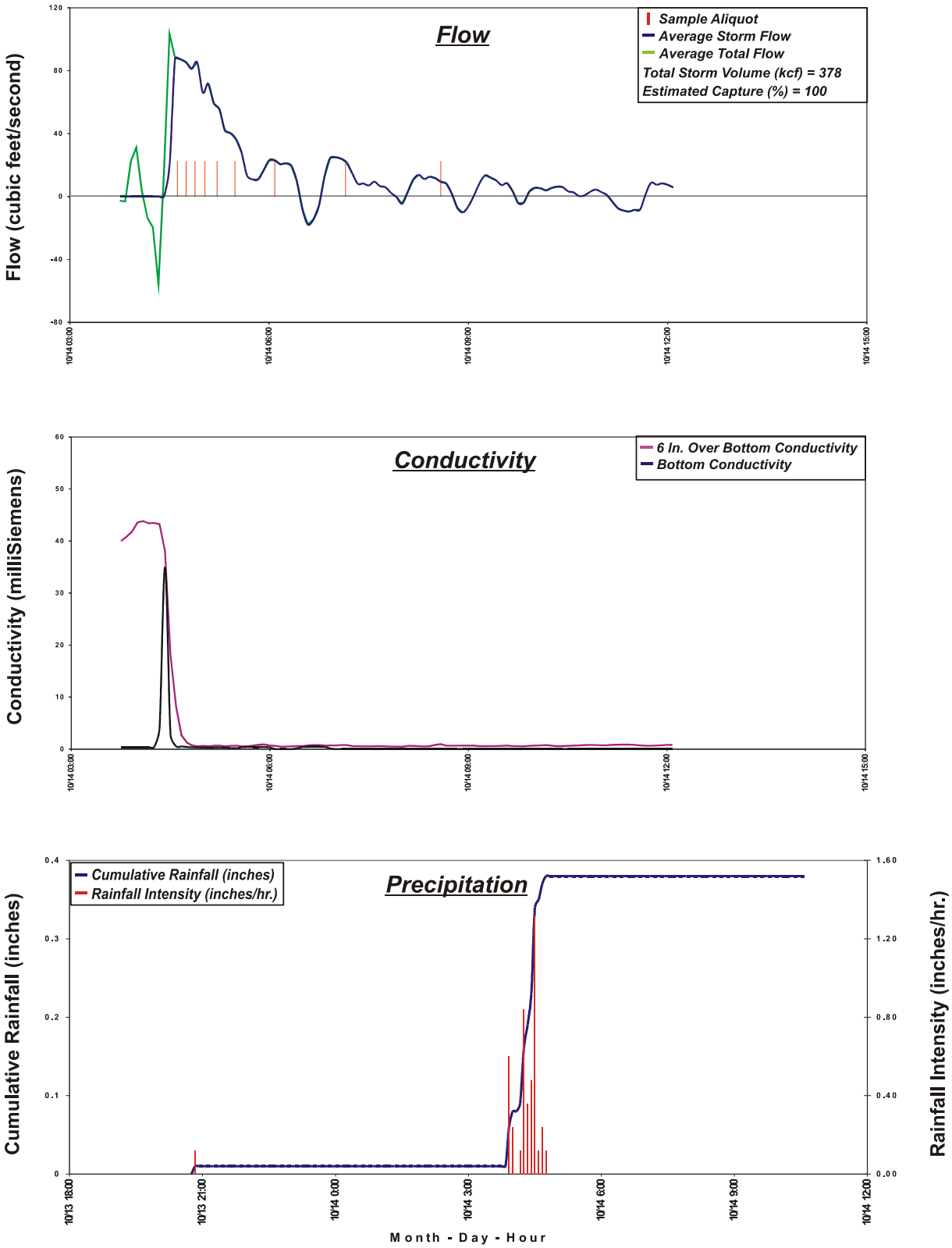



**Figure 5.3** **Bouton Creek – Event 1 (October 14, 2006 – Global Event 1).**

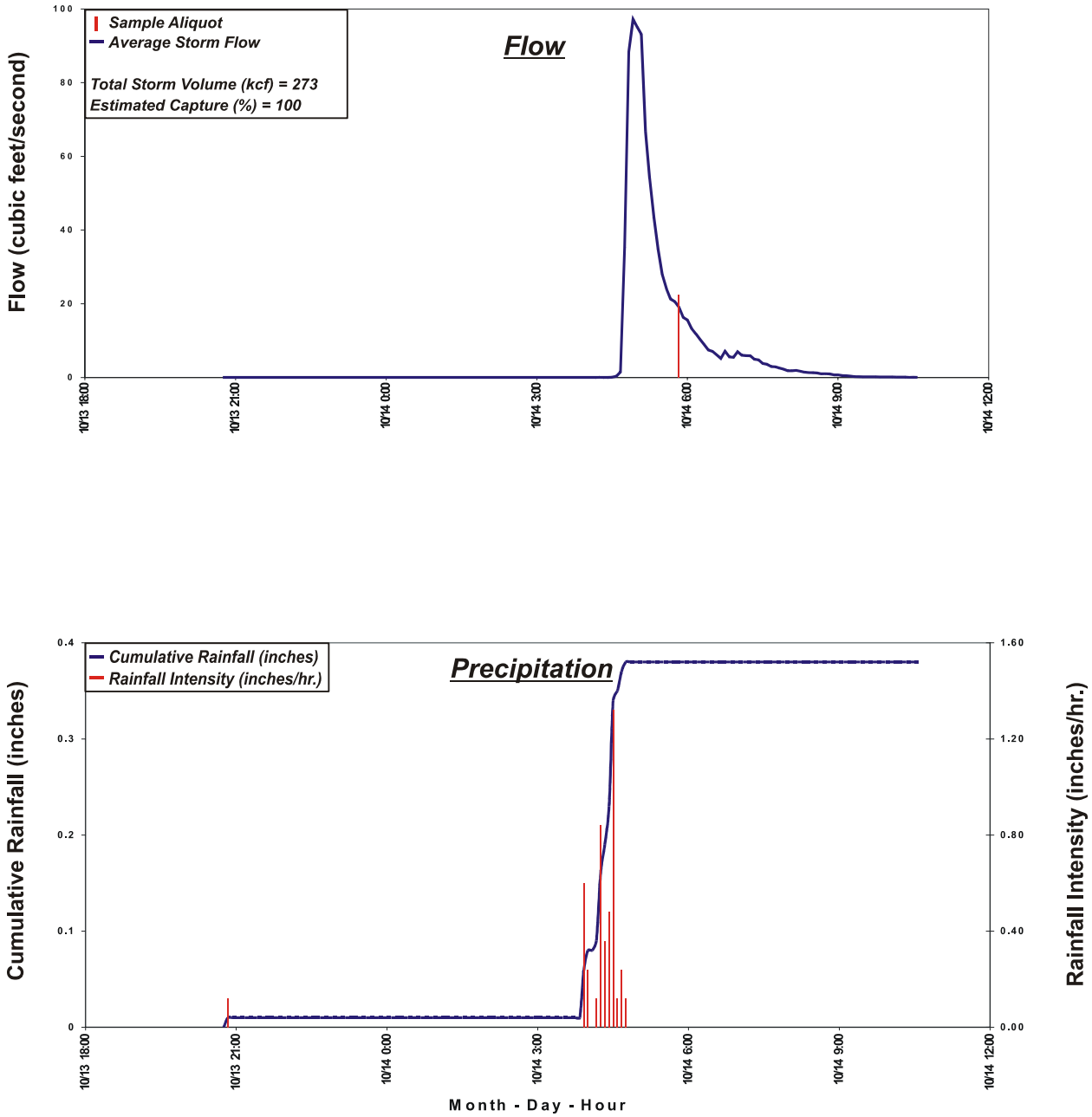



**Figure 5.4** **Los Cerritos Channel – Event 1 (October 14, 2006 – Global Event 1).**

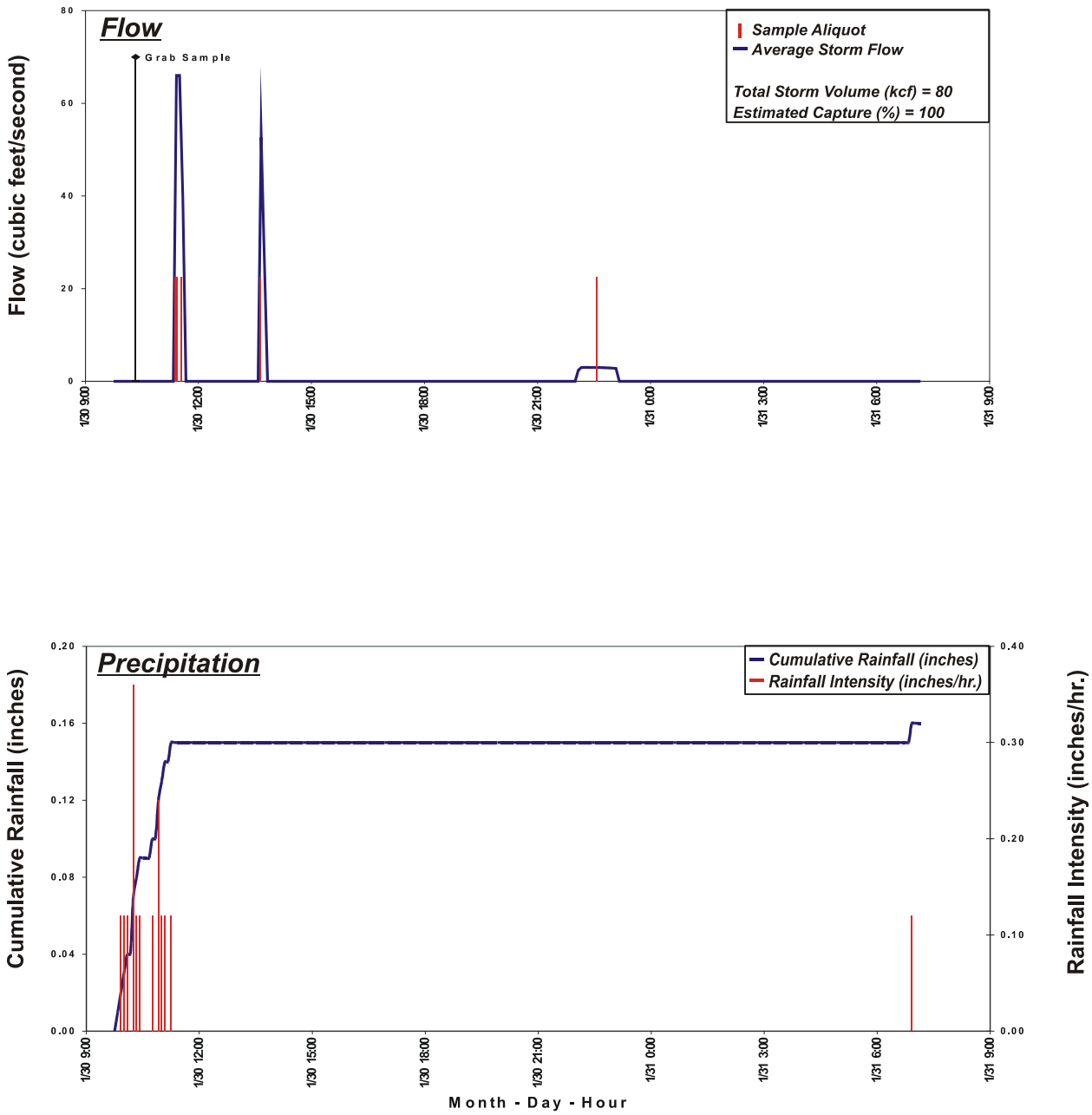



**Figure 5.5** **Belmont Pump Station – Event 1 (January 1, 2007 – Global Event 2).**

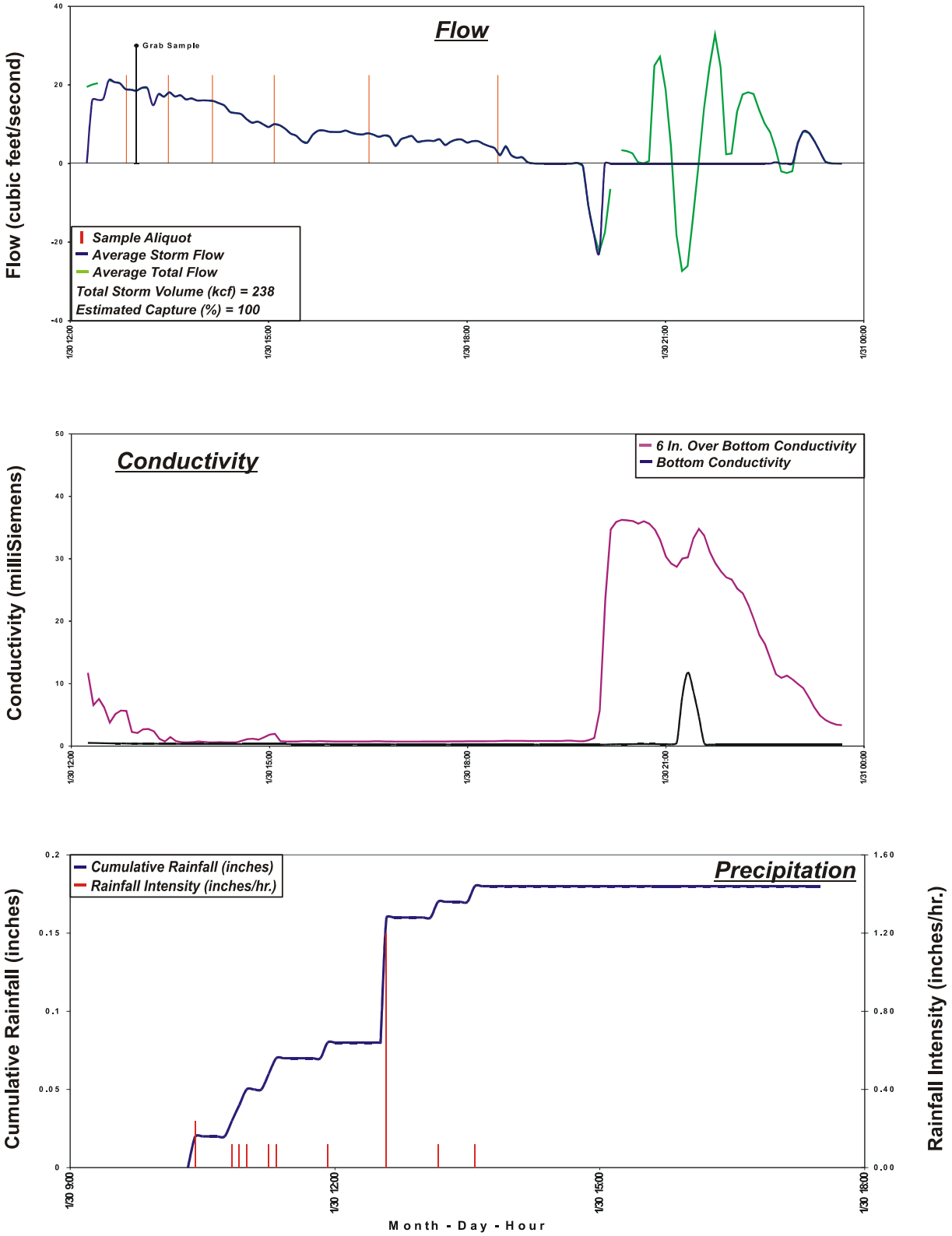



**Figure 5.6** **Bouton Creek – Event 2 (January 1, 2007 – Global Event 2).**

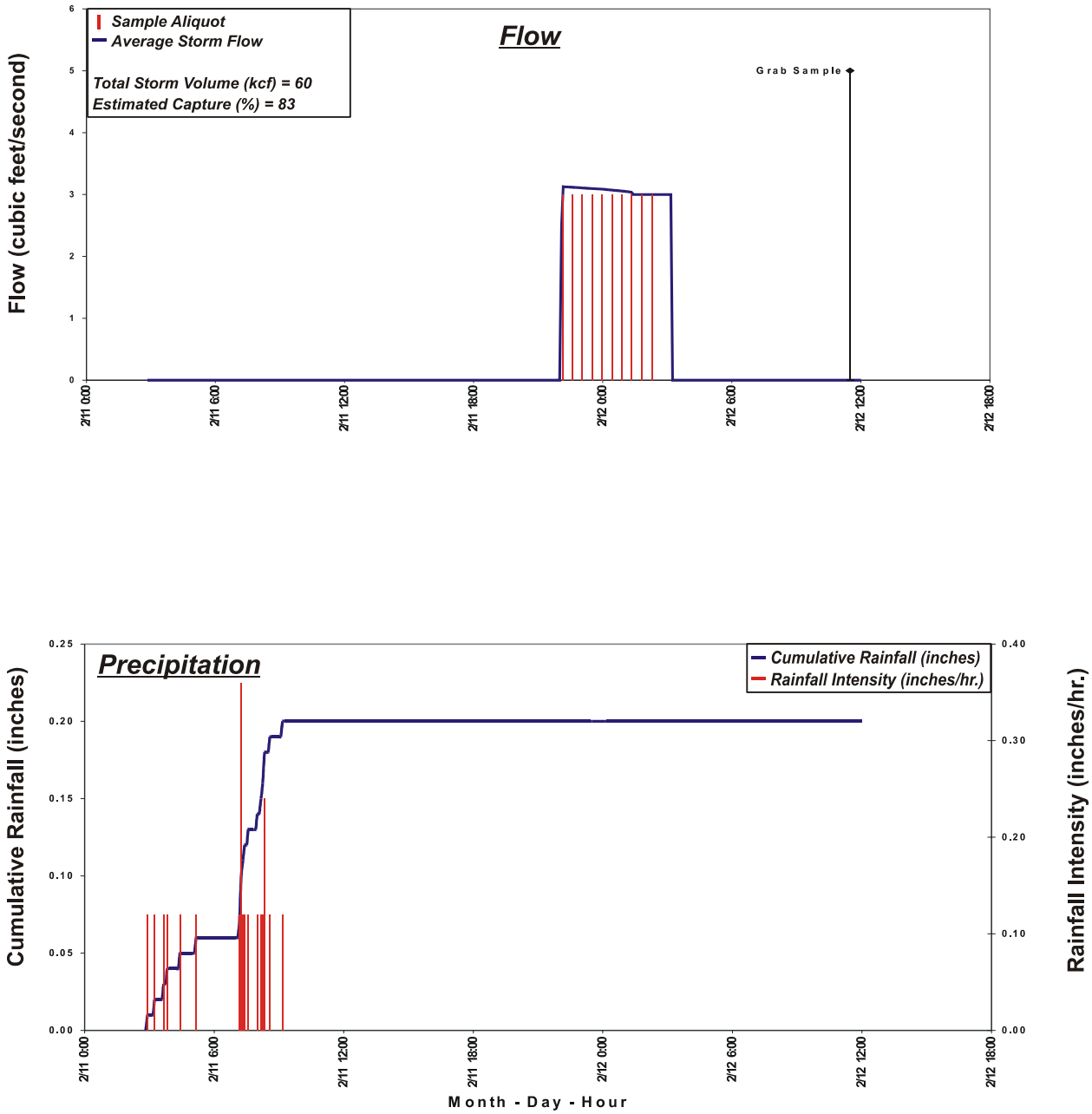



**Figure 5.7** **Belmont Pump Station – Event 2 (February 11 - 12, 2007 – Global Event 3).**

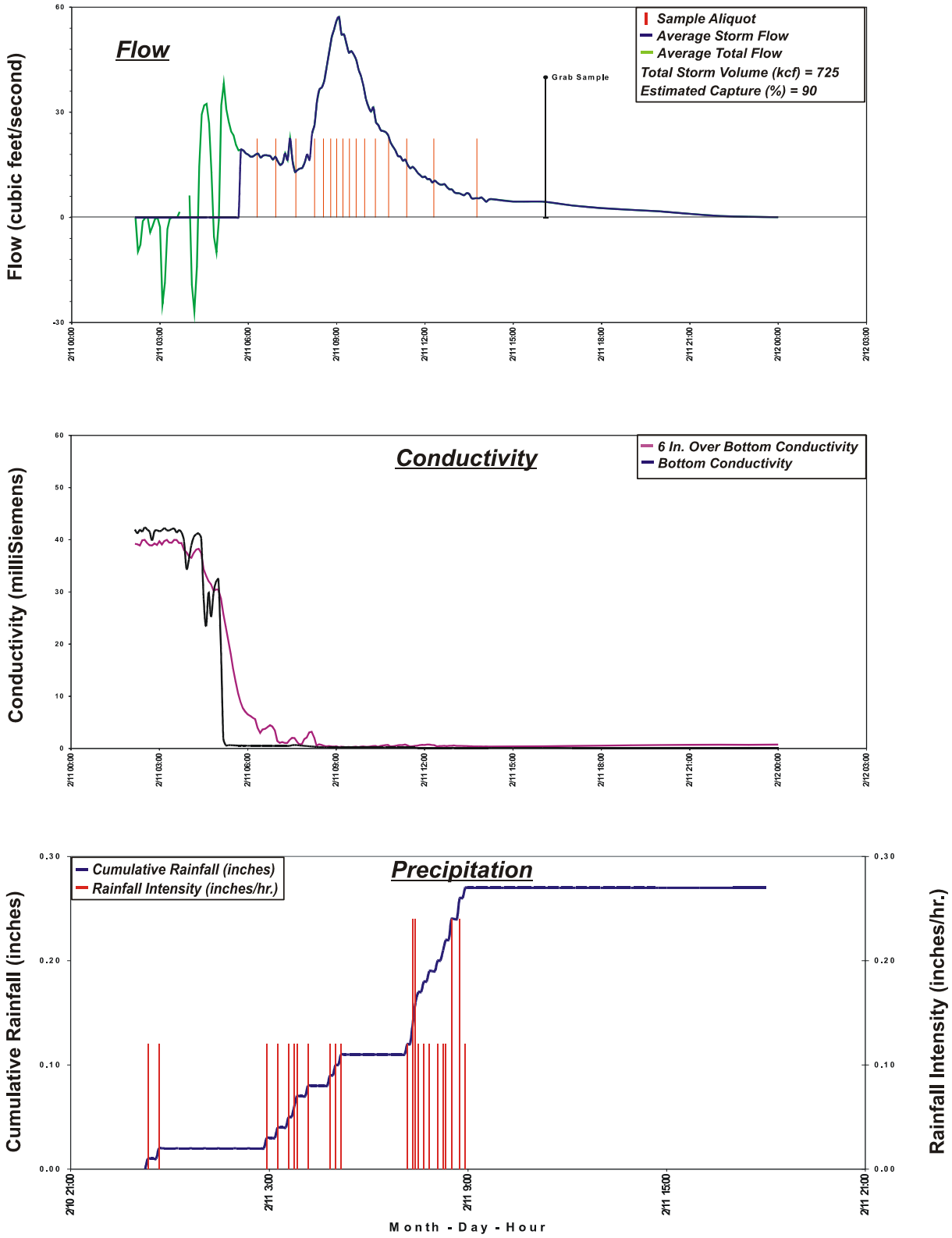



**Figure 5.8** **Bouton Creek – Event 3 (February 11 - 12, 2006 – Global Event 3).**

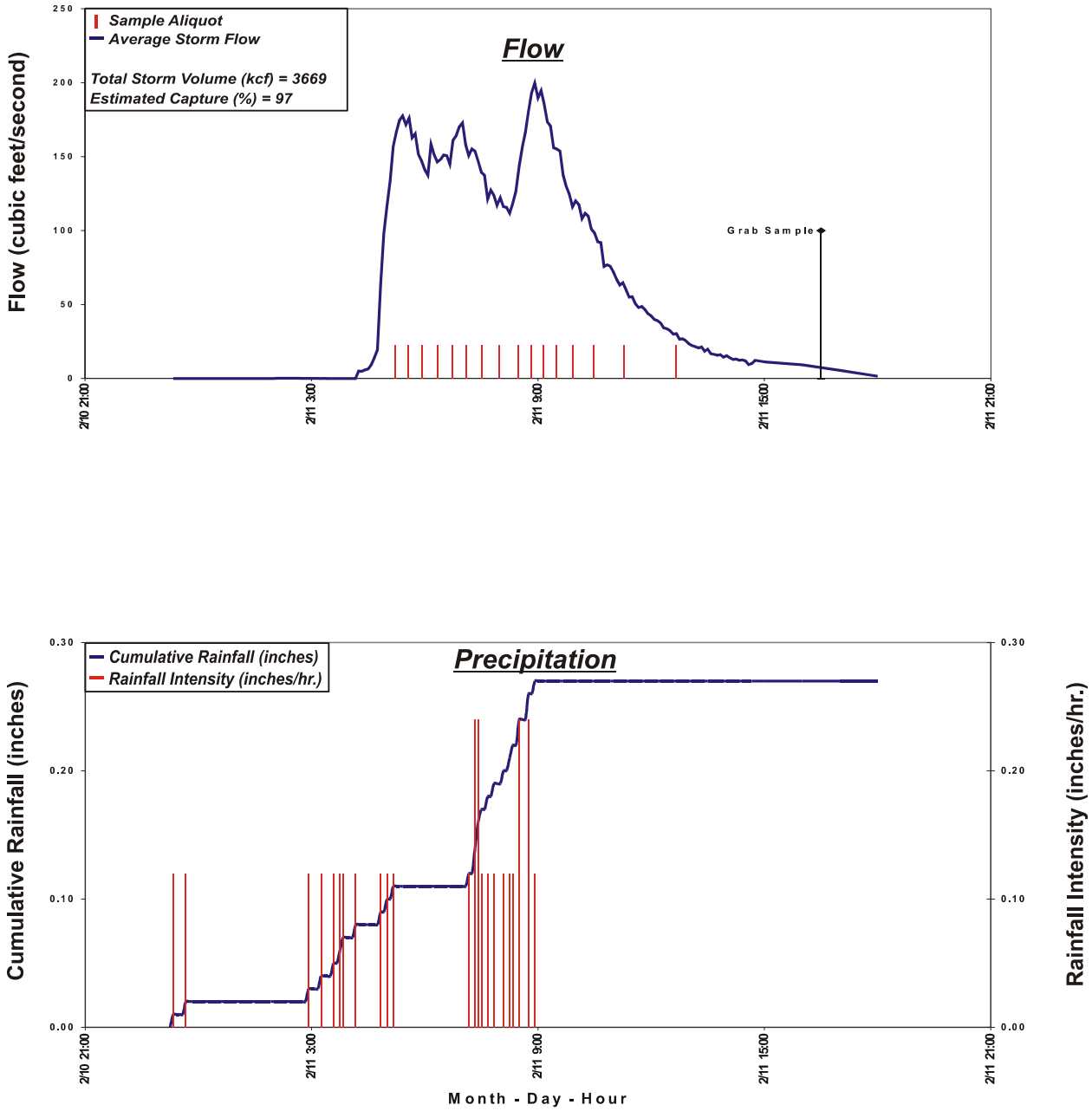



**Figure 5.9** **Los Cerritos Channel – Event 2 (February 11 - 12, 2006 – Global Event 3).**

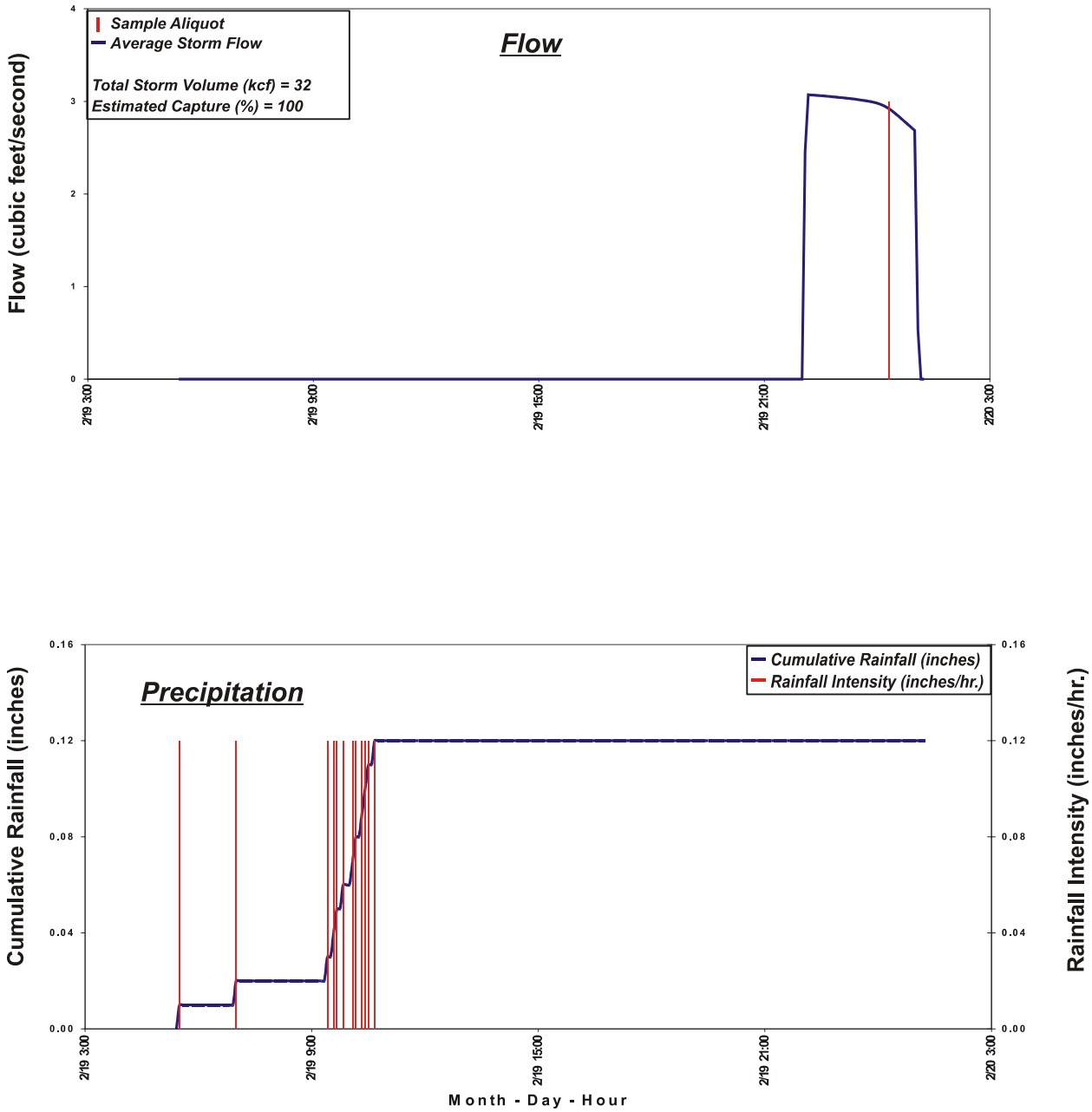



**Figure 5.10 Belmont Pump Station – Event 3 (February 19 - 20, 2007 – Global Event 4).**

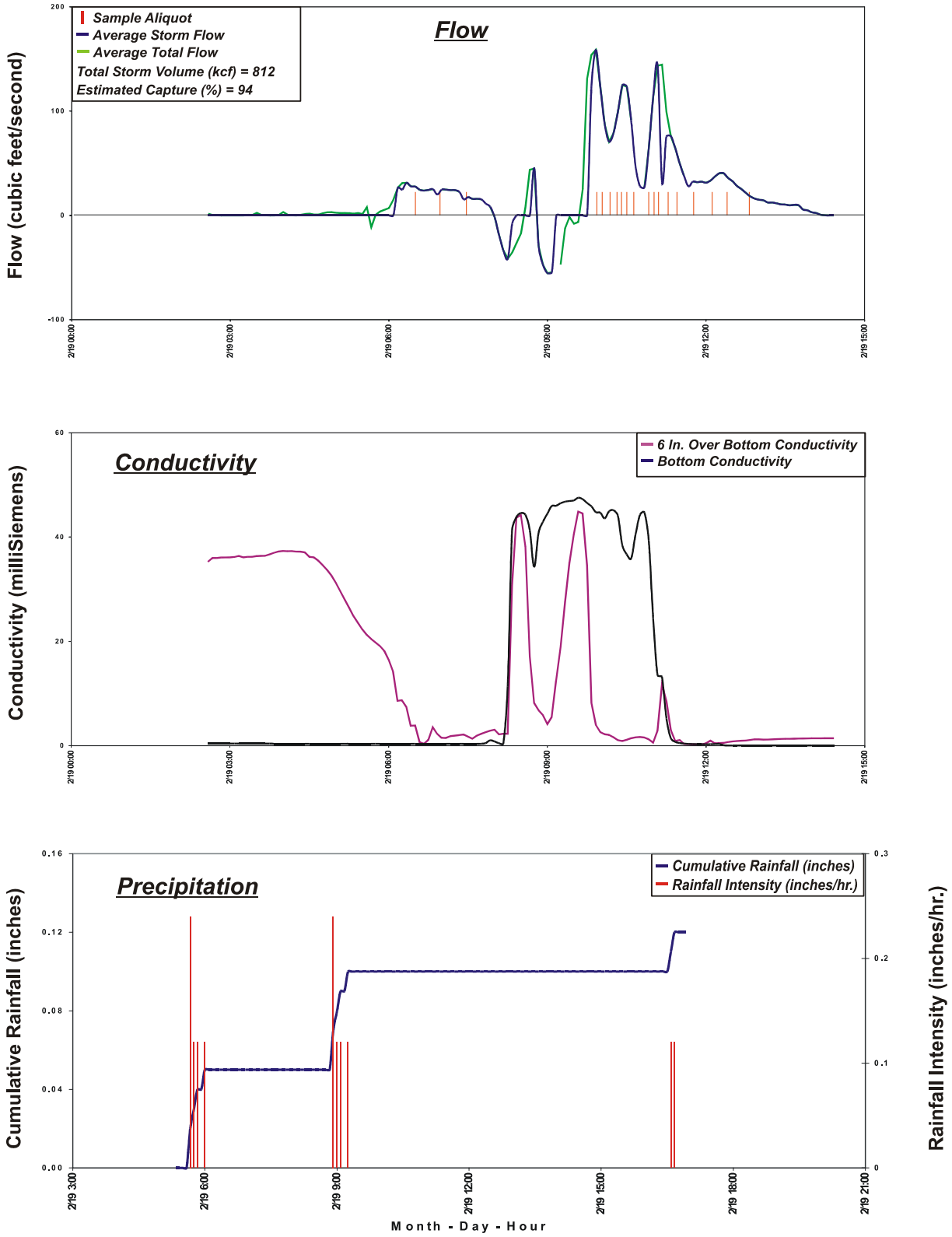



**Figure 5.11** **Bouton Creek – Event 4 (February 19 - 20, 2007 – Global Event 4).**

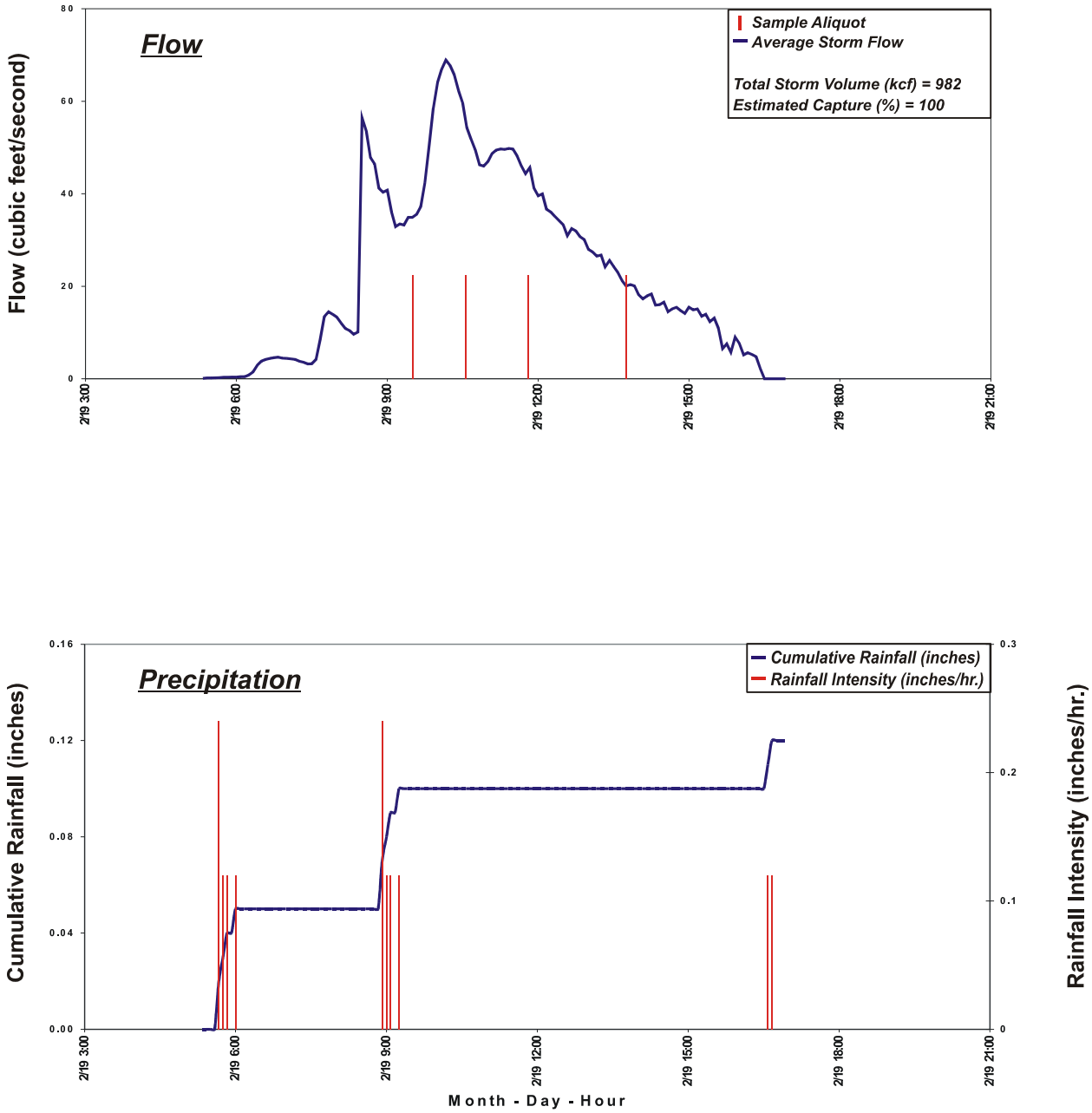



**Figure 5.12 Los Cerritos Channel – Event 3 (February 19 - 20, 2007 – Global Event 4).**

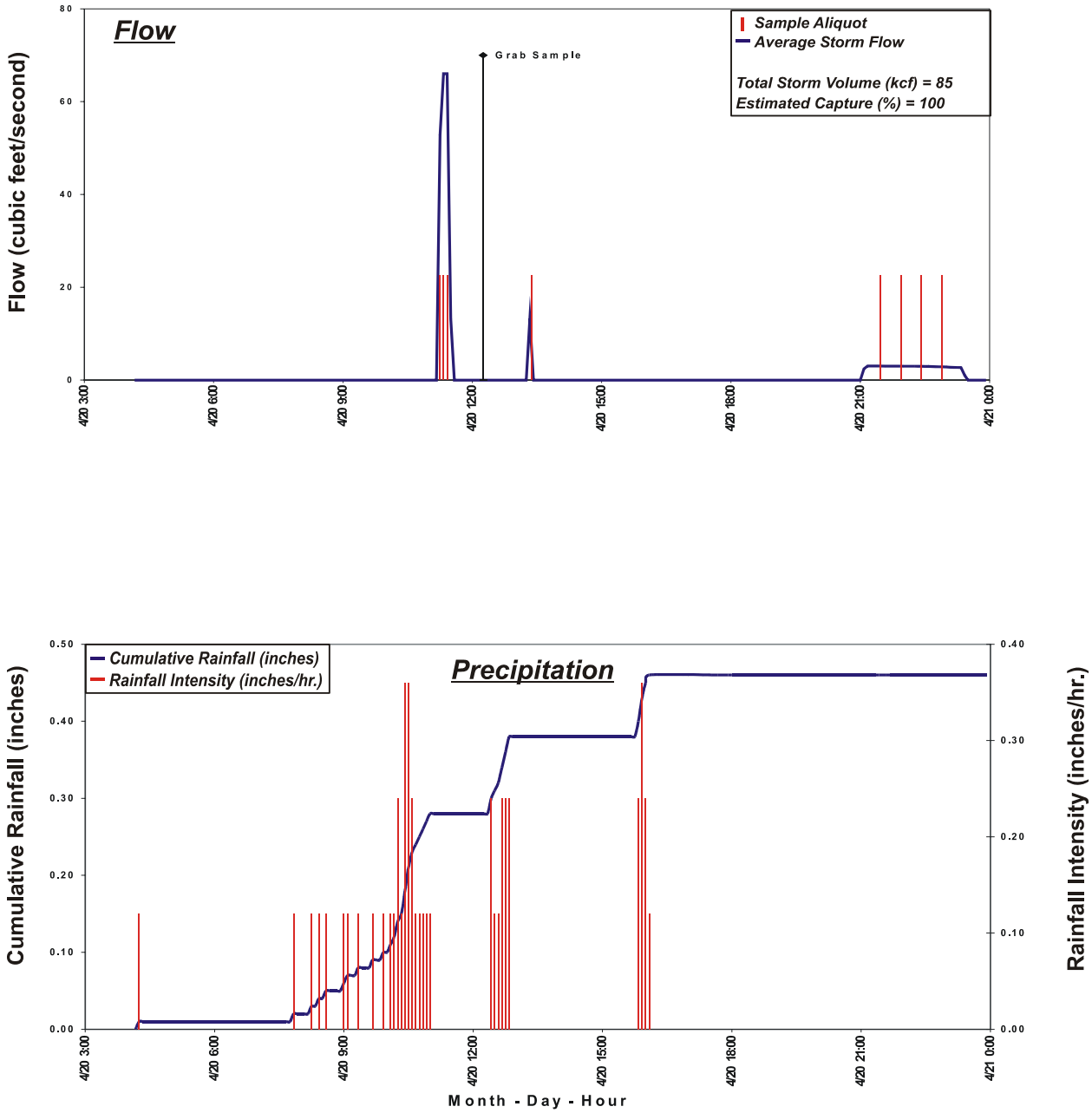



**Figure 5.13 Belmont Pump Station – Event 4 (April 20 - 21, 2007 – Global Event 5).**

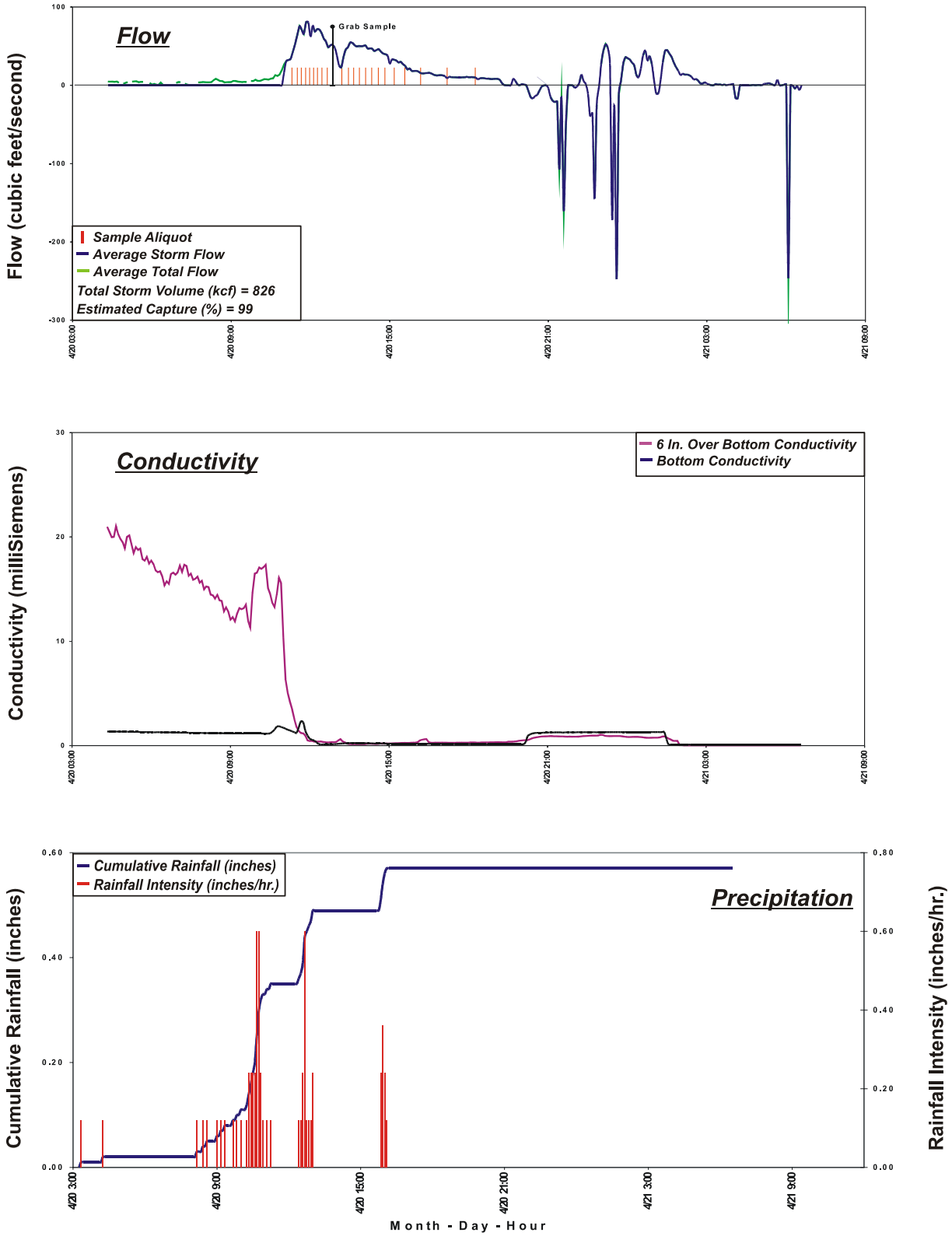



**Figure 5.14 Bouton Creek – Event 5 (April 20 - 21, 2007 – Global Event 5).**

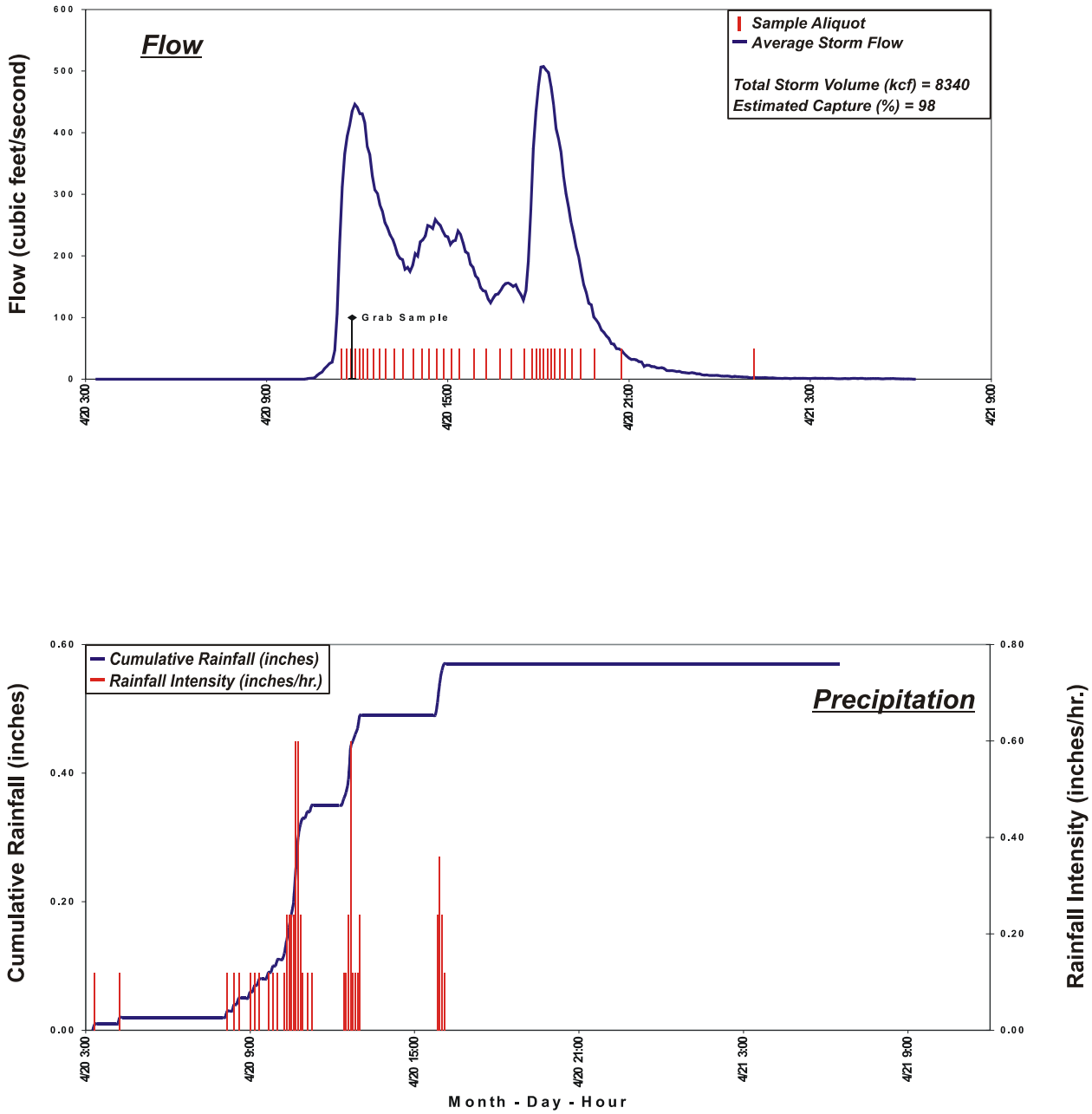



**Figure 5.15** **Los Cerritos Channel – Event 5 (April 20 - 21, 2007 – Global Event 5).**

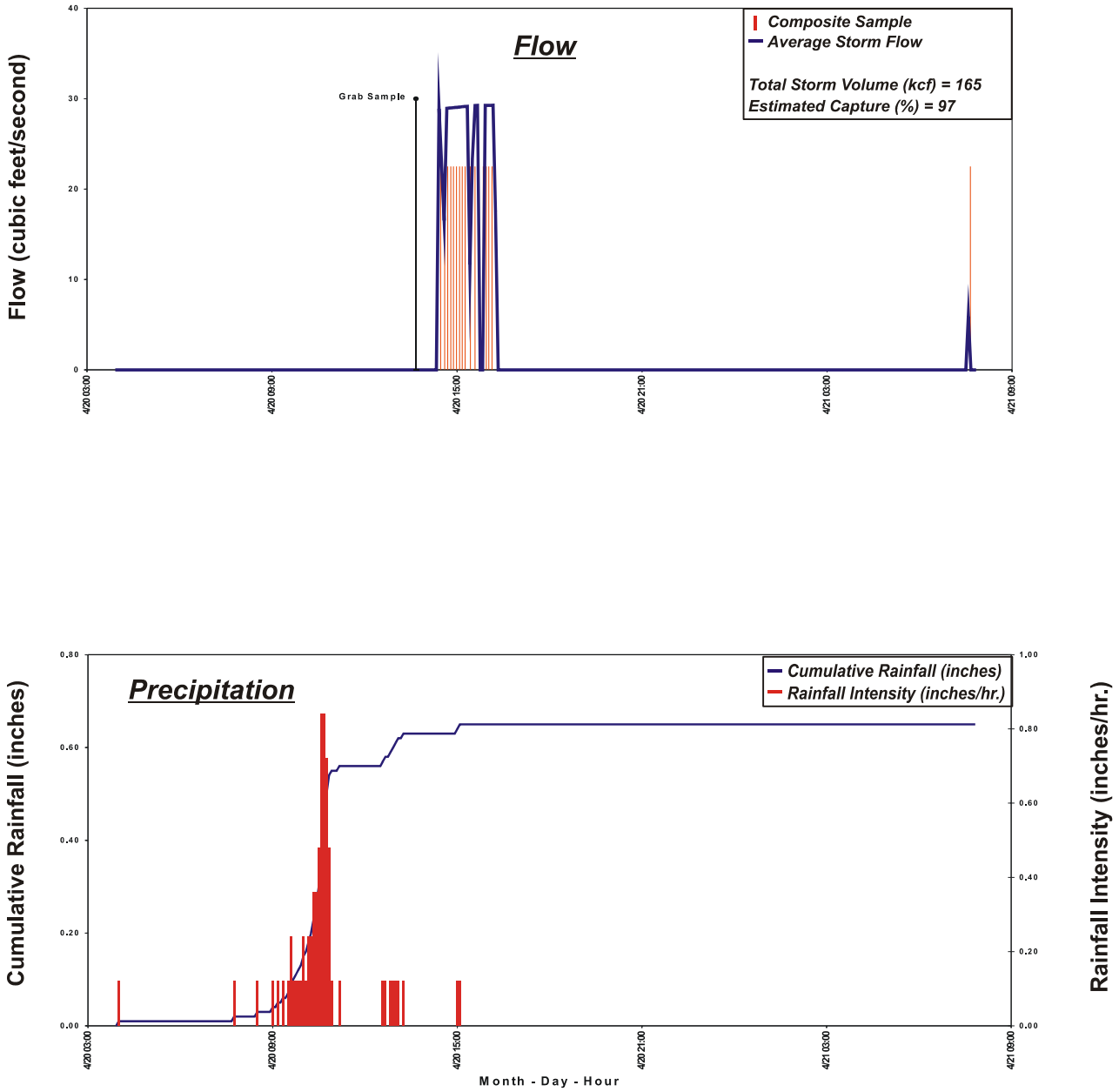



**Figure 5.16 Dominguez Gap Pump Station – Event 1 (April 20 - 21, 2007 – Global Event 5).**

**Table 5.1 Daily Rainfall Data at Belmont Pump Station during the 2005/2006 and 2006/2007 Wet Weather Seasons.**

| | October | | November | | December | | January | | February | | March | | April | | Season Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Day** | **2005** | **2006** | **2005** | **2006** | **2005** | **2006** | **2006** | **2007** | **2006** | **2007** | **2006** | **2007** | **2006** | **2007** | **2005/2006** | **2006/2007** |
| 1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.46 | 0.00 | 0.00 | 0.00 | 0.58 | 0.00 | 0.02 | 0.00 | | |
| 2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.31 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.15 | 0.00 | | |
| 3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.00 | 0.31 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | |
| 4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.04 | 0.00 | 0.00 | 0.22 | 0.00 | 0.00 | 0.00 | | |
| 5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.39 | 0.00 | 0.00 | 0.97 | 0.00 | | |
| 6 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.11 | 0.00 | | |
| 7 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.22 | 0.00 | 0.00 | 0.00 | | |
| 8 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | |
| 9 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | |
| 10 | 0.00 | 0.00 | 0.04 | 0.00 | 0.03 | 0.12 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | |
| 11 | 0.00 | 0.00 | 0.07 | 0.00 | 0.00 | 0.13 | 0.00 | 0.00 | 0.00 | 0.20 | 0.03 | 0.00 | 0.00 | 0.00 | | |
| 12 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.07 | 0.00 | 0.00 | 0.00 | | |
| 13 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | |
| 14 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | |
| 15 | 0.00 | 0.11 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.22 | 0.00 | | |
| 16 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | |
| 17 | 0.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.07 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | |
| 18 | 0.09 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.04 | 0.00 | 0.09 | 0.00 | 0.00 | 0.00 | | |
| 19 | 0.17 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.27 | 0.13 | 0.00 | 0.00 | 0.00 | 0.00 | | |
| 20 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.38 | | |
| 21 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.08 | 0.03 | 0.00 | 0.00 | | |
| 22 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.08 | 0.00 | 0.00 | 0.00 | 0.07 | 0.00 | 0.00 | 0.00 | 0.00 | | |
| 23 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | | |
| 24 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | |
| 25 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | |
| 26 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | |
| 27 | 0.00 | 0.00 | 0.01 | 0.00 | 0.03 | 0.26 | 0.00 | 0.00 | 0.00 | 0.33 | 0.00 | 0.00 | 0.00 | 0.00 | | |
| 28 | 0.00 | 0.00 | 0.00 | 0.19 | 0.00 | 0.00 | 0.00 | 0.00 | 0.72 | 0.00 | 0.08 | 0.00 | 0.00 | 0.00 | | |
| 29 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | | 1.00 | 0.00 | 0.00 | 0.00 | | |
| 30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.15 | | | 0.07 | 0.00 | 0.00 | 0.00 | | |
| 31 | 0.00 | 0.00 | | | 0.00 | 0.00 | 0.00 | 0.01 | | | 0.00 | 0.00 | | | | |
| **Total** | 0.56 | 0.11 | 0.13 | 0.20 | 0.09 | 0.69 | 1.08 | 0.21 | 1.05 | 1.12 | 2.44 | 0.03 | 1.48 | 0.38 | 6.83 | 2.74 |

**Table 5.2 Daily Rainfall Data at Los Cerritos Channel during the 2005/2006 and 2006/2007 Wet Weather Seasons.**

| | October | | November | | December | | January | | February | | March | | April | | Season Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Day** | **2005** | **2006** | **2005** | **2006** | **2005** | **2006** | **2006** | **2007** | **2006** | **2007** | **2006** | **2007** | **2006** | **2007** | **2005/2006** | **2006/2007** |
| 1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.42 | 0.00 | 0.00 | 0.00 | 0.44 | 0.00 | 0.00 | 0.00 | | |
| 2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.20 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.31 | 0.00 | | |
| 3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | |
| 4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.26 | 0.00 | 0.00 | 0.00 | | |
| 5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.88 | 0.00 | | |
| 6 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.10 | 0.00 | | |
| 7 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.15 | 0.00 | 0.00 | 0.00 | | |
| 8 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | | |
| 9 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | |
| 10 | 0.00 | 0.00 | 0.02 | 0.00 | 0.05 | 0.13 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | |
| 11 | 0.00 | 0.00 | 0.03 | 0.00 | 0.00 | 0.04 | 0.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 | 0.00 | 0.00 | | |
| 12 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.25 | 0.09 | 0.00 | 0.00 | 0.00 | | |
| 13 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | | |
| 14 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | |
| 15 | 0.00 | 0.37 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.17 | 0.00 | | |
| 16 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | | |
| 17 | 0.23 | 0.13 | 0.00 | 0.00 | 0.00 | 0.12 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | |
| 18 | 0.12 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.07 | 0.00 | 0.00 | 0.00 | | |
| 19 | 0.20 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.10 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | | |
| 20 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.05 | 0.12 | 0.00 | 0.00 | 0.00 | 0.00 | | |
| 21 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.10 | 0.00 | 0.00 | 0.57 | | |
| 22 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | |
| 23 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.09 | 0.00 | 0.00 | 0.00 | 0.09 | 0.00 | 0.00 | 0.01 | 0.00 | | |
| 24 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | |
| 25 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | |
| 26 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | |
| 27 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | |
| 28 | 0.00 | 0.00 | 0.00 | 0.12 | 0.00 | 0.14 | 0.00 | 0.00 | 0.70 | 0.17 | 0.06 | 0.00 | 0.00 | 0.00 | | |
| 29 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | | 0.97 | 0.00 | 0.00 | 0.00 | | |
| 30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | | 0.10 | 0.00 | 0.00 | 0.00 | | |
| 31 | 0.00 | 0.00 | | | 0.01 | 0.00 | 0.00 | 0.10 | | | 0.00 | 0.00 | | | | |
| **Total** | 0.55 | 0.51 | 0.06 | 0.13 | 0.08 | 0.53 | 0.94 | 0.15 | 0.85 | 0.65 | 2.29 | 0.00 | 1.48 | 0.57 | 6.25 | 2.54 |

**Table 5.3 Daily Rainfall Data at the Dominguez Gap Pump Station during the 2005/2006 and 2006/2007 Wet Weather Seasons.**

| | October | | November | | December | | January | | February | | March | | April | | Season Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Day** | **2005** | **2006[1]** | **2005** | **2006[1]** | **2005** | **2006[1]** | **2006** | **2007[1]** | **2006** | **2007[1]** | **2006** | **2007** | **2006** | **2007** | **2005/2006** | **2006/2007** |
| 1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.29 | 0.00 | 0.00 | 0.00 | 0.42 | 0.00 | 0.10 | 0.00 | | |
| 2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.18 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | |
| 3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.71 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | | |
| 4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.38 | 0.00 | 0.79 | 0.00 | | |
| 5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.10 | 0.00 | | |
| 6 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | |
| 7 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.12 | 0.00 | 0.00 | 0.00 | | |
| 8 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | |
| 9 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.08 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | |
| 10 | 0.00 | 0.00 | 0.08 | 0.00 | 0.02 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | |
| 11 | 0.00 | 0.00 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.16 | 0.05 | 0.00 | 0.00 | 0.00 | | |
| 12 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | | |
| 13 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | |
| 14 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.31 | 0.00 | | |
| 15 | 0.00 | 0.24 | 0.00 | 0.00 | 0.00 | 0.00 | 0.09 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | |
| 16 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.08 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | |
| 17 | 0.23 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | |
| 18 | 0.15 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.21 | 0.00 | 0.00 | 0.00 | | |
| 19 | 0.23 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.09 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | |
| 20 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.20 | 0.08 | 0.00 | 0.00 | 0.00 | 0.00 | | |
| 21 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.11 | 0.01 | 0.00 | 0.65 | | |
| 22 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.08 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.01 | 0.00 | | |
| 23 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.05 | 0.00 | 0.00 | 0.00 | 0.05 | | |
| 24 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | | |
| 25 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | |
| 26 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | |
| 27 | 0.00 | 0.00 | 0.00 | 0.11 | 0.01 | 0.12 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | |
| 28 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.80 | 0.03 | 0.02 | 0.01 | 0.00 | 0.00 | | |
| 29 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | | 0.43 | 0.00 | 0.00 | 0.00 | | |
| 30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.19 | | | 0.29 | 0.00 | 0.00 | 0.00 | | |
| 31 | 0.00 | 0.00 | | | 0.00 | 0.00 | 0.00 | 0.00 | | | 0.09 | 0.00 | | | | |
| **Total** | 0.61 | 0.24 | 0.11 | 0.11 | 0.05 | 0.40 | 1.30 | 0.19 | 1.11 | 0.34 | 2.14 | 0.02 | 1.32 | 0.70 | 6.64 | 2.00 |

**Table 5.4 Rainfall for all Monitored Events during the 2006/2007 Wet-Weather Season.**

| Site/Event | Start Rain Date | Start Rain Time | End Rain Date | End Rain Time | Duration Rain (hrs:mins) | Total Rain (inches) | Max Intensity (Inches/hr) | Antecedent Rain (days) | Antecedent Rain (inches) | Sampling Code |
|---|---|---|---|---|---|---|---|---|---|---|
| **Event 1** | | | | | | | | | | |
| **BELMONT PUMP ST.** | | | | | | | | | | ND |
| **LOS CERRITOS CHANNEL/ BOUTON CREEK** | 10/13/2006 | 20:20 | 10/14/2006 | 4:45 | 8:25 | 0.38 | 1.32 | 144.4 | 0.55 | TSS |
| **DOMINGUEZ PUMP ST.** | | | | | | | | | | ND |
| **Event 2** | | | | | | | | | | |
| **BELMONT PUMP ST.** | 1/30/2007 | 9:50 | 1/31/2007 | 6:55 | 21:05 | 0.16 | 0.36 | 34.0 | 0.26 | TSS |
| **LOS CERRITOS CHANNEL/ BOUTON CREEK** | 1/30/2007 | 10:25 | 1/30/2007 | 13:35 | 3:10 | 0.18 | 1.20 | 34.2 | 0.14 | TSS[1] |
| **DOMINGUEZ PUMP ST.** | | | | | | | | | | ND |
| **Event 3** | | | | | | | | | | |
| **BELMONT PUMP ST.** | 2/11/2007 | 2:55 | 2/11/2007 | 9:10 | 6:15 | 0.20 | 0.36 | 10.8 | 0.16 | Full |
| **LOS CERRITOS CHANNEL/ BOUTON CREEK** | 2/10/2007 | 23:20 | 2/11/2007 | 18:00 | 18:40 | 0.27 | 0.24 | 11.4 | 0.10 | Full |
| **DOMINGUEZ PUMP ST.** | | | | | | | | | | ND |
| **Event 4** | | | | | | | | | | |
| **BELMONT PUMP ST.** | 2/19/2007 | 5:30 | 2/19/2007 | 10:40 | 5:10 | 0.12 | 0.12 | 7.8 | 0.20 | TSS |
| **LOS CERRITOS CHANNEL/ BOUTON CREEK** | 2/19/2007 | 5:40 | 2/19/2007 | 16:55 | 11:15 | 0.12 | 0.24 | 7.5 | 0.27 | TSS |
| **DOMINGUEZ PUMP ST.** | | | | | | | | | | ND |
| **Event 5** | | | | | | | | | | |
| **BELMONT PUMP ST.** | 4/20/2007 | 4:15 | 4/20/2007 | 16:05 | 11:50 | 0.46 | 0.84 | 51.9 | 0.32 | Full |
| **LOS CERRITOS CHANNEL/ BOUTON CREEK** | 4/20/2007 | 3:20 | 4/20/2007 | 15:05 | 11:45 | 0.57 | 0.60 | 51.8 | 0.17 | Full |
| **DOMINGUEZ PUMP ST.** | 4/20/2007 | 4:00 | 4/20/2007 | 17:05 | 13:05 | 0.65 | 0.84 | 67.9 | 0.16 | Full |

1. TSS event for Bouton Creek only. Los Cerritos did not discharge a sufficient amount for sampling.

**Sampling Codes**

Full = Sampled for full suite of chemical constituents
TSS = Sampled for TSS only
MF = Sampler or other equipment malfunction

**Table 5.5 Descriptive Statistics - Rainfall and Flow Data for All Monitored Events (2006/2007).**

| Site / Parameter | n | Min | Max | Mean | Standard Deviation | 1st Quartile | Median | 3rd Quartile |
|---|---|---|---|---|---|---|---|---|
| **BELMONT PUMP ST.** | | | | | | | | |
| Duration Flow (days) | 4 | 0.13 | 0.51 | 0.34 | 0.19 | 0.19 | 0.35 | 0.49 |
| Total Flow (kcf) | 4 | 32.0 | 85.0 | 64.3 | 24.1 | 53.0 | 70.0 | 81.3 |
| Duration Rain (days) | 4 | 0.22 | 0.88 | 0.46 | 0.30 | 0.25 | 0.38 | 0.59 |
| Total Rain (inches) | 4 | 0.12 | 0.46 | 0.24 | 0.15 | 0.15 | 0.18 | 0.27 |
| Max Intensity (inches/hr) | 4 | 0.12 | 0.84 | 0.42 | 0.30 | 0.30 | 0.36 | 0.48 |
| Antecedent Dry (days) | 4 | 7.9 | 51.9 | 26.1 | 20.8 | 10.1 | 22.4 | 38.5 |
| Antecedent Rain (inches) | 4 | 0.16 | 0.32 | 0.24 | 0.07 | 0.19 | 0.23 | 0.28 |
| **LOS CERRITOS CHANNEL/ BOUTON CREEK** | | | | | | | | |
| Duration Flow (days) | 4 | 0.26 | 0.83 | 0.56 | 0.25 | 0.41 | 0.56 | 0.71 |
| Total Flow (kcf) | 4 | 273 | 8340 | 3316 | 3655 | 805 | 2326 | 4837 |
| Duration Rain (days) | 4 | 0.35 | 0.78 | 0.52 | 0.18 | 0.44 | 0.48 | 0.56 |
| Total Rain (inches) | 4 | 0.12 | 0.57 | 0.34 | 0.19 | 0.23 | 0.33 | 0.43 |
| Max Intensity (inches/hr) | 4 | 0.24 | 1.32 | 0.60 | 0.51 | 0.24 | 0.42 | 0.78 |
| Antecedent Dry (days) | 4 | 7.5 | 144 | 53.8 | 64 | 10.4 | 31.6 | 75 |
| Antecedent Rain (inches) | 4 | 0.10 | 0.55 | 0.27 | 0.20 | 0.15 | 0.22 | 0.34 |
| **DOMINGUEZ GAP PUMP ST.** | | | | | | | | |
| Duration Flow (days) | 1 | 0.72 | 0.72 | 0.72 | NA | 0.72 | 0.72 | 0.72 |
| Total Flow (kcf) | 1 | 165 | 165 | 165 | NA | 165 | 165 | 165 |
| Duration Rain (days) | 1 | 0.55 | 0.55 | 0.55 | NA | 0.55 | 0.55 | 0.55 |
| Total Rain (inches) | 1 | 0.65 | 0.65 | 0.65 | NA | 0.65 | 0.65 | 0.65 |
| Max Intensity (inches/hr) | 1 | 0.84 | 0.84 | 0.84 | NA | 0.84 | 0.84 | 0.84 |
| Antecedent Dry (days) | 1 | 67.9 | 67.9 | 67.9 | NA | 67.9 | 67.9 | 67.9 |
| Antecedent Rain (inches) | 1 | 0.10 | 0.10 | 0.10 | NA | 0.10 | 0.10 | 0.10 |

**Table 5.6 Flow for all Monitored Events during the 2007/2007 Wet Weather Season.**

| Site/Event | Start Flow Date | Start Flow Time | End Flow Date | End Flow Time | Flow or Discharge Duration (hrs:mins) | Total Flow (kcf) | No. of Sample Aliquots Collected | Peak Flow (cfs) | % Storm Capture | Peak Capture | Sampling Code |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Event 1** | | | | | | | | | | | |
| **BELMONT PUMP ST.** | | | | | | | | | | | ND |
| **BOUTON CREEK** | 10/14/2006 | 4:25 | 10/14/2006 | 12:05 | 7:40 | 378 | 9 | 88 | 100 | Y | TSS |
| **LOS CERRITOS CHANNEL** | 10/14/2006 | 4:15 | 10/14/2006 | 10:35 | 6:20 | 273 | 1 | 97 | 100 | Y | TSS |
| **DOMINGUEZ PUMP ST.** | | | | | | | | | | | ND |
| **Event 2** | | | | | | | | | | | |
| **BELMONT PUMP ST.** | 1/30/2007 | 11:20 | 1/30/2007 | 23:06 | 11:46 | 80 | 5 | 66 | 100 | Y | TSS |
| **BOUTON CREEK** | 1/30/2007 | 12:20 | 1/30/2007 | 23:35 | 11:15 | 238 | 6 | 21 | 100 | Y | TSS |
| **LOS CERRITOS CHANNEL** | | | | | | | | | | | ND |
| **DOMINGUEZ PUMP ST** | | | | | | | | | | | ND |
| **Event 3** | | | | | | | | | | | |
| **BELMONT PUMP ST.** | 2/11/2007 | 22:01 | 2/12/2007 | 3:14 | 5:13 | 60 | 10 | 3 | 83 | Y | Full |
| **BOUTON CREEK** | 2/11/2007 | 5:45 | 2/12/2007 | 0:00 | 18:15 | 725 | 16 | 57 | 90 | Y | Full |
| **LOS CERRITOS CHANNEL** | 2/11/2007 | 2:06 | 2/11/2007 | 18:00 | 15:54 | 3669 | 16 | 200 | 97 | Y | Full |
| **DOMINGUEZ PUMP ST** | | | | | | | | | | | ND |
| **Event 4** | | | | | | | | | | | |
| **BELMONT PUMP ST.** | 2/19/2007 | 22:01 | 2/20/2007 | 1:01 | 3:00 | 32 | 1 | 3 | 100 | Y | TSS |
| **BOUTON CREEK** | 2/19/2007 | 6:10 | 2/19/2007 | 14:25 | 8:15 | 812 | 19 | 159 | 94 | Y | TSS |
| **LOS CERRITOS CHANNEL** | 2/19/2007 | 5:20 | 2/19/2007 | 16:30 | 11:10 | 982 | 4 | 69 | 100 | Y | TSS |
| **DOMINGUEZ PUMP ST** | | | | | | | | | | | ND |
| **Event 5** | | | | | | | | | | | |
| **BELMONT PUMP ST.** | 4/20/2007 | 11:11 | 4/20/2007 | 23:22 | 12:11 | 85 | 8 | 66 | 100 | Y | Full |
| **BOUTON CREEK** | 4/20/2007 | 11:00 | 4/21/2007 | 6:00 | 19:00 | 826 | 23 | 81 | 99 | Y | Full |
| **LOS CERRITOS CHANNEL** | 4/20/2007 | 10:20 | 4/21/2007 | 6:20 | 20:00 | 8340 | 38 | 508 | 98 | Y | Full |
| **DOMINGUEZ PUMP ST** | 4/20/2007 | 14:20 | 4/21/2007 | 7:39 | 17:19 | 165 | 16 | 29 | 97 | Y | Full |

**Sampling Codes**
Full = Sampled for full suite of chemical constituents
TSS = Sampled for TSS only
MF = Sampler or other equipment malfunction
ND = No discharge

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# 6.0 CHEMISTRY RESULTS

## 6.1 Wet Weather Chemistry Results

The extreme drought conditions in Los Angeles County resulted in a limited number of events that were suitable for monitoring. A total of five storm events were monitored during the 2006/2007 season (Table 6.1). Of these, only two storm events were monitored for the full set of analytical constituents at the Belmont Pump Station, Bouton Creek and Los Cerritos Channel site. One storm event was monitored for the full set of analytical constituents at the Dominguez Gap Pump Station site.

Rainfall and runoff were far below predicted levels during the first two events of the season (October 14, 2006 and January 30, 2007). This resulted in stormwater composite volumes that were insufficient and inappropriate for the full suite of tests. Only TSS was measured at sites with sufficient flow to trigger the storm monitoring sites.

Considering the drought conditions, it was unusual that any of the storm events was sufficient to produce discharges from the Dominguez Gap Pump Station to the Los Angeles River. This site rarely discharges due to the large capacity of the site for infiltration but construction activities designed to improve the infiltration basin as a wetland habitat resulted in a temporary restriction of the area available for infiltration. Coffer dams located on either side of the Pump Station were used to allow grading to be conducted in the basin for development of managed wetland habitat.

The results of the chemical analysis of these composite and grab stormwater samples are summarized in Tables 6.2 through 6.4. Toxicity results for the composite samples and the receiving water samples from these monitored events are given in Section 7 below.

## 6.2 Wet Weather Load Calculations

Estimates of total pollutant loads associated with stormwater runoff during each storm event are provided in Tables 6.5 through 6.7. Load calculations were made by multiplying the measured concentration times the total stormwater discharge along with the appropriate unit conversion factors. The following calculation is an example of the process used for analytes such as TSS that are measured in mg/L. The specific example is for the first storm event at the Los Cerritos Channel site

$$(190 \text{ mg/L}) \times [(3669 \text{ kcf})(28317 \text{ L/kcf})] \times (1 \text{ pound}/453592 \text{ mg}) = 43{,}519 \text{ pounds}$$

Consistent with sound scientific practice, total pollutant loads are reported to two significant figures since all chemical data are also reported to two significant figures. Thus the total TSS load for the first event at the Los Cerritos Channel is reported as 44,000 pounds.

As one would expect, pollutant loads are largely controlled by the size of the watershed. Over the past seven years, the Los Cerritos Channel (Table 6.6 and 6.7) has consistently produced the highest overall loads of solids and total metals simply due to the large size of the watershed and lack of infiltration capacity such as that associated with the Dominguez Gap Pump Station. Estimates of solids discharged in association with the four events at the Los Cerritos Channel ranged from 6,100 and 150,000 pounds. Estimates of total copper were 13 and 41 pounds for the two events that included all analytes.

Pollutant loads are consistently lowest at the Belmont Pump Station (Tables 6.5 and 6.7) which has the smallest catchment area. This site was estimated to discharge 130 and 1,800 pounds of solids in association with the four events. The load of total copper discharged from the Belmont Pump Station during the two fully monitored events was estimated at 0.14 and 0.53 pounds.

Loading estimates for solids from the Dominguez Gap Pump Station have typically been lower than all other sites but, this year, total solid loads were slightly greater than those measured at the Belmont Pump Station during the same event (Tables 6.6 and 6.7). A total of 1,500 pounds of sediment were discharged from the Dominguez Gap Pump Station during the April 21, 2007 storm event compared to 1,100 pounds of sediment discharged at the Belmont Pump Station. Estimated loads of total recoverable metals such as copper and lead remain among the lowest encountered at all mass emission sites despite the much reduced area of the infiltration during this season.

## 6.3 Dry Weather Chemistry Results

The NPDES Permit requires that two dry weather inspections and sampling events are to be conducted each year. These surveys are conducted during the summer dry weather period at each of the four mass emission stations. A total of 16 dry weather surveys have now been conducted since issuance of the permit in 1999 (Table 6.8). Events 15 and 16 conducted during the 2006/2007 season are shaded. Field measurements are provided in Table 6.9 for the 2006/2007 season. Chemical analyses performed in the laboratory are summarized in Table 6.10 for the 2006/2007 season.

### 6.3.1 Basin 23: Belmont Pump Station Monitoring Site

A grab sample representative of the total dry weather discharge was conducted during the evening of September 6, 2006 over a 15 minute period beginning at 2210. Although the water level in the sump was high enough to trip the pump, it did not turn on at 2200 as it normally does. During a visit to the pump house during the forenoon it was observed that the level in the sump was 5.7 feet. At a subsequent visit at about 1600 the level was down to 3.2 feet. The confined space log for the facility showed that there had been visits by two teams of maintenance personal since the morning visit. During one of those visits the sump appeared to have been pumped manually. Subsequent monitoring of the facility via the sampling station's telemetry showed that the maintenance pump was malfunctioning.

Grab samples for TPH and bacteria were manually collected from the sump September 7$^{th}$ at 0745. The reason the manual grab samples were not collected immediately after the composite grab sample was collected on September 6$^{th}$ was due to the need to maintain a maximum six hour holding time for the bacteria samples. Laboratories are not available during nighttime hours.

A grab composite sampling was again conducted during the evening of May 16, 2007 over a 15 minute period beginning at 2200 while the maintenance pump was running. Grab samples for TPH and bacteria were manually collected from the sump on May 17, 2007 at 0730, again to maintain a maximum six hour holding time for bacteria samples, after the level of the water in the sump had somewhat recovered during the nighttime hours.

### 6.3.2 Basin 20: Bouton Creek Monitoring Site

Bouton Creek was sampled 2-3 hours after the low tide on September 7, 2006 from 0610 to 0625 and on May 17, 2007 from 0850 to 0910 a.m. At these times, flow in the creek was not impeded by seawater backing into the creek. This assured that the flow was fresh water flowing downstream and that influences of the saline tidal water had the least possible impact on the sample of dry weather discharges of fresh water. During the May event the salinity was still 10.5 ppt. Salinity of the dry weather discharge at this monitoring point is usually about 4 to 5 ppt at this tidal stage.

Continuous sampling over a period of 15 minutes was performed to collect water from the Creek when the effects of residual salinity in the channel were minimized. Samples were collected from the creek and deposited into one 20-liter borosilicate glass bottle using the pump on the automatic sampler operating in

manual mode. Grab samples for TPH and bacteria were collected just before the pumped sampling on September 7th at 0607 and on May 17th at 0845.

### 6.3.3 Portions of Basins 18, 19, 27 and 29: Los Cerritos Channel Monitoring Site

Time-weighted sampling of the water flowing down the channel was conducted over a 24-hour period. Sampling began on September 6, 2006 and ended on September 7th. A separate sampling event began on May 16, 2007 and ended the following day.

Samples were taken from the middle of the channel using the automated sampler installed on the bank of the channel. Dry weather flows consisted of a shallow, narrow stream located near the middle of the channel. To reach the water, the sampling hose that is used for sampling storm water was extended an additional 33 feet to reach the low flow channel. Every half-hour for 24 hours, an aliquot of approximately 0.75 liters of water was pumped into a 20-liter bottle. The bottles were changed every 12 hours and chilled to 4°C with ice during sampling and transportation. Following completion of the sampling, the bottles of water were combined into a composite sample. Grab samples were manually collected for TPH and bacteria at the end of the 24-hour sampling on September 7th at 0920 and at the end of the 24-hour sampling on May 17th at1015.

When the station was closed down on May 17th a line of debris was located just below the sampler intake point and stretched completely across the channel indicated that the high tide overnight had backed water up that far. The salinity of the sample indicated that salt water had not reached the sampler intake.

### 6.3.4 Basin 14: Dominguez Gap Monitoring Site

Inspections for dry weather flow were conducted at the Dominguez Gap Pump Station on September 6, 2006 and on May 17, 2007. There were pools of standing water in the concrete channel east of the infiltration basin, but no flowing water was observed on either occasion. During the September inspection it was noted that work on re-contouring the infiltration basin associated with the Pump Station and replacing the two diesel pumps with natural gas driven pumps had begun. Both projects proceeded throughout the wet season and were still underway during the May inspection.

**Table 6.1 Monitored Storm Events, 2006/2007.**

| Global Event | Event 1 | Event 2 | Event 3 | Event 4 | Event 5 |
|---|---|---|---|---|---|
| Date | 14-Oct-06 | 30-Jan-07 | 12-Feb-07 | 20-Feb-07 | 20-Apr-07 |
| Belmont Pump | - | TSS-1 | S-1 | TSS-2 | S-2 |
| Bouton Creek | TSS-1 | TSS-2 | S-1 | TSS-3 | S-2 |
| Los Cerritos Channel | TSS-1 | - | S-1 | TSS-3 | S-2 |
| Dominguez Gap | - | - | - | - | S-1 |

S=Full Storm Composites
TSS=Storm Events monitored for TSS only

**Table 6.2 Belmont Pump and Bouton Creek Stormwater Chemistry Results: 2006/2007.**

| Analytical Parameter | Belmont Pump 12-Feb-07 | Belmont Pump 20-Apr-07 | Bouton Creek 11-Feb-07 | Bouton Creek 20-Apr-07 |
|---|---|---|---|---|
| ***Conventionals (mg/L)*** *unless noted* | | | | |
| pH (pH Units) | 7.12 | 7.12 | 7.81 | 7.54 |
| Conductivity (µmhos/cm) | 1100 | 730 | 440 | 210 |
| Alkalinity as CaCO3 | 160 | 79 | 34 | 29 |
| Hardness as CaCO3 | 160 | 100 | 69 | 60 |
| Biochemical Oxygen Demand | 19 | 28 | 22 | 30 |
| Chemical Oxygen Demand | 130 | 190 | 96 | 190 |
| Total Organic Carbon | 29 | 44 | 27 | 43 |
| Chloride | 250 | 140 | 99 | 25 |
| Fluoride | 0.67 | 0.43 | 0.37 | 0.33 |
| MBAS | 0.25 | 0.096 | 0.32 | 0.082 |
| Oil and Grease | 4.6J | 5.5 | 5U | 4.3J |
| Total Ammonia (as N) | 1.3 | 0.68 | 0.59 | 0.7 |
| Total Kjeldahl Nitrogen | 4.5 | 3.9 | 2.4 | 4.9 |
| Nitrate (as N) | 0.99 | 1.3 | 1.1 | 1.3 |
| Nitrite (as N) | 0.1U | 0.082J | 0.1U | 0.062J |
| Orthophosphate (as P) | 1.6 | 0.38 | 0.28 | 0.17 |
| Total Phosphorus | 1.9 | 1 | 0.64 | 0.92 |
| Total Recoverable Phenolics | 0.1U | 0.1U | 0.1U | 0.1U |
| Total Dissolved Solids | 680 | 410J | 280 | 100J |
| Total Suspended Solids | 35 | 200 | 50 | 240 |
| Total Volatile Solids | 16 | 63 | 25 | 89 |
| Turbidity (NTU) | 24 | 120 | 38 | 100 |
| ***Dissolved Metals (µg/L)*** | | | | |
| Aluminum | 18J | 47 | 31 | 51 |
| Arsenic | 2.5 | 2.3 | 2.7 | 1.9 |
| Cadmium | 0.06J | 0.11J | 0.061J | 0.057J |
| Chromium | 0.96 | 1.3 | 1 | 1.3 |
| Copper | **16** [5,6] | **18** [5,6] | **13** [5,6] | **15** [5,6] |
| Iron | 110 | 140 | 89 | 140 |
| Lead | 0.86 | 1 | 1.1 | 1.9 |
| Nickel | 6.4 | 7.7 | 3.8 | 5.5 |
| Selenium | 1U | 1U | 1U | 1U |
| Silver | 0.2U | 0.2U | 0.2U | 0.2U |
| Zinc | 78 | **100** [6] | 66 | 74 |
| ***Total Metals (µg/L)*** | | | | |
| Aluminum | **570** [7] | **5900** [2,7] | **1000** [7] | **4000** [2,7] |
| Arsenic | 2.8 | 5.5 | 3.5 | 4.2 |
| Cadmium | 0.26 | 1.1 | 0.28 | 0.87 |
| Chromium | 2.9 | 15 | 3.9 | 11 |
| Copper | **37** [1] | **100** [1] | **29** [1] | **71** [1] |
| Iron | 1000 | **9500** [7] | 1600 | **6300** [7] |
| Lead | **8.3** [1] | **46J** [1] | 7.9 | **34J** [1] |
| Nickel | 8 | 19 | 6.5 | 14 |
| Selenium | 1U | 1U | 1U | 1U |
| Silver | 0.027J | 0.17J | 0.037J | 0.11J |
| Zinc | **170** [1] | **500** [1] | **160** [1] | **440** [1] |

Bolded values with superscripts exceed criteria 1-Ocean Plan, 2-LA Basin Plan, 3-Cal. Fish&Game Freshwater 4-Cal Fish&Game Saltwater, 5-Cal Toxics Rule Freshwater, 6-Cal Toxics Rule Saltwater, 7- National Non Priority Pollutant Freshwater, 8- National Non Priority Pollutant Saltwater; U=not detected at the detection limit, J=value is considered an estimate, J-=value is considered to be a low estimate, J+=values is considered to be a high estimate.

**Table 6.2 Belmont Pump and Bouton Creek Stormwater Chemistry Results: 2006/2007. (continued)**

| Analytical Parameter | Belmont Pump 12-Feb-07 | Belmont Pump 20-Apr-07 | Bouton Creek 11-Feb-07 | Bouton Creek 20-Apr-07 |
|---|---|---|---|---|
| ***Bacteria (MPN/100 ml)*** | | | | |
| Enterococcus | **26000J [1,2]** | **6710 [1,2]** | 63J | **8260 [1,2]** |
| Fecal Coliform | **30000 [1,2]** | **8000 [1,2]** | **3000 [1,2]** | **13000 [1,2]** |
| Total Coliform | **240000 [1,2]** | **50000 [1,2]** | **17000 [1,2]** | **80000 [1,2]** |
| ***Aroclors (µg/L)*** | | | | |
| Aroclor 1016 | 0.02U | 0.02U | 0.02U | 0.02U |
| Aroclor 1221 | 0.02U | 0.02U | 0.02U | 0.02U |
| Aroclor 1232 | 0.02U | 0.02U | 0.02U | 0.02U |
| Aroclor 1242 | 0.02U | 0.02U | 0.02U | 0.02U |
| Aroclor 1248 | 0.02U | 0.02U | 0.02U | 0.02U |
| Aroclor 1254 | 0.02U | 0.02U | 0.02U | 0.02U |
| Aroclor 1260 | 0.02U | 0.02U | 0.02U | 0.02U |
| ***Chlorinated Pesticides (µg/L)*** | | | | |
| 2,4'-DDD | 0.005U | 0.005U | 0.005U | 0.005U |
| 2,4'-DDE | 0.005U | 0.005U | 0.005U | 0.005U |
| 2,4'-DDT | 0.005U | 0.005U | 0.005U | 0.005U |
| 4,4'-DDD | 0.005U | 0.005U | 0.005U | 0.005U |
| 4,4'-DDE | 0.005U | 0.005U | 0.005U | 0.005U |
| 4,4'-DDT | 0.005U | 0.005U | 0.005U | 0.005U |
| Total DDT | 0 | 0 | 0 | 0 |
| Aldrin | 0.005U | 0.005U | 0.005U | 0.005U |
| Dieldrin | 0.005U | 0.005U | 0.005U | 0.005U |
| Endrin | 0.005U | 0.005U | 0.005U | 0.005U |
| Endrin aldehyde | 0.005U | 0.005U | 0.005U | 0.005U |
| Endrin ketone | 0.005U | 0.005U | 0.005U | 0.005U |
| alpha-BHC | 0.005U | 0.005U | 0.005U | 0.005U |
| beta-BHC | 0.005U | 0.005U | 0.005U | 0.005U |
| delta-BHC | 0.005U | 0.005U | 0.005U | 0.005U |
| gamma-BHC (Lindane) | 0.005U | 0.005U | 0.005U | 0.005U |
| Endosulfan I | 0.005U | 0.005U | 0.005U | 0.005U |
| Endosulfan II | 0.005U | 0.005U | 0.005U | 0.005U |
| Endosulfan sulfate | 0.005U | 0.005U | 0.005U | 0.005U |
| alpha-Chlordane | 0.0038J | 0.0186 | 0.005U | 0.005U |
| gamma-Chlordane | 0.0039J | 0.0219 | 0.005U | 0.005U |
| Heptachlor | 0.005U | 0.005U | 0.005U | 0.005U |
| Heptachlor epoxide | 0.005U | 0.005U | 0.005U | 0.005U |
| Oxychlordane | 0.005U | 0.005U | 0.005U | 0.005U |
| cis-Nonachlor | 0.005U | 0.005U | 0.005U | 0.005U |
| trans-Nonachlor | 0.0039J | 0.0135 | 0.005U | 0.005U |
| Total Chlordane | 0.0116 | 0.054 | 0 | 0 |
| Methoxychlor | 0.005U | 0.005U | 0.005U | 0.005U |
| Mirex | 0.005U | 0.005U | 0.005U | 0.005U |
| Toxaphene | 0.05U | 0.05U | 0.05U | 0.05U |

Bolded values with superscripts exceed criteria 1-Ocean Plan, 2-LA Basin Plan, 3-Cal. Fish&Game Freshwater 4-Cal Fish&Game Saltwater, 5-Cal Toxics Rule Freshwater, 6-Cal Toxics Rule Saltwater, 7- National Non Priority Pollutant Freshwater, 8- National Non Priority Pollutant Saltwater; U=not detected at the detection limit, J=value is considered an estimate, J-=value is considered to be a low estimate, J+=values is considered to be a high estimate.

**Table 6.2 Belmont Pump and Bouton Creek Stormwater Chemistry Results: 2006/2007. (continued)**

| | Belmont Pump | | Bouton Creek | |
|---|---|---|---|---|
| **Analytical Parameter** | **12-Feb-07** | **20-Apr-07** | **11-Feb-07** | **20-Apr-07** |
| ***Organophosphates (µg/L)*** | | | | |
| Bolstar (Sulprofos) | 0.004U | 0.004U | 0.004U | 0.004U |
| Chlorpyrifos | 0.002U | 0.002U | 0.002U | 0.002U |
| Demeton | 0.002U | 0.002U | 0.002U | 0.002U |
| Diazinon | 0.004U | 0.004UJ | 0.004U | 0.004UJ |
| Dichlorvos | 0.006U | 0.006U | 0.006U | 0.006U |
| Dimethoate | 0.006U | 0.006U | 0.006U | 0.006U |
| Disulfoton | 0.002U | 0.002U | 0.002U | 0.002U |
| Ethoprop | 0.002U | 0.002U | 0.002U | 0.002U |
| Fensulfothion | 0.002U | 0.002U | 0.002U | 0.002U |
| Fenthion | 0.004U | 0.004U | 0.004U | 0.004U |
| Malathion | **0.424** [7,8] | **0.519** [7,8] | 0.006U | **0.134** [7,8] |
| Merphos | 0.002U | 0.002U | 0.002U | 0.002U |
| Methyl Parathion | 0.002U | 0.002U | 0.002U | 0.002U |
| Mevinphos | 0.016U | 0.016U | 0.016U | 0.016U |
| Phorate | 0.012U | 0.012U | 0.012U | 0.012U |
| Ronnel | 0.004U | 0.004U | 0.004U | 0.004U |
| Tetrachlorvinphos (Stirophos) | 0.004U | 0.004U | 0.004U | 0.004U |
| Tokuthion (Prothiofos) | 0.006U | 0.006U | 0.006U | 0.006U |
| Trichloronate | 0.002U | 0.002U | 0.002U | 0.002U |
| ***Triazines (µg/L)*** | | | | |
| Ametryn | 0.01U | 0.01U | 0.01U | 0.01U |
| Atraton | 0.01U | 0.01U | 0.01U | 0.01U |
| Atrazine | 0.01U | 0.01U | 0.01U | 0.01U |
| Cyanazine | 0.01U | 0.01U | 0.01U | 0.01U |
| Prometon | 0.01U | 0.01U | 0.01U | 0.01U |
| Prometryn | 0.01U | 0.01U | 0.01U | 0.01U |
| Propazine | 0.01U | 0.01U | 0.01U | 0.01U |
| Secbumeton | 0.01U | 0.01U | 0.01U | 0.01U |
| Simazine | 0.01U | 0.041 | 0.01U | 0.031 |
| Simetryn | 0.01U | 0.01U | 0.01U | 0.01U |
| Terbutryn | 0.01U | 0.01U | 0.01U | 0.01U |
| Terbutylazine | 0.01U | 0.01U | 0.01U | 0.01U |

Bolded values with superscripts exceed criteria 1-Ocean Plan, 2-LA Basin Plan, 3-Cal. Fish&Game Freshwater 4-Cal Fish&Game Saltwater, 5-Cal Toxics Rule Freshwater, 6-Cal Toxics Rule Saltwater, 7- National Non Priority Pollutant Freshwater, 8- National Non Priority Pollutant Saltwater; U=not detected at the detection limit, J=value is considered an estimate, J-=value is considered to be a low estimate, J+=values is considered to be a high estimate.

**Table 6.3 Los Cerritos Channel and Dominguez Gap Pump Stormwater Chemistry Results: 2006/2007.**

| Analytical Parameter | Los Cerritos Channel 11-Feb-07 | Los Cerritos Channel 21-Apr-07 | Dominguez Gap 20-Apr-07 |
|---|---|---|---|
| ***Conventionals (mg/L)*** *unless noted* | | | |
| pH (pH Units) | **8.9** [2] | 8.0 | 6.8 |
| Conductivity (µmhos/cm) | 140 | 100 | 210 |
| Alkalinity as CaCO3 | 32 | 21 | 33 |
| Hardness as CaCO3 | 49 | 42 | 50 |
| Biochemical Oxygen Demand | 36 | 22 | 26 |
| Chemical Oxygen Demand | 120 | 150 | 150 |
| Total Organic Carbon | 24 | 25 | 47 |
| Chloride | 9.3 | 9.4 | 22 |
| Fluoride | 0.26 | 0.18 | 0.32 |
| MBAS | 0.29 | 0.071 | 0.082 |
| Oil and Grease | 1.6J | 1.1J | 5.3 |
| Total Ammonia (as N) | 0.93 | 0.62 | 0.89 |
| Total Kjeldahl Nitrogen | 3.6 | 3.8 | 3.7 |
| Nitrate (as N) | 0.97 | 0.87 | 1.3 |
| Nitrite (as N) | 0.1U | 0.044J | 0.069J |
| Orthophosphate (as P) | 0.28 | 0.24 | 0.41 |
| Total Phosphorus | 1.1 | 1.1 | 0.96 |
| Total Recoverable Phenolics | 0.1U | 0.1U | 0.1U |
| Total Dissolved Solids | 100 | 72J | 140J |
| Total Suspended Solids | 190 | 280 | 150 |
| Total Volatile Solids | 63 | 80 | 42 |
| Turbidity (NTU) | 63 | 110 | 120 |
| ***Dissolved Metals (µg/L)*** | | | |
| Aluminum | 27 | 73 | 53 |
| Arsenic | 1.8 | 1.5 | 2.2 |
| Cadmium | 0.071J | 0.12J | 0.1J |
| Chromium | 1.1 | 1.4 | 0.9 |
| Copper | **10** [5,6] | **12** [5,6] | **11** [6] |
| Iron | 81 | 120 | 200 |
| Lead | 0.86 | 1.5 | 1.8 |
| Nickel | 3.7 | 4.2 | 5.7 |
| Selenium | 1U | 1U | 1U |
| Silver | 0.2U | 0.2U | 0.2U |
| Zinc | **78** [5,6] | **91** [5,6] | **82** [6] |
| ***Total Metals (µg/L)*** | | | |
| Aluminum | **4000** [2,7] | **5900** [2,7] | **4800** [2,7] |
| Arsenic | 4.2 | 5.1 | 4.7 |
| Cadmium | 1.1 | 1.7 | 0.55 |
| Chromium | 11 | 17 | 9.9 |
| Copper | **57** [1] | **78** [1] | **47** [1] |
| Iron | **6000** [7] | **9100** [7] | **7400** [7] |
| Lead | **28** [1] | **93J** [1] | **29J** [1] |
| Nickel | 15 | **23** [1] | 13 |
| Selenium | 1U | 1U | 1U |
| Silver | 0.13J | 0.18J | 0.091J |
| Zinc | **450** [1] | **630** [1] | **260** [1] |

Bolded values with superscripts exceed criteria 1-Ocean Plan, 2-LA Basin Plan, 3-Cal. Fish&Game Freshwater 4-Cal Fish&Game Saltwater, 5-Cal Toxics Rule Freshwater, 6-Cal Toxics Rule Saltwater, 7- National Non Priority Pollutant Freshwater, 8- National Non Priority Pollutant Saltwater; U=not detected at the detection limit, J=value is considered an estimate, J-=value is considered to be a low estimate, J+=values is considered to be a high estimate.

**Table 6.3 Los Cerritos Channel and Dominguez Gap Pump Stormwater Chemistry Results: 2006/2007. (continued)**

| Analytical Parameter | Los Cerritos Channel 11-Feb-07 | Los Cerritos Channel 21-Apr-07 | Dominguez Gap 20-Apr-07 |
|---|---|---|---|
| ***Bacteria (MPN/100 ml)*** | | | |
| Enterococcus | **109J [1,2]** | **9950 [1,2]** | **7860 [1,2]** |
| Fecal Coliform | 300 | **8000 [1,2]** | **24000 [1,2]** |
| Total Coliform | 2800 | **50000 [1,2]** | **130000 [1,2]** |
| ***Aroclors (µg/L)*** | | | |
| Aroclor 1016 | 0.02U | 0.02U | 0.02U |
| Aroclor 1221 | 0.02U | 0.02U | 0.02U |
| Aroclor 1232 | 0.02U | 0.02U | 0.02U |
| Aroclor 1242 | 0.02U | 0.02U | 0.02U |
| Aroclor 1248 | 0.02U | 0.02U | 0.02U |
| Aroclor 1254 | 0.02U | 0.19 | 0.02U |
| Aroclor 1260 | 0.02U | 0.02U | 0.02U |
| ***Chlorinated Pesticides (µg/L)*** | | | |
| 2,4'-DDD | 0.005U | 0.005U | 0.005U |
| 2,4'-DDE | 0.005U | 0.005U | 0.005U |
| 2,4'-DDT | 0.005U | 0.005U | 0.005U |
| 4,4'-DDD | 0.005U | 0.005U | 0.005U |
| 4,4'-DDE | 0.005U | 0.005U | 0.005U |
| 4,4'-DDT | 0.005U | 0.005U | 0.005U |
| Total DDT | 0 | 0 | 0 |
| Aldrin | 0.005U | 0.005U | 0.005U |
| Dieldrin | 0.005U | 0.005U | 0.005U |
| Endrin | 0.005U | 0.005U | 0.005U |
| Endrin aldehyde | 0.005U | 0.005U | 0.005U |
| Endrin ketone | 0.005U | 0.005U | 0.005U |
| alpha-BHC | 0.005U | 0.005U | 0.005U |
| beta-BHC | 0.005U | 0.005U | 0.005U |
| delta-BHC | 0.005U | 0.005U | 0.005U |
| gamma-BHC (Lindane) | 0.005U | 0.005U | 0.005U |
| Endosulfan I | 0.005U | 0.005U | 0.005U |
| Endosulfan II | 0.005U | 0.005U | 0.005U |
| Endosulfan sulfate | 0.005U | 0.005U | 0.005U |
| alpha-Chlordane | 0.0081 | 0.0139 | 0.005U |
| gamma-Chlordane | 0.0081 | 0.0147 | 0.005U |
| Heptachlor | 0.005U | 0.005U | 0.005U |
| Heptachlor epoxide | 0.005U | 0.005U | 0.005U |
| Oxychlordane | 0.005U | 0.005U | 0.005U |
| cis-Nonachlor | 0.005U | 0.0116 | 0.005U |
| trans-Nonachlor | 0.0064 | 0.0096 | 0.005U |
| Total Chlordane | 0.0226 | 0.0498 | 0 |
| Methoxychlor | 0.005U | 0.005U | 0.005U |
| Mirex | 0.005U | 0.005U | 0.005U |
| Toxaphene | 0.05U | 0.05U | 0.05U |

Bolded values with superscripts exceed criteria 1-Ocean Plan, 2-LA Basin Plan, 3-Cal. Fish&Game Freshwater 4-Cal Fish&Game Saltwater, 5-Cal Toxics Rule Freshwater, 6-Cal Toxics Rule Saltwater, 7- National Non Priority Pollutant Freshwater, 8- National Non Priority Pollutant Saltwater; U=not detected at the detection limit, J=value is considered an estimate, J-=value is considered to be a low estimate, J+=values is considered to be a high estimate.

**Table 6.3 Los Cerritos Channel and Dominguez Gap Pump Stormwater Chemistry Results: 2006/2007. (continued)**

| Analytical Parameter | Los Cerritos Channel 11-Feb-07 | Los Cerritos Channel 21-Apr-07 | Dominguez Gap 20-Apr-07 |
|---|---|---|---|
| ***Organophosphates (µg/L)*** | | | |
| Bolstar (Sulprofos) | 0.004U | 0.004U | 0.004U |
| Chlorpyrifos | 0.002U | 0.002U | 0.002U |
| Demeton | 0.002U | 0.002U | 0.002U |
| Diazinon | 0.004U | 0.0232J | 0.004UJ |
| Dichlorvos | 0.006U | 0.006U | 0.006U |
| Dimethoate | 0.006U | 0.006U | 0.006U |
| Disulfoton | 0.002U | 0.002U | 0.002U |
| Ethoprop | 0.002U | 0.002U | 0.002U |
| Fensulfothion | 0.002U | 0.002U | 0.002U |
| Fenthion | 0.004U | 0.004U | 0.004U |
| Malathion | 0.006U | **0.165** [7,8] | **0.167** [7,8] |
| Merphos | 0.002U | 0.002U | 0.002U |
| Methyl Parathion | 0.002U | 0.002U | 0.002U |
| Mevinphos | 0.016U | 0.016U | 0.016U |
| Phorate | 0.012U | 0.012U | 0.012U |
| Ronnel | 0.004U | 0.004U | 0.004U |
| Tetrachlorvinphos (Stirophos) | 0.004U | 0.004U | 0.004U |
| Tokuthion (Prothiofos) | 0.006U | 0.006U | 0.006U |
| Trichloronate | 0.002U | 0.002U | 0.002U |
| ***Triazines (µg/L)*** | | | |
| Ametryn | 0.01U | 0.01U | 0.01U |
| Atraton | 0.01U | 0.01U | 0.01U |
| Atrazine | 0.01U | 0.01U | 0.01U |
| Cyanazine | 0.01U | 0.01U | 0.01U |
| Prometon | 0.01U | 0.01U | 0.01U |
| Prometryn | 0.01U | 0.01U | 0.01U |
| Propazine | 0.01U | 0.01U | 0.01U |
| Secbumeton | 0.01U | 0.01U | 0.01U |
| Simazine | 0.01U | 0.01U | 0.035 |
| Simetryn | 0.01U | 0.01U | 0.01U |
| Terbutryn | 0.01U | 0.01U | 0.01U |
| Terbutylazine | 0.01U | 0.01U | 0.01U |

Bolded values with superscripts exceed criteria 1-Ocean Plan, 2-LA Basin Plan, 3-Cal. Fish&Game Freshwater 4-Cal Fish&Game Saltwater, 5-Cal Toxics Rule Freshwater, 6-Cal Toxics Rule Saltwater, 7- National Non Priority Pollutant Freshwater, 8- National Non Priority Pollutant Saltwater; U=not detected at the detection limit, J=value is considered an estimate, J-=value is considered to be a low estimate, J+=values is considered to be a high estimate.

**Table 6.4 Summary of Results for TSS Events: 2006/2007.**

| Storm Event | TSS in mg/L | | | |
|---|---|---|---|---|
| | Belmont Pump | Bouton Creek | Los Cerritos Channel | Dominguez Pump |
| 14-Oct-06 | - | 616 | 504 | - |
| 30-Jan-07 | 360 | 54 | - | - |
| 20-Feb-07 | 260 | 120 | 100 | - |

**Table 6.5 Belmont Pump and Bouton Creek Load Calculations (in pounds) for Storm Events.**

| | Belmont Pump | | Bouton Creek | |
|---|---|---|---|---|
| **Analytical Parameter** | **12-Feb-07** | **20-Apr-07** | **11-Feb-07** | **20-Apr-07** |
| ***Conventionals*** | | | | |
| Alkalinity as $CaCO_3$ | 600 | 420 | 1500 | 1500 |
| Hardness as $CaCO_3$ | 600 | 530 | 3100 | 3100 |
| Biochemical Oxygen Demand | 71 | 150 | 1000 | 1500 |
| Chemical Oxygen Demand | 490 | 1000 | 4300 | 9800 |
| Total Organic Carbon | 110 | 230 | 1200 | 2200 |
| Chloride | 940 | 740 | 4500 | 1300 |
| Fluoride | 2.5 | 2.3 | 17 | 17 |
| MBAS | 0.94 | 0.51 | 14 | 4.2 |
| Oil and Grease | 17 | 29 | ND | 220 |
| Total Ammonia (as N) | 4.9 | 3.6 | 27 | 36 |
| Total Kjeldahl Nitrogen | 17 | 21 | 110 | 250 |
| Nitrate (as N) | 3.7 | 6.9 | 50 | 67 |
| Nitrite (as N) | ND | 0.44 | ND | 3.2 |
| Orthophosphate-P | 6 | 2 | 13 | 8.8 |
| Total Phosphorus | 7.1 | 5.3 | 29 | 47 |
| Total Recoverable Phenolics | ND | ND | ND | ND |
| Total Dissolved Solids | 2500 | 2200 | 13000 | 5200 |
| Total Suspended Solids | 130 | 1100 | 2300 | 12000 |
| Total Volatile Solids | 60 | 330 | 1100 | 4600 |
| ***Dissolved Metals*** | | | | |
| Aluminum | 0.067 | 0.25 | 1.4 | 2.6 |
| Arsenic | 0.0094 | 0.012 | 0.12 | 0.098 |
| Cadmium | 0.00022 | 0.00058 | 0.0028 | 0.0029 |
| Chromium | 0.0036 | 0.0069 | 0.045 | 0.067 |
| Copper | 0.06 | 0.096 | 0.59 | 0.77 |
| Iron | 0.41 | 0.74 | 4 | 7.2 |
| Lead | 0.0032 | 0.0053 | 0.05 | 0.098 |
| Nickel | 0.024 | 0.041 | 0.17 | 0.28 |
| Selenium | ND | ND | ND | ND |
| Silver | ND | ND | ND | ND |
| Zinc | 0.29 | 0.53 | 3 | 3.8 |
| ***Total Metals*** | | | | |
| Aluminum | 2.1 | 31 | 45 | 210 |
| Arsenic | 0.01 | 0.029 | 0.16 | 0.22 |
| Cadmium | 0.00097 | 0.0058 | 0.013 | 0.045 |
| Chromium | 0.011 | 0.08 | 0.18 | 0.57 |
| Copper | 0.14 | 0.53 | 1.3 | 3.7 |
| Iron | 3.7 | 50 | 72 | 320 |
| Lead | 0.031 | 0.24 | 0.36 | 1.8 |
| Nickel | 0.03 | 0.1 | 0.29 | 0.72 |
| Selenium | ND | ND | ND | ND |
| Silver | 0.0001 | 0.0009 | 0.0017 | 0.0057 |
| Zinc | 0.64 | 2.7 | 7.2 | 23 |

ND indicates that an analysis was performed but the analyte was not detected.
A blank cell (-) indicates that the analysis was not performed.

**Table 6.5 Belmont Pump and Bouton Creek Load Calculations (in pounds) for Storm Events. (continued)**

| | Belmont Pump | | Bouton Creek | |
|---|---|---|---|---|
| **Analytical Parameter** | **12-Feb-07** | **20-Apr-07** | **11-Feb-07** | **20-Apr-07** |
| ***Aroclors*** | | | | |
| Aroclor 1016 | ND | ND | ND | ND |
| Aroclor 1221 | ND | ND | ND | ND |
| Aroclor 1232 | ND | ND | ND | ND |
| Aroclor 1242 | ND | ND | ND | ND |
| Aroclor 1248 | ND | ND | ND | ND |
| Aroclor 1254 | ND | ND | ND | ND |
| Aroclor 1260 | ND | ND | ND | ND |
| ***Chlorinated Pesticides*** | | | | |
| 2,4'-DDD | ND | ND | ND | ND |
| 2,4'-DDE | ND | ND | ND | ND |
| 2,4'-DDT | ND | ND | ND | ND |
| 4,4'-DDD | ND | ND | ND | ND |
| 4,4'-DDE | ND | ND | ND | ND |
| 4,4'-DDT | ND | ND | ND | ND |
| Total DDT | ND | ND | ND | ND |
| Aldrin | ND | ND | ND | ND |
| Dieldrin | ND | ND | ND | ND |
| Endrin | ND | ND | ND | ND |
| Endrin aldehyde | ND | ND | ND | ND |
| Endrin ketone | ND | ND | ND | ND |
| alpha-BHC | ND | ND | ND | ND |
| beta-BHC | ND | ND | ND | ND |
| delta-BHC | ND | ND | ND | ND |
| gamma-BHC (Lindane) | ND | ND | ND | ND |
| Endosulfan I | ND | ND | ND | ND |
| Endosulfan II | ND | ND | ND | ND |
| Endosulfan sulfate | ND | ND | ND | ND |
| alpha-Chlordane | 0.000014 | 0.000099 | ND | ND |
| gamma-Chlordane | 0.000015 | 0.00012 | ND | ND |
| Heptachlor | ND | ND | ND | ND |
| Heptachlor epoxide | ND | ND | ND | ND |
| Oxychlordane | ND | ND | ND | ND |
| cis-Nonachlor | ND | ND | ND | ND |
| trans-Nonachlor | 0.000015 | 0.000072 | ND | ND |
| Total Chlordane | 0.000043 | 0.00029 | ND | ND |
| Methoxychlor | ND | ND | ND | ND |
| Mirex | ND | ND | ND | ND |
| Toxaphene | ND | ND | ND | ND |

ND indicates that an analysis was performed but the analyte was not detected.
A blank cell (-) indicates that the analysis was not performed.

**Table 6.5 Belmont Pump and Bouton Creek Load Calculations (in pounds) for Storm Events. (continued)**

| | Belmont Pump | | Bouton Creek | |
|---|---|---|---|---|
| **Analytical Parameter** | **12-Feb-07** | **20-Apr-07** | **11-Feb-07** | **20-Apr-07** |
| ***Organophosphates*** | | | | |
| Bolstar (Sulprofos) | ND | ND | ND | ND |
| Chlorpyrifos | ND | ND | ND | ND |
| Demeton | ND | ND | ND | ND |
| Diazinon | ND | ND | ND | ND |
| Dichlorvos | ND | ND | ND | ND |
| Dimethoate | ND | ND | ND | ND |
| Disulfoton | ND | ND | ND | ND |
| Ethoprop | ND | ND | ND | ND |
| Fensulfothion | ND | ND | ND | ND |
| Fenthion | ND | ND | ND | ND |
| Malathion | 0.0016 | 0.0028 | ND | 0.0069 |
| Merphos | ND | ND | ND | ND |
| Methyl Parathion | ND | ND | ND | ND |
| Mevinphos | ND | ND | ND | ND |
| Phorate | ND | ND | ND | ND |
| Ronnel | ND | ND | ND | ND |
| Tetrachlorvinphos (Stirophos) | ND | ND | ND | ND |
| Tokuthion (Prothiofos) | ND | ND | ND | ND |
| Trichloronate | ND | ND | ND | ND |
| ***Triazines*** | | | | |
| Ametryn | ND | ND | ND | ND |
| Atraton | ND | ND | ND | ND |
| Atrazine | ND | ND | ND | ND |
| Cyanazine | ND | ND | ND | ND |
| Prometon | ND | ND | ND | ND |
| Prometryn | ND | ND | ND | ND |
| Propazine | ND | ND | ND | ND |
| Secbumeton | ND | ND | ND | ND |
| Simazine | ND | 0.00022 | ND | 0.0016 |
| Simetryn | ND | ND | ND | ND |
| Terbutryn | ND | ND | ND | ND |
| Terbutylazine | ND | ND | ND | ND |

ND indicates that an analysis was performed but the analyte was not detected.
A blank cell (-) indicates that the analysis was not performed.

**Table 6.6 Los Cerritos Channel and Dominguez Gap Pump Load Calculations (in pounds) for Storm Events.**

| Analytical Parameter | Los Cerritos 11-Feb-07 | Los Cerritos 20-Apr-07 | Dominguez Gap 20-Apr-07 |
|---|---|---|---|
| ***Conventionals*** | | | |
| Alkalinity as $CaCO_3$ | 7300 | 11000 | 340 |
| Hardness as $CaCO_3$ | 11000 | 22000 | 520 |
| Biochemical Oxygen Demand | 8200 | 11000 | 270 |
| Chemical Oxygen Demand | 27000 | 78000 | 1500 |
| Total Organic Carbon | 5500 | 13000 | 480 |
| Chloride | 2100 | 4900 | 230 |
| Fluoride | 60 | 94 | 3.3 |
| MBAS | 66 | 37 | 0.84 |
| Oil and Grease | 370 | 570 | 55 |
| Total Ammonia (as N) | 210 | 320 | 9.2 |
| Total Kjeldahl Nitrogen | 820 | 2000 | 38 |
| Nitrate (as N) | 220 | 450 | 13 |
| Nitrite (as N) | ND | 23 | 0.71 |
| Orthophosphate-P | 64 | 120 | 4.2 |
| Total Phosphorus | 250 | 570 | 9.9 |
| Total Recoverable Phenolics | ND | ND | ND |
| Total Dissolved Solids | 23000 | 37000 | 1400 |
| Total Suspended Solids | 44000 | 150000 | 1500 |
| Total Volatile Solids | 14000 | 42000 | 430 |
| ***Dissolved Metals*** | | | |
| Aluminum | 6.2 | 38 | 0.55 |
| Arsenic | 0.41 | 0.78 | 0.023 |
| Cadmium | 0.016 | 0.062 | 0.001 |
| Chromium | 0.25 | 0.73 | 0.0093 |
| Copper | 2.3 | 6.2 | 0.11 |
| Iron | 19 | 62 | 2.1 |
| Lead | 0.2 | 0.78 | 0.019 |
| Nickel | 0.85 | 2.2 | 0.059 |
| Selenium | ND | ND | ND |
| Silver | ND | ND | ND |
| Zinc | 18 | 47 | 0.84 |
| ***Total Metals*** | | | |
| Aluminum | 920 | 3100 | 49 |
| Arsenic | 0.96 | 2.7 | 0.048 |
| Cadmium | 0.25 | 0.89 | 0.0057 |
| Chromium | 2.5 | 8.9 | 0.1 |
| Copper | 13 | 41 | 0.48 |
| Iron | 1400 | 4700 | 76 |
| Lead | 6.4 | 48 | 0.3 |
| Nickel | 3.4 | 12 | 0.13 |
| Selenium | ND | ND | ND |
| Silver | 0.03 | 0.094 | 0.00094 |
| Zinc | 100 | 330 | 2.7 |

ND indicates that an analysis was performed but the analyte was not detected.
A blank cell (-) indicates that the analysis was not performed.

**Table 6.6 Los Cerritos Channel and Dominguez Gap Pump Load Calculations (in pounds) for Storm Events. (continued)**

| Analytical Parameter | Los Cerritos 11-Feb-07 | Los Cerritos 20-Apr-07 | Dominguez Gap 20-Apr-07 |
|---|---|---|---|
| ***Aroclors*** | | | |
| Aroclor 1016 | ND | ND | ND |
| Aroclor 1221 | ND | ND | ND |
| Aroclor 1232 | ND | ND | ND |
| Aroclor 1242 | ND | ND | ND |
| Aroclor 1248 | ND | ND | ND |
| Aroclor 1254 | ND | 0.099 | ND |
| Aroclor 1260 | ND | ND | ND |
| ***Chlorinated Pesticides*** | | | |
| 2,4'-DDD | ND | ND | ND |
| 2,4'-DDE | ND | ND | ND |
| 2,4'-DDT | ND | ND | ND |
| 4,4'-DDD | ND | ND | ND |
| 4,4'-DDE | ND | ND | ND |
| 4,4'-DDT | ND | ND | ND |
| Total DDT | ND | ND | ND |
| Aldrin | ND | ND | ND |
| Dieldrin | ND | ND | ND |
| Endrin | ND | ND | ND |
| Endrin aldehyde | ND | ND | ND |
| Endrin ketone | ND | ND | ND |
| alpha-BHC | ND | ND | ND |
| beta-BHC | ND | ND | ND |
| delta-BHC | ND | ND | ND |
| gamma-BHC (Lindane) | ND | ND | ND |
| Endosulfan I | ND | ND | ND |
| Endosulfan II | ND | ND | ND |
| Endosulfan sulfate | ND | ND | ND |
| alpha-Chlordane | 0.0019 | 0.0072 | ND |
| gamma-Chlordane | 0.0019 | 0.0077 | ND |
| Heptachlor | ND | ND | ND |
| Heptachlor epoxide | ND | ND | ND |
| Oxychlordane | ND | ND | ND |
| cis-Nonachlor | ND | 0.006 | ND |
| trans-Nonachlor | 0.0015 | 0.005 | ND |
| Total Chlordane | 0.0052 | 0.026 | ND |
| Methoxychlor | ND | ND | ND |
| Mirex | ND | ND | ND |
| Toxaphene | ND | ND | ND |

ND indicates that an analysis was performed but the analyte was not detected.
A blank cell (-) indicates that the analysis was not performed.

**Table 6.6 Los Cerritos Channel and Dominguez Gap Pump Load Calculations (in pounds) for Storm Events. (continued)**

| Analytical Parameter | Los Cerritos 11-Feb-07 | Los Cerritos 20-Apr-07 | Dominguez Gap 20-Apr-07 |
|---|---|---|---|
| ***Organophosphates*** | | | |
| Bolstar (Sulprofos) | ND | ND | ND |
| Chlorpyrifos | ND | ND | ND |
| Demeton | ND | ND | ND |
| Diazinon | ND | 0.012 | ND |
| Dichlorvos | ND | ND | ND |
| Dimethoate | ND | ND | ND |
| Disulfoton | ND | ND | ND |
| Ethoprop | ND | ND | ND |
| Fensulfothion | ND | ND | ND |
| Fenthion | ND | ND | ND |
| Malathion | ND | 0.086 | 0.0017 |
| Merphos | ND | ND | ND |
| Methyl Parathion | ND | ND | ND |
| Mevinphos | ND | ND | ND |
| Phorate | ND | ND | ND |
| Ronnel | ND | ND | ND |
| Tetrachlorvinphos (Stirophos) | ND | ND | ND |
| Tokuthion (Prothiofos) | ND | ND | ND |
| Trichloronate | ND | ND | ND |
| ***Triazines*** | | | |
| Ametryn | ND | ND | ND |
| Atraton | ND | ND | ND |
| Atrazine | ND | ND | ND |
| Cyanazine | ND | ND | ND |
| Prometon | ND | ND | ND |
| Prometryn | ND | ND | ND |
| Propazine | ND | ND | ND |
| Secbumeton | ND | ND | ND |
| Simazine | ND | ND | 0.00036 |
| Simetryn | ND | ND | ND |
| Terbutryn | ND | ND | ND |
| Terbutylazine | ND | ND | ND |

ND indicates that an analysis was performed but the analyte was not detected.
A blank cell (-) indicates that the analysis was not performed.

**Table 6.7 Load Calculations (in pounds) for TSS Storm Events at Each Station.**

| Storm Event | Belmont Pump | Bouton Creek | Los Cerritos Channel | Dominguez Gap |
|---|---|---|---|---|
| 14-Oct-06 | - | 15000 | 8600 | - |
| 30-Jan-07 | 1800 | 800 | - | - |
| 12-Feb-07 | 130 | 2300 | 44000 | - |
| 20-Feb-07 | 520 | 6100 | 6100 | - |
| 21-Apr-07 | 1100 | 12000 | 150000 | 1500 |

## Table 6.8 Monitored Dry Weather Events, 1999-2007

| Station | 1 - 10/4/99 | 2 - 6/21/00 | 3 - 6/29/00 | 4 - 6/5/01 | 5 - 8/16/01 | 6 - 5/9,14/02 | 7 - 9/5/02 | 8 - 5/20/03 | 9 - 9/II/03 | 10 - 5/4/04 | 11 – 8/4/04 | 12 – 5/4/05 | 13 -8/18/05 | 14 -5/11/06 | 15 -9/7/06 | 16 -5/17/07 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bouton Creek | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Belmont Pump | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Los Cerritos Channel | | | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Dominguez Gap | | ●[1] | ●[1] | ●[1] | ●[1] | ●[1] | ●[1] | ●[1] | ●[1] | ●[1] | ●[1] | ●[1] | ●[1] | ●[1] | ●[1] | ●[1] |
| Alamitos Bay | ● | ● | ● | ● | ● | ● | | | | | | | | | | |

1. Intake to basin was observed to be dry. Therefore, no samples were collected.
Shading indicates 2006/2007 Dry Weather Surveys included in this report.

## Table 6.9 Field Measurements for Bouton Creek, Belmont Pump, and Los Cerritos Channel, Dry Weather Season (2006/2007).

| | Belmont Pump | | Bouton Creek | | Los Cerritos Channel | |
|---|---|---|---|---|---|---|
| **Date** | **07-Sept-06** | **17-May-07** | **07-Sept-06** | **17-May-07** | **07-Sept-06** | **17-May-07** |
| **Time** | **0745** | **0730** | **0630** | **0900** | **0921** | **1015** |
| Temperature (°C) | 23.7 | 18.8 | 20.5 | 17.8 | 26.6 | 17.8 |
| pH | 8.15 | 7.90 | 7.93 | 8.15 | 8.75 | 8.52 |
| Specific Conductivity (mS/cm) | 25.6[1] | 2.42 | 5.88 | 11.40 | 0.83 | 0.59 |
| Flow (cfs) | [2][3] | [2] | 2.88[4] | 0.85[4] | 4.97[4] | 2.38[4] |
| Dissolved Oxygen (mg/L) | 3.84 | Not measured | 4.90 | 9.70 | 19.4 | 9.60 |

1. This conductivity is much higher than has usually been measured during previous dry weather events at the Belmont Pump Station. Due to a problem with the timer that controls the maintenance pump, the sump was not being pumped down on a regular basis, so the water was becoming stagnant.
2. The flow rate was determined by observing changes in water level in the sump area over a 24-hour period.
3. Since the sump had not been pumped down to empty for several days, the water level exceeded the sump limits and was backing up in the inflow pipe. As a result, the accuracy of the calculated flow measurement is diminished by an undetermined amount.
4. Flow was determined by measuring the depth and width of the water channel, as well as the velocity of a floating object in the water.

**Table 6.10 Summary of Chemical Analyses of Dry Weather Monitoring, 2006/2007.**

| Analyte Name | Belmont Pump 7-Sept-2006 | Belmont Pump 16-May-2007 | Bouton Creek 7-Sept-2006 | Bouton Creek 17-May-2007 | Los Cerritos Channel 7-Sept-2006 | Los Cerritos Channel 17-May-2007 |
|---|---|---|---|---|---|---|
| ***Bacteria (MPN/100 ml)*** | | | | | | |
| Enterococcus | **4500J** [1,2] | **2600** [1,2] | **5500J** [1,2] | **750** [1,2] | **2400J** [1,2] | **9900** [1,2] |
| Fecal Coliform | **30000** [1,2] | **30000** [1,2] | **9000** [1,2] | 130 | **5000** [1] | **16000** [1,2] |
| Total Coliform | **50000** [1,2] | **80000J** [1,2] | **22000** [1,2] | 2400J | **26000** [1] | **24000J** [1,2] |
| ***Conventionals (mg/L)*** *unless noted* | | | | | | |
| pH (pH units-field measurements) | 8.29 | 7.7 | 7.89 | 8.14 | **9.13** [2] | **9.04** [2] |
| Conductivity (µmhos/cm) | 2500 | 4000 | 8400 | 14000 | 950 | 1100 |
| Alkalinity as CaCO3 | 420 | 490 | 160 | 150 | 140 | 120 |
| Hardness as CaCO3 | 240 | 94 | 930 | 240 | 130 | 180 |
| Biochemical Oxygen Demand | 4.8 | 2.3 | 3.6 | 5.3 | 22 | 23 |
| Chemical Oxygen Demand | 110 | 390 | 230 | 130 | 120 | 130 |
| Total Organic Carbon | 11 | 8.7 | 12 | 17 | 47 | 40 |
| Chloride | 520 | 1000 | 3000 | 5800 | 160 | 180 |
| Fluoride | 1.5 | 1.4 | 0.89 | 0.88J | 0.7 | 1.4 |
| MBAS | 0.14 | 0.1U | 0.22 | 0.073J | 0.25 | 0.11 |
| Oil and Grease | 7.4 | 5U | 5U | 5U | 5U | 5U |
| Total Ammonia (as N) | 0.33 | 0.37 | 0.039J | 0.059J | 0.16 | 0.11 |
| Total Kjeldahl Nitrogen | 1.2 | 1.3 | 0.85 | 1.4 | 4.1 | 4.4 |
| Nitrate (as N) | 0.77 | 0.79 | 0.5U | 1U | 0.21 | 0.032J |
| Nitrite (as N) | 0.14J | 0.24 | 0.5U | 1U | 0.1U | 0.1U |
| Orthophosphate (as P) | 0.1 | 0.88 | 0.01U | 0.035 | 0.017 | 0.01U |
| Total Phosphorus | 1.1 | 0.94 | 0.041 | 0.056 | 0.23 | 0.2 |
| Total Recoverable Phenolics | 100U | | 100U | | 100U | |
| Total Dissolved Solids | 1600 | 2200 | 5900 | 11000 | 640 | 630 |
| Total Suspended Solids | 4.2 | 1.3 | 2.2 | 2.8 | 38 | 20 |
| Total Volatile Solids | 1U | 0.93J | 1U | 2.1 | 1U | 16 |
| Turbidity (NTU) | 5.7 | 2.7 | 2.2 | 3 | 25 | 12 |

Bolded values with superscripts exceed criteria 1-Ocean Plan, 2-LA Basin Plan, 3-Cal. Fish&Game Freshwater 4-Cal Fish&Game Saltwater, 5-Cal Toxics Rule Freshwater, 6-Cal Toxics Rule Saltwater, 7- National Non Priority Pollutant Freshwater, 8- National Non Priority Pollutant Saltwater; U=not detected at the detection limit, J=value is considered an estimate, J-=value is considered to be a low estimate, J+=values is considered to be a high estimate.

**Table 6.10 Summary of Chemical Analyses of Dry Weather Monitoring, 2006/2007. (continued).**

| Analyte Name | Belmont Pump 7-Sept-2006 | Belmont Pump 16-May-2007 | Bouton Creek 7-Sept-2006 | Bouton Creek 17-May-2007 | Los Cerritos Channel 7-Sept-2006 | Los Cerritos Channel 17-May-2007 |
|---|---|---|---|---|---|---|
| ***Dissolved Metals (µg/L)*** | | | | | | |
| Aluminum | 43J | 17J | 100J | 26J | 16J | 4.1J |
| Arsenic | 5.5 | 3.7 | 2.7 | 2.7J | 4.8 | 4.2 |
| Cadmium | 0.2U | 1U | 0.2U | 0.05J | 0.046J | 0.25 |
| Chromium | 0.78 | 0.91J | 0.35J | 0.57J | 0.27J | 0.29J |
| Copper | **4.1** [6] | 1.6J | **3.4** [6] | **6.7** [6] | **7.5** [6] | **12** [6] |
| Iron | 42 | 65J | 36 | 23J | 19 | 30J |
| Lead | 0.65J | 0.2J | 0.65J | 0.58J | 0.74J | 0.8 |
| Nickel | 2.9J | 2.5U | 1.4J | 5U | 3.2J | 3.2 |
| Selenium | 1U | 5U | 1U | 10U | 1U | 1U |
| Silver | 0.018J | 1U | 0.019J | 2U | 0.2U | 0.026J |
| Zinc | 14J | 5.4 | 12J | 16 | 6.7J | 13 |
| ***Total Metals (µg/L)*** | | | | | | |
| Aluminum | **160** [7] | 56J | 45J | 54J | **170** [7] | **89** [7] |
| Arsenic | 5.9 | 4.1 | 3.5 | 2.9J | 6.3 | 5 |
| Cadmium | 0.2U | 0.07J | 0.2U | 0.1J | 0.096J | 0.29 |
| Chromium | 1.5J | 1.3J | 0.62J | 1J | 1.2J | 0.46J |
| Copper | 7.4 | 4.1 | 7.6 | 12 | **14** [1] | **19** [1] |
| Iron | 330 | 170 | 73 | 100 | 310 | 150 |
| Lead | 1.9 | 0.62J | 0.96 | 1.5J | 1.5 | 1.8 |
| Nickel | 4J | 2.2J | 1.6J | 2.3J | 4.9J | 4.4 |
| Selenium | 5U | 5U | 5U | 10U | 5U | 1 |
| Silver | 0.026J | 1U | 0.032J | 2U | 0.026J | 0.027J |
| Zinc | 29 | 12 | 15 | 26 | 22 | 24 |
| ***Aroclors (µg/L)100*** | | | | | | |
| Aroclor 1016 | 0.02U | 0.02U | 0.02U | 0.02U | 0.02U | 0.02U |
| Aroclor 1221 | 0.02U | 0.02U | 0.02U | 0.02U | 0.02U | 0.02U |
| Aroclor 1232 | 0.02U | 0.02U | 0.02U | 0.02U | 0.02U | 0.02U |
| Aroclor 1242 | 0.02U | 0.02U | 0.02U | 0.02U | 0.02U | 0.02U |
| Aroclor 1248 | 0.02U | 0.02U | 0.02U | 0.02U | 0.02U | 0.02U |
| Aroclor 1254 | 0.02U | 0.02U | 0.02U | 0.02U | 0.02U | 0.02U |
| Aroclor 1260 | 0.02U | 0.02U | 0.02U | 0.02U | 0.02U | 0.02U |

Bolded values with superscripts exceed criteria 1-Ocean Plan, 2-LA Basin Plan, 3-Cal. Fish&Game Freshwater 4-Cal Fish&Game Saltwater, 5-Cal Toxics Rule Freshwater, 6-Cal Toxics Rule Saltwater, 7- National Non Priority Pollutant Freshwater, 8- National Non Priority Pollutant Saltwater; U=not detected at the detection limit, J=value is considered an estimate, J-=value is considered to be a low estimate, J+=values is considered to be a high estimate.

**Table 6.10 Summary of Chemical Analyses of Dry Weather Monitoring, 2006/2007. (continued).**

| Analyte Name | Belmont Pump 7-Sept-2006 | Belmont Pump 16-May-2007 | Bouton Creek 7-Sept-2006 | Bouton Creek 17-May-2007 | Los Cerritos Channel 7-Sept-2006 | Los Cerritos Channel 17-May-2007 |
|---|---|---|---|---|---|---|
| ***Chlorinated Pesticides (µg/L)*** | | | | | | |
| 2,4'-DDD | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U |
| 2,4'-DDE | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U |
| 2,4'-DDT | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U |
| 4,4'-DDD | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U |
| 4,4'-DDE | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U |
| 4,4'-DDT | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U |
| Total DDT | 0 | 0 | 0 | 0 | 0 | 0 |
| Aldrin | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U |
| Dieldrin | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U |
| Endrin | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U |
| Endrin aldehyde | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U |
| Endrin ketone | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U |
| alpha-BHC | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U |
| beta-BHC | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U |
| delta-BHC | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U |
| gamma-BHC (Lindane) | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U |
| Endosulfan I | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U |
| Endosulfan II | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U |
| Endosulfan sulfate | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U |
| alpha-Chlordane | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U |
| gamma-Chlordane | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U |
| Heptachlor | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U |
| Heptachlor epoxide | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U |
| Oxychlordane | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U |
| cis-Nonachlor | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U |
| trans-Nonachlor | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U |
| Total Chlordane | 0 | 0 | 0 | 0 | 0 | 0 |
| Methoxychlor | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U |
| Mirex | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U | 0.005U |
| Toxaphene | 0.05U | 0.05U | 0.05U | 0.05U | 0.05U | 0.05U |

Bolded values with superscripts exceed criteria 1-Ocean Plan, 2-LA Basin Plan, 3-Cal. Fish&Game Freshwater 4-Cal Fish&Game Saltwater, 5-Cal Toxics Rule Freshwater, 6-Cal Toxics Rule Saltwater, 7- National Non Priority Pollutant Freshwater, 8- National Non Priority Pollutant Saltwater; U=not detected at the detection limit, J=value is considered an estimate, J-=value is considered to be a low estimate, J+=values is considered to be a high estimate.

**Table 6.10 Summary of Chemical Analyses of Dry Weather Monitoring, 2006/2007. (continued).**

| Analyte Name | Belmont Pump 7-Sept-2006 | Belmont Pump 16-May-2007 | Bouton Creek 7-Sept-2006 | Bouton Creek 17-May-2007 | Los Cerritos Channel 7-Sept-2006 | Los Cerritos Channel 17-May-2007 |
|---|---|---|---|---|---|---|
| ***Organophosphates (µg/L)*** | | | | | | |
| Bolstar (Sulprofos) | 0.004U | 0.004U | 0.004U | 0.004U | 0.004U | 0.004U |
| Chlorpyrifos | 0.002U | 0.002U | 0.002U | 0.002U | 0.002U | 0.002U |
| Demeton | 0.002U | 0.002U | 0.002U | 0.002U | 0.002U | 0.002U |
| Diazinon | 0.0305 | 0.004U | 0.004U | 0.004U | 0.004U | 0.004U |
| Dichlorvos | 0.006U | 0.006U | 0.006U | 0.006U | 0.006U | 0.006U |
| Dimethoate | 0.006U | 0.006U | 0.006U | 0.006U | 0.006U | 0.006U |
| Disulfoton | 0.002U | 0.002U | 0.002U | 0.002U | 0.002U | 0.002U |
| Ethoprop | 0.002U | 0.002U | 0.002U | 0.002U | 0.002U | 0.002U |
| Fensulfothion | 0.002U | 0.002U | 0.002U | 0.002U | 0.002U | 0.002U |
| Fenthion | 0.004U | 0.004U | 0.004U | 0.004U | 0.004U | 0.004U |
| Malathion | 0.006U | 0.006U | 0.006U | 0.006U | 0.006U | 0.006U |
| Merphos | 0.002U | 0.002U | 0.002U | 0.002U | 0.002U | 0.002U |
| Methyl Parathion | 0.002U | 0.002U | 0.002U | 0.002U | 0.002U | 0.002U |
| Mevinphos | 0.016U | 0.016U | 0.016U | 0.016U | 0.016U | 0.016U |
| Phorate | 0.012U | 0.012U | 0.012U | 0.012U | 0.012U | 0.012U |
| Ronnel | 0.004U | 0.004U | 0.004U | 0.004U | 0.004U | 0.004U |
| Tetrachlorvinphos (Stirophos) | 0.004U | 0.004U | 0.004U | 0.004U | 0.004U | 0.004U |
| Tokuthion (Prothiofos) | 0.006U | 0.006U | 0.006U | 0.006U | 0.006U | 0.006U |
| Trichloronate | 0.002U | 0.002U | 0.002U | 0.002U | 0.002U | 0.002U |
| ***Triazines (µg/L)*** | | | | | | |
| Ametryn | 0.01U | 0.01U | 0.01U | 0.01U | 0.01U | 0.01U |
| Atraton | 0.01U | 0.01U | 0.01U | 0.01U | 0.01U | 0.01U |
| Atrazine | 0.01U | 0.01U | 0.01U | 0.01U | 0.01U | 0.01U |
| Cyanazine | 0.01U | 0.01U | 0.01U | 0.01U | 0.01U | 0.01U |
| Prometon | 0.033 | 0.051 | 0.01U | 0.051 | 0.01U | 0.01U |
| Prometryn | 0.01U | 0.01U | 0.01U | 0.01U | 0.01U | 0.01U |
| Propazine | 0.01U | 0.01U | 0.01U | 0.01U | 0.01U | 0.01U |
| Secbumeton | 0.01U | 0.01U | 0.01U | 0.01U | 0.01U | 0.01U |
| Simazine | 0.01U | 0.01U | 0.01U | 0.01U | 0.0096J | 0.01U |
| Simetryn | 0.01U | 0.01U | 0.01U | 0.01U | 0.01U | 0.01U |
| Terbutryn | 0.01U | 0.01U | 0.01U | 0.01U | 0.01U | 0.01U |
| Terbutylazine | 0.01U | 0.01U | 0.01U | 0.01U | 0.01U | 0.01U |

Bolded values with superscripts exceed criteria 1-Ocean Plan, 2-LA Basin Plan, 3-Cal. Fish&Game Freshwater 4-Cal Fish&Game Saltwater, 5-Cal Toxics Rule Freshwater, 6-Cal Toxics Rule Saltwater, 7- National Non Priority Pollutant Freshwater, 8- National Non Priority Pollutant Saltwater; U=not detected at the detection limit, J=value is considered an estimate, J-=value is considered to be a low estimate, J+=values is considered to be a high estimate.

## 7.0 TOXICITY RESULTS

Toxicity tests were conducted on subsamples of the composites collected for chemical analysis. Wet weather samples were collected from two storm events: February 11-12 and April 20, 2007. Composite samples were collected during each of these two storm events and were tested with two species, the water flea (freshwater crustacean), and the sea urchin (marine echinoderm).

Dry weather sampling occurred on September 6-7, 2006 and May 16-17, 2007.

### 7.1 Wet Weather Discharge

Toxicity testing of wet weather discharges was conducted during two events at three sites. The following provides a summary of the results of toxicity tests conducted on stormwater composite samples at each site.

#### 7.1.1 Belmont Pump

Toxicity results from the Belmont Pump station are presented in Table 7.1 and Figure 7.1. The first sample from the Belmont Pump station was collected on February 12, 2007. This sample caused measurable toxic effects in the sea urchin, but no measurable toxicity in the water flea. Water flea survival and reproduction each showed NOECs of 100% (1 $TU_c$). The $LC_{50}$ for survival and the $EC_{50}$ for reproduction were both >100% sample (< 1 $TU_a$). The urchin fertilization test showed a NOEC of <3.1 % sample (>32 $TU_c$). The $EC_{50}$ was 18.5% sample and there were 5.4 $TU_a$ in this sample. A sea urchin TIE was initiated for this sample.

The second Belmont Pump sample was collected on April 20 2007. There was no measurable toxicity to water fleas and only minor toxicity to sea urchins. Water flea survival and reproduction each showed NOECs of 100% (1 $TU_c$). $LC_{50}$ and $EC_{50}$ values were both >100% sample (<1 $TU_a$). There was minor toxicity detected in the sea urchin fertilization test, where the NOEC was 25% sample (4 $TU_c$) and the $EC_{50}$ was >50% sample (<2 $TU_a$).

#### 7.1.2. Bouton Creek

Toxicity results from the Bouton Creek station are presented in Table 7.2 and Figure 7.2. The first sample from the Bouton Creek station was collected on February 11, 2007. The water flea bioassay showed no mortality in any test concentration, and reproduction was not significantly reduced from control levels (NOECs > 100% sample, 1 $TU_c$). The $LC_{50}$ and $EC_{50}$ were both >100% (<1 $TU_a$). The sea urchin fertilization bioassay showed a NOEC of 25% sample (4 $TU_c$) and an $EC_{50}$ of >50% sample (<2 $TU_a$).

The second Bouton Creek sample was collected on April 20 2007 and produced no toxic responses in water flea survival/reproduction (NOECs = 100% sample (1 $TU_c$) and LC/$EC_{50}$s >100%, <1 $TU_a$). The sea urchin fertilization NOEC was 12.5% sample (8 $TU_c$) and the $EC_{50}$ was >50% sample (<2 $TU_a$).

#### 7.1.3. Los Cerritos Channel

Toxicity results from the Los Cerritos Channel station are presented in Table 7.3 and Figure 7.3. The first sample from the Los Cerritos Channel station was collected on February 11, 2006. This sample produced no measurable toxicity to water flea survival and reproduction, and substantial toxicity to sea urchin

fertilization. The NOEC for both water flea survival and reproduction was 100% sample (1 $TU_c$) and the $LC_{50}$ and $EC_{50}$ were each >100% sample (<1 $TU_a$). For the sea urchin fertilization test, the NOEC was <3.1% sample (>32.3 $TU_c$) and the $EC_{50}$ was 2.25% sample (44 $TU_a$). A sea urchin TIE was initiated for this sample.

The second Los Cerritos Channel sample was collected on April 21, 2007. Water flea survival and reproduction showed no measurable toxicity. The NOECs were both 100% of the sample (1 $TU_c$) and LC/$EC_{50}$s were both >100% sample (<1 $TU_a$). The sea urchin test showed minor toxicity. The NOEC for fertilization was 25% sample (4 $TU_c$) and the $EC_{50}$ was >50% sample (<2 $TU_a$). This did not meet the criteria for initiation of a TIE.

## 7.2 Dry Weather Discharge

Toxicity results from the dry weather samples are presented in Table 7.4 and Figures 7.4 through 7.6. Toxicity tests were conducted on samples from dry weather sampling events, on September 6-7, 2006 and May 16-17, 2007. The Bouton Creek sample collected in September 2006 contained, about 5.8 ppt salinity, which is about 1.6 times the $LC_{50}$ for the water flea. This level of salinity is considered to have a potential to affect the water flea toxicity data. The May 2007 Bouton Creek sample contained a much higher salinity level (11.1 ppt) which was considered too high to allow valid testing with water fleas.

### 7.2.1 Belmont Pump Station

In September 2006, no concentration of the Belmont Pump sample produced either measurably decreased survival/reproduction in the water flea NOECs = 100% (1 $TU_c$), LC/$IC_{50}$s = >50% (<1 $TU_a$). There was no measurable decrease in sea urchin fertilization NOEC = 50% (2 $TU_c$) and $EC_{50}$ + >50% (<2 $TU_a$).

The May 2007 dry weather sample did not produce significantly decreased survival or reproduction of water fleas in any test concentration. The NOECs were 100% (1 $TU_c$) and the LC/$IC_{50}$s were >100% (<1 $TU_a$). For sea urchin fertilization the NOEC was 25% (4 $TU_c$) and the $EC_{50}$ was >50% (<2 $TU_a$)

### 7.2.2 Bouton Creek

The September 2006 bioassays showed significantly decreased survival of *Ceriodaphnia* in the 100% and 50% test concentrations. The NOEC for survival was 25% sample (4 $TU_c$) and the $LC_{50}$ for survival was 38.9 % sample (2.6 $TU_a$). There was also significantly decreased water flea reproduction in the top two sample concentrations. The NOEC for reproduction was 25% sample (4 $TU_c$) and the $EC_{50}$ for reproduction was 37.6% sample (2.7 $TU_a$).

The salinity of the May 2007 dry weather sample was too high (11.1 ppt) to allow testing with *Ceriodaphnia*. There was no measurable decrease in sea urchin fertilization NOEC = 50% (2$TU_c$) and EC50 + >50% (<2 $TU_a$) in either the September 2006 or the May 2007 Bouton Creek dry weather samples.

### 7.2.3 Los Cerritos Channel

The September 2006 dry weather sample from Los Cerritos Channel produced no significant mortality of *Ceriodaphnia* in any test concentration. The NOEC for survival was 100% sample (1 $TU_c$) and the LC50 for survival was >100% sample (<1 $TU_a$). There was significantly decreased water flea reproduction in the 100% sample concentration. The NOEC for reproduction was 50% sample (2 $TU_c$) and the $EC_{50}$ for reproduction was 74.7% sample (1.4 $TU_a$).

The September 2006 dry weather sample from Los Cerritos Channel did not produce significantly decreased fertilization of sea urchin eggs in any test concentration. The NOEC was 50% sample (2 $TU_c$) and the $EC_{50}$ was >50% (<2 $TU_a$).

The May 2007 Los Cerritos Channel dry weather sample showed no measurable decrease in either survival or reproduction in *Ceriodaphnia*. The NOEC for both test endpoints was 100% (1 $TU_c$) and the LC and $EC_{50}$s were >100% (<1 $TU_a$).

In May 2007 the sea urchin fertilization test showed significantly decreased fertilization in the 50% concentration of Los Cerritos Channel sample. The NOEC was 25% (4 $TU_c$) and the $EC_{50}$ was >50% (<2 $TU_a$).

## 7.3 Toxicity Identification Evaluations (TIEs)

A TIE was initiated when a $LC_{50}$ of ≤50% (equivalent to ≥2 acute TU) was obtained for water flea survival or an $EC_{50}$ of ≤33% (≥3 acute TU) was obtained for the sea urchin fertilization test.

Sample manipulations were performed when the TIE trigger was exceeded, but the manipulated samples were subjected to toxicity evaluations only if the baseline toxicity showed persistent toxicity of at least 2 $TU_a$. TIE activity is summarized in Table 7.5.

### 7.3.1 Stormwater Toxicity Identification Evaluations

Sea urchin TIEs were triggered for the February sampling event by samples from the Belmont Pump and Los Cerritos Channel stations. The initial sample toxicities were 5.4 and 44.4 $TU_a$, respectively. TIEs were initiated on February 20th, but baseline toxicity had fallen to <2 $TU_a$ and the TIEs were abandoned.

### 7.3.2 Dry Weather Toxicity Identification Evaluations

No dry weather samples from any of the three monitoring stations showed sufficient toxicity to trigger a TIE.

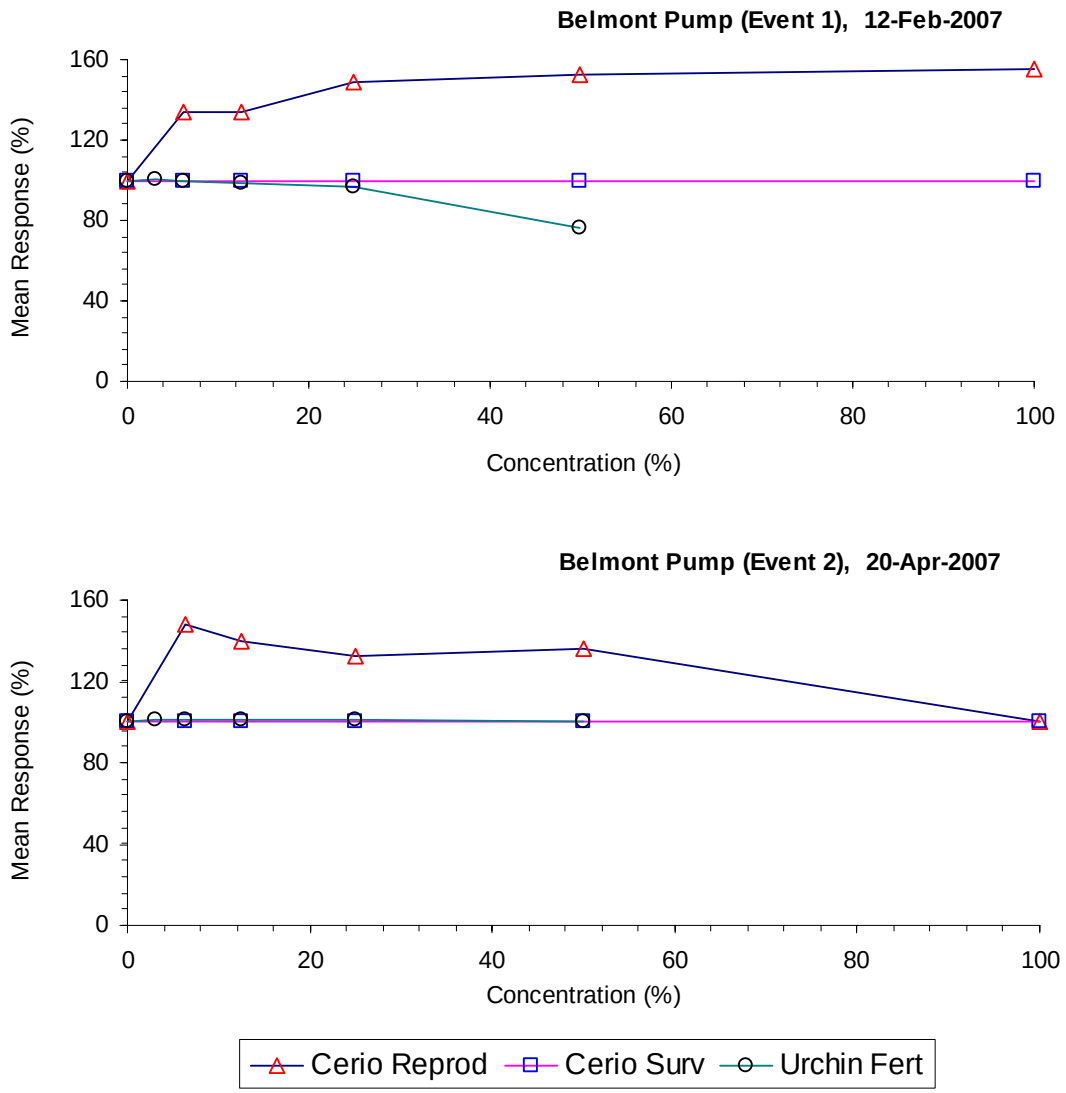



**Figure 7.1** **Toxicity Dose Response Plots for Stormwater Samples Collected from Belmont Pump, 2006/2007.**

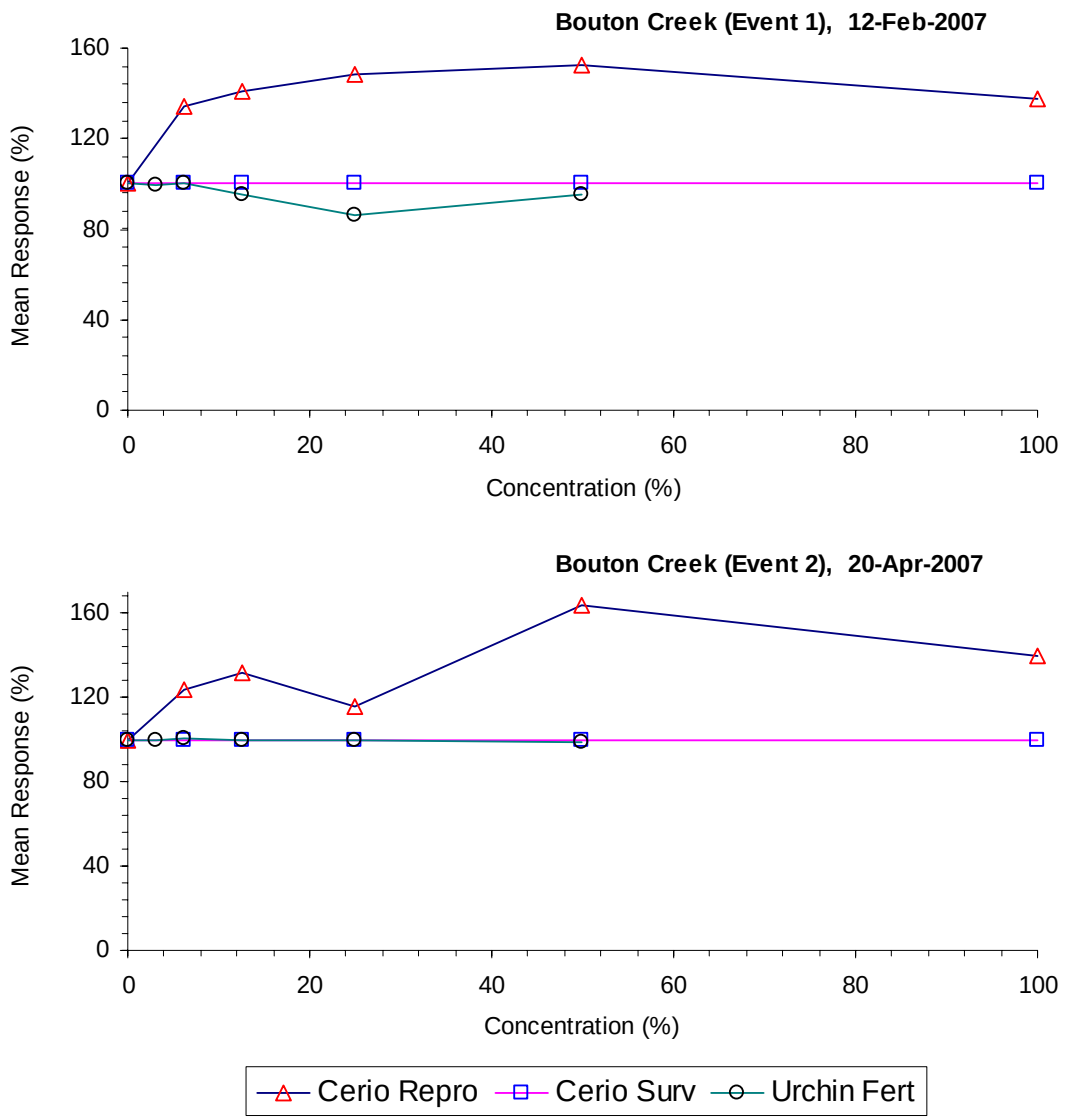



**Figure 7.2** **Toxicity Dose Response Plots for Stormwater Samples Collected from Bouton Creek, 2006/2007.**

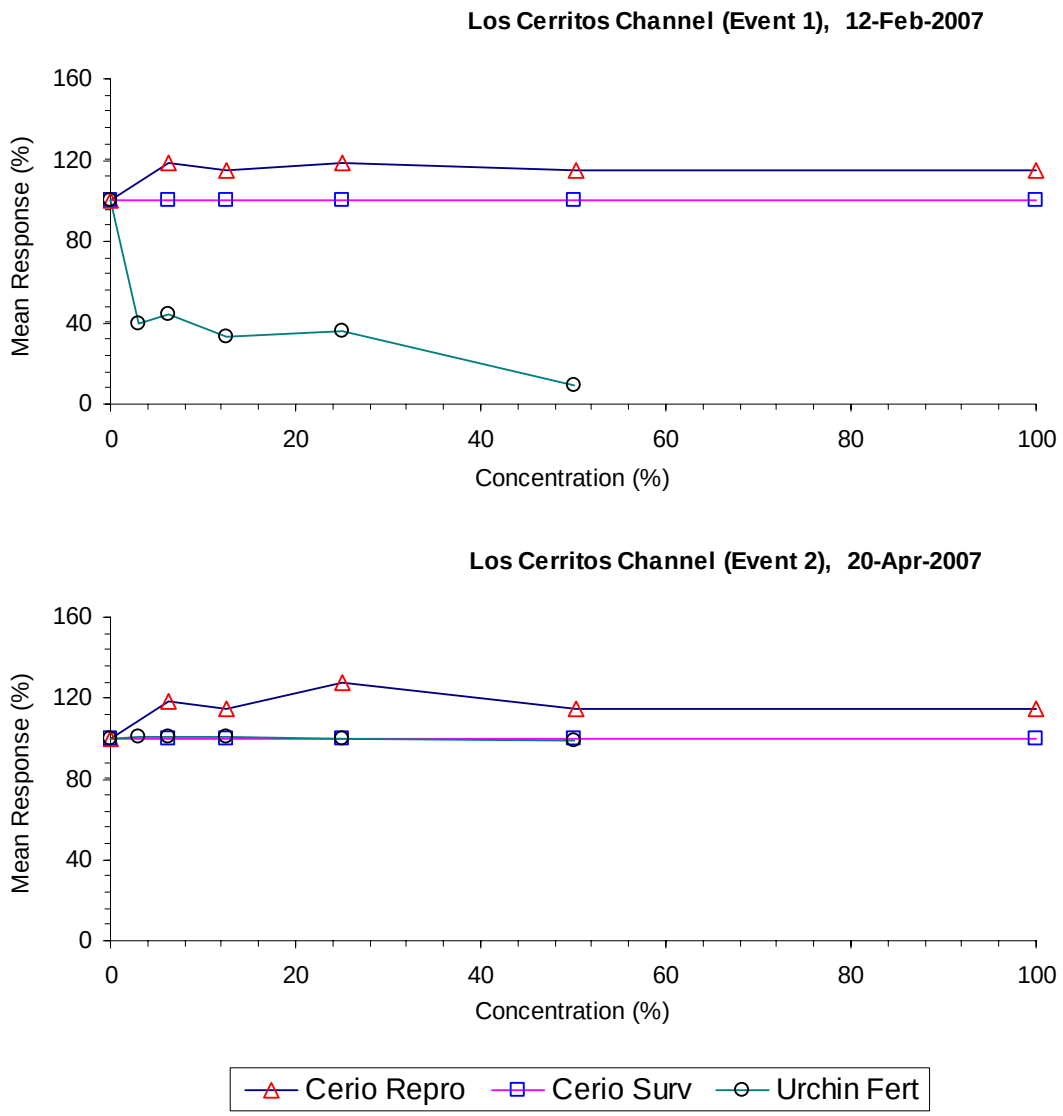



**Figure 7.3** **Toxicity Dose Response Plots for Stormwater Samples Collected from Los Cerritos Channel, 2006/2007.**

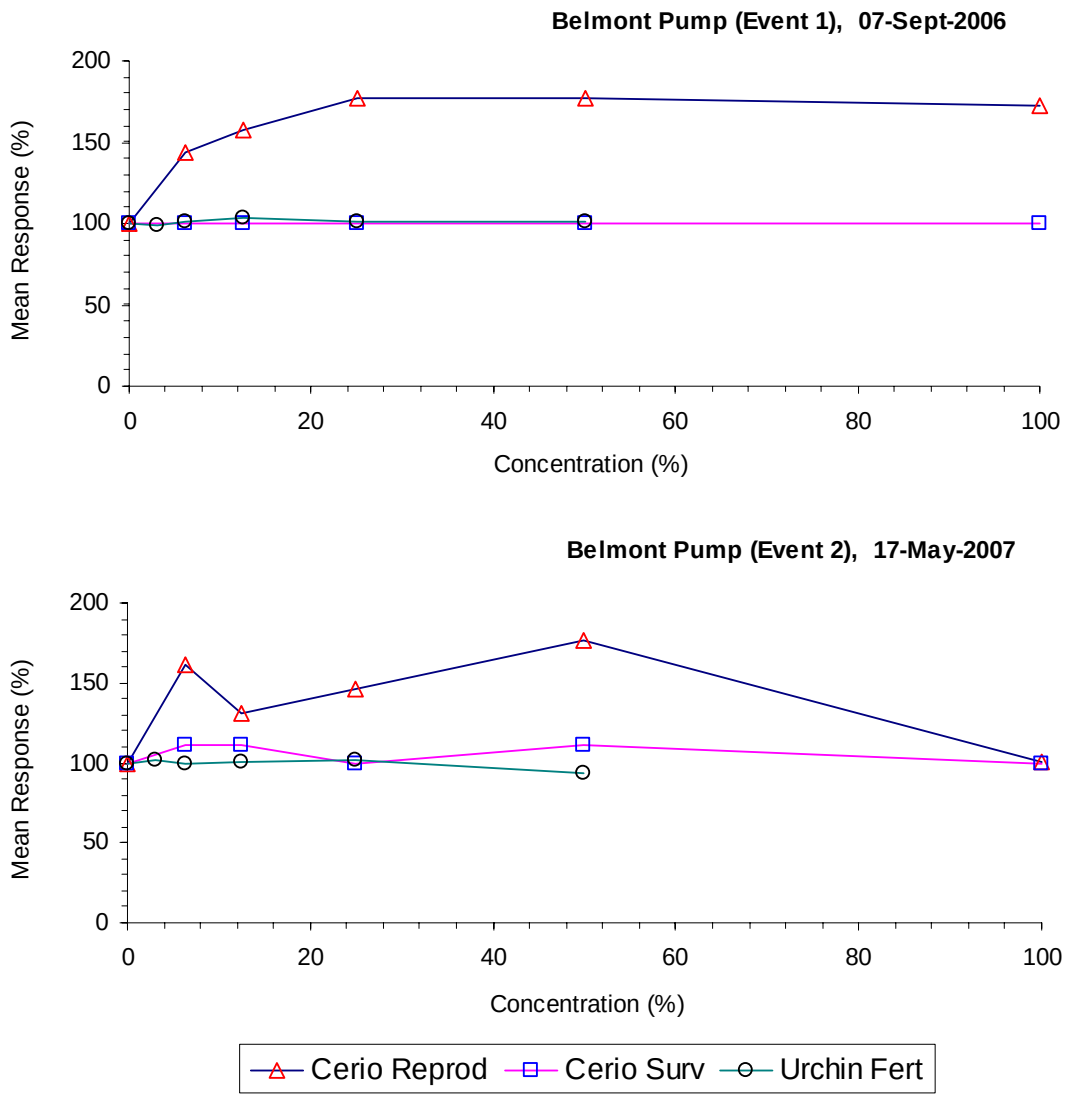



**Figure 7.4** **Toxicity Dose Response Plots for Dry Weather Samples Collected from Belmont Pump Station, 2006/2007.**

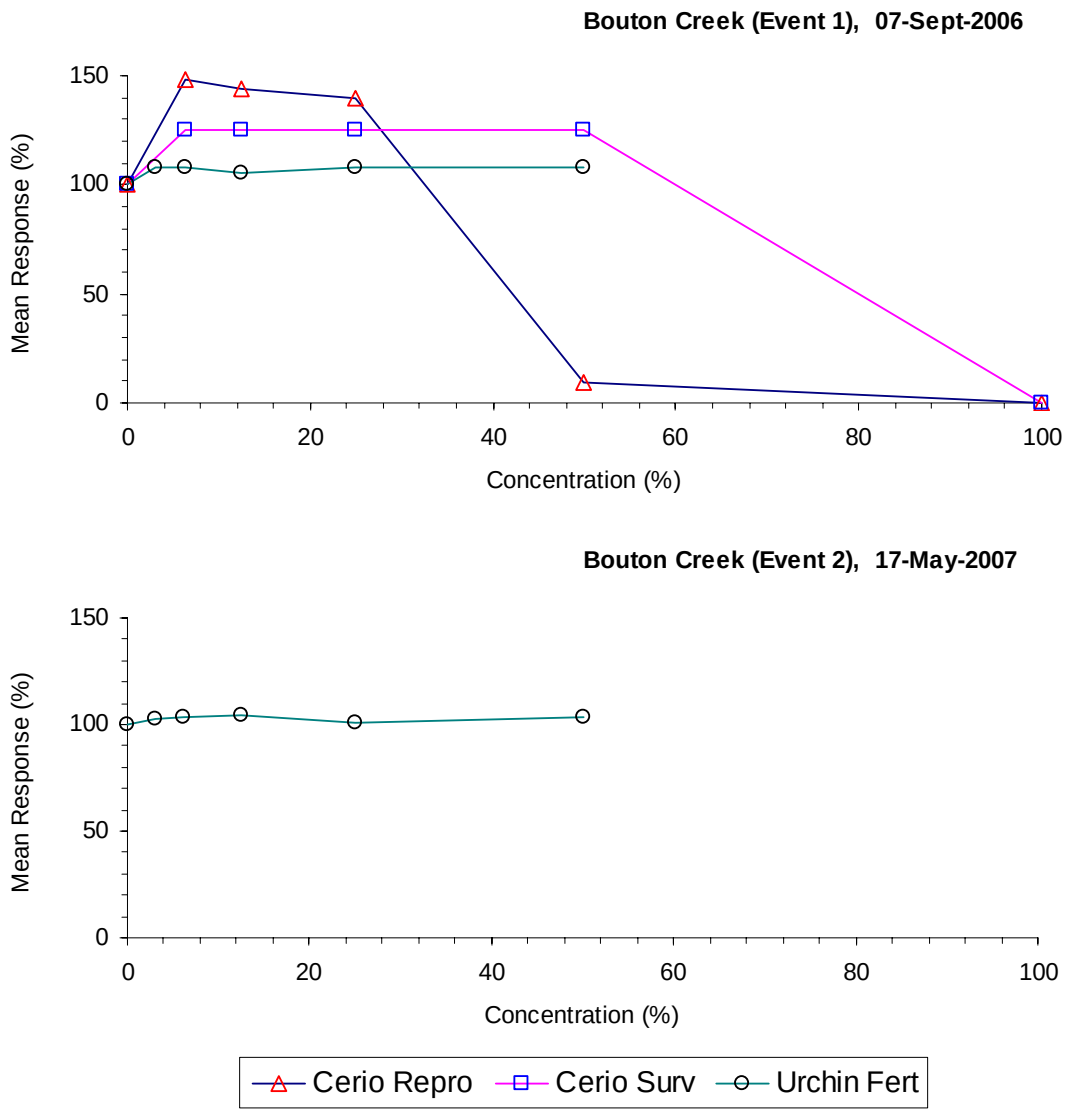



**Figure 7.5 Toxicity Dose Response Plots for Dry Weather Samples Collected from Bouton Creek, 2006/2007.**

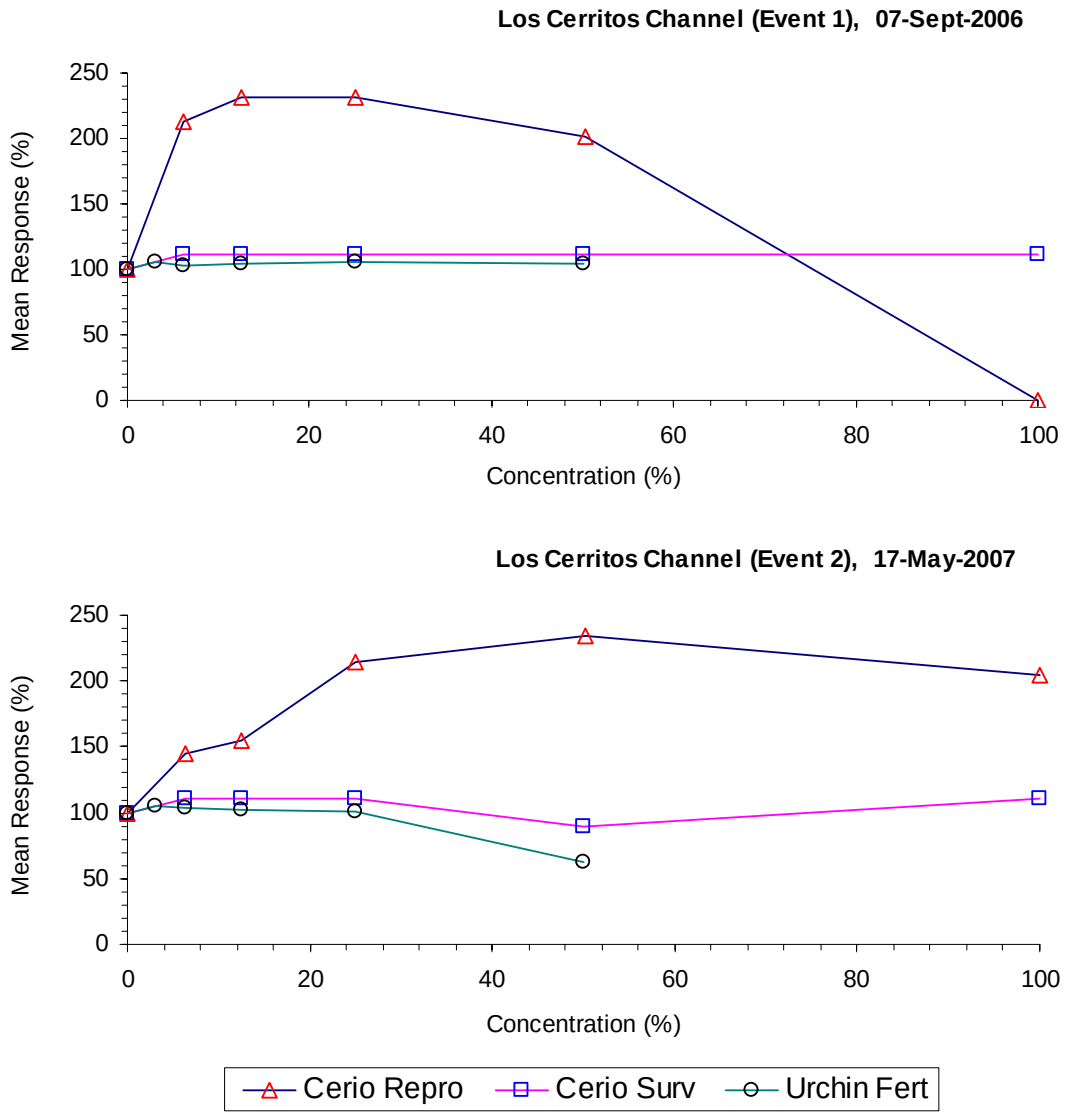



**Figure 7.6 Toxicity Dose Response Plots for Dry Weather Samples Collected from Los Cerritos Channel, 2006/2007.**

**Table 7.1** **Toxicity of Wet Weather Samples Collected from the City of Long Beach Belmont Pump Station during the 2006/2007 Monitoring Season**. Test results indicating toxicity are shown in bold type.

| Date | Test | Test Response (% sample) | | | $TU_a$[d] | $TU_c$[e] |
|---|---|---|---|---|---|---|
| | | NOEC[a] | LOEC[b] | Median Response[c] | | |
| 2/12/07 | Water Flea Survival | 100 | >100 | >100 | 1 | 1 |
| 2/12/07 | Water Flea Reproduction | 100 | >100 | >100 | 1 | 1 |
| **2/12/07** | **Sea Urchin Fertilization** | **<3.1** | **3.1** | **18.5** | **5.4** | **>32** |
| 4/20/07 | Water Flea Survival | 100 | >100 | >100 | 1 | 1 |
| 4/20/07 | Water Flea Reproduction | 100 | >100 | >100 | 1 | 1 |
| **4/20/07** | **Sea Urchin Fertilization** | **25** | **50** | **>50** | **<2** | **4** |

[a] No Observed Effect Concentration: the highest concentration with a test response not significantly different from the control.
[b] Lowest Observed Effect concentration: the lowest concentration producing a test response that was significantly different from the control.
[c] Concentration causing 50% mortality to water fleas ($LC_{50}$), 50% inhibition in water flea reproduction ($IC_{50}$), or 50% reduction in sea urchin fertilization ($EC_{50}$).
[d] Acute toxicity units = 100/ $LC_{50}$ or 100/ $IC_{50}$,
[e.] Chronic toxicity units = 100/NOEC.

**Table 7.2** **Toxicity of Wet Weather Samples Collected from the City of Long Beach Bouton Creek Station during the 2006/2007 Monitoring Season**. Test results indicating toxicity are shown in bold type.

| Date | Test | Test Response (% sample) | | | $TU_a$[d] | $TU_c$[d] |
|---|---|---|---|---|---|---|
| | | NOEC[a] | LOEC[b] | Median Response[c] | | |
| 2/12/07 | Water Flea Survival | 100 | >100 | >100 | 1 | 1 |
| 2/12/07 | Water Flea Reproduction | 100 | >100 | >100 | 1 | 1 |
| **2/12/07** | **Sea Urchin Fertilization** | **25** | **50** | **>50** | **<2** | **4** |
| 5/20/07 | Water Flea Survival | 100 | >100 | >100 | 1 | 1 |
| 5/20/07 | Water Flea Reproduction | 100 | >100 | >100 | 1 | 1 |
| **5/20/07** | **Sea Urchin Fertilization** | **12.5** | **25** | **>50** | **<2** | **8** |

[a] No Observed Effect Concentration: the highest concentration with a test response not significantly different from the control.
[b] Lowest Observed Effect concentration: the lowest concentration producing a test response that was significantly different from the control.
[c] Concentration causing 50% mortality to water fleas ($LC_{50}$), 50% inhibition in water flea reproduction ($IC_{50}$), or 50% reduction in sea urchin fertilization ($EC_{50}$).
[d] Acute toxicity units = 100/ $LC_{50}$ or 100/ $IC_{50}$,
[e.] Chronic toxicity units = 100/NOEC.

**Table 7.3** **Toxicity of Wet Weather Samples Collected from the City of Long Beach Los Cerritos Channel Station during the 2006/2007 Monitoring Season.** Test results indicating toxicity are shown in bold type.

| Date | Test | Test Response (% sample) | | | $TU_a$[d] | $TU_c$[d] |
|---|---|---|---|---|---|---|
| | | NOEC[a] | LOEC[b] | Median Response[c] | | |
| 2/12/07 | Water Flea Survival | 100 | >100 | >100 | 1 | 1 |
| 2/12/07 | Water Flea Reproduction | 100 | >100 | >100 | 1 | 1 |
| **2/12/07** | **Sea Urchin Fertilization** | **<3.1** | **3.1** | **2.25** | **44** | **32.3** |
| 5/20/07 | Water Flea Survival | 100 | >100 | >100 | 1 | 1 |
| 5/20/07 | Water Flea Reproduction | 100 | >100 | >100 | 1 | 1 |
| **5/20/07** | **Sea Urchin Fertilization** | **25** | **50** | **>50** | **<2** | **4** |

[a] No Observed Effect Concentration: the highest concentration with a test response not significantly different from the control.
[b] Lowest Observed Effect concentration: the lowest concentration producing a test response that was significantly different from the control.
[c] Concentration causing 50% mortality to water fleas ($LC_{50}$), 50% inhibition in water flea reproduction ($IC_{50}$), or 50% reduction in sea urchin fertilization ($EC_{50}$).
[d] Acute toxicity units = 100/ $LC_{50}$ or 100/ $IC_{50}$,
[e.] Chronic toxicity units = 100/NOEC.

**Table 7.4** **Toxicity of Dry Weather Samples from the City of Long Beach during the 2006/2007 Monitoring Season.** Test results indicating toxicity are shown in bold type.

| Station | Date | Test | Test Response (% sample) | | | $TU_a$[d] | $TU_c$[e] |
|---|---|---|---|---|---|---|---|
| | | | NOEC[a] | LOEC[b] | Median Response[c] | | |
| Belmont | 9/7/06 | Water Flea Survival | 100 | >100 | >100 | 1 | 1 |
| Belmont | 9/7/06 | Water Flea Reproduction | 100 | >100 | >100 | 1 | 1 |
| Belmont | 9/17/06 | Sea Urchin Fertilization | 50 | >50 | >50 | <2 | 2 |
| **Bouton** | **9/7/06** | **Water Flea Survival** | **25** | **50** | **38.9** | **2.6** | **4** |
| **Bouton** | **9/7/06** | **Water Flea Reproduction** | **25** | **50** | **37.6** | **2.7** | **4** |
| Bouton. | 9/7/06 | Sea Urchin Fertilization | 50 | >50 | >50 | <2 | 2 |
| Los Cerritos | 9/7/06 | Water Flea Survival | 100 | >100 | >100 | 1 | 1 |
| **Los Cerritos** | **9/7/06** | **Water Flea Reproduction** | **50** | **100** | **74.7** | **1.3** | **2** |
| Los Cerritos | 9/7/06 | Sea Urchin Fertilization | 50 | >50 | >50 | <2 | 2 |
| Belmont | 5/17/07 | Water Flea Survival | 100 | >100 | >100 | 1 | 1 |
| Belmont | 5/17/07 | Water Flea Reproduction | 100 | >100 | >100 | 1 | 1 |
| **Belmont** | **5/17/07** | **Sea Urchin Fertilization** | **25** | **50** | **>50** | **<2** | **4** |
| Bouton | 5/17/07 | Water Flea Survival | NT | NT | NT | NT | NT |
| Bouton | 5/17/07 | Water Flea Reproduction | NT | NT | NT | NT | NT |
| Bouton | 5/17/07 | Sea Urchin Fertilization | 50 | >50 | >50 | <2 | 2 |
| Los Cerritos | 5/17/07 | Water Flea Survival | 100 | >100 | >100 | 1 | 1 |
| Los Cerritos | 5/17/07 | Water Flea Reproduction | 100 | >100 | >100 | 1 | 1 |
| **Los Cerritos** | **5/17/07** | **Sea Urchin Fertilization** | **25** | **50** | **>50** | **<2** | **4** |

NT=Sample not tested due to elevated salinity

[a] No Observed Effect Concentration: the highest concentration with a test response not significantly different from the control.

[b] Lowest Observed Effect concentration: the lowest concentration producing a test response that was significantly different from the control.

[c] Concentration causing 50% mortality to water fleas ($LC_{50}$), 50% inhibition in water flea reproduction ($IC_{50}$), or 50% reduction in sea urchin fertilization ($EC_{50}$).

[d] Acute toxicity units = 100/ $LC_{50}$ or 100/ $IC_{50}$,

[e.] Chronic toxicity units = 100/NOEC.

**Table 7.5** **Summary of TIE Activities.** Acute Toxic Units ($TU_a$s) for the initial (TU-I) and TIE baseline (TU-B) tests are shown (96 hr exposure time for water flea), along with the TIE-related action taken. TIEs were abandoned when the baseline $TU_a$ value fell below 2.0.

| | | Water Flea | | | Sea Urchin | | |
|---|---|---|---|---|---|---|---|
| Date | Test | TU-I | TU-B | Action | TU-I | TU-B | Action |
| **Wet Weather Events** | | | | | | | |
| 2/12/07 | Belmont | | | | 5.4 | <2 | Abandon |
| 2/12/07 | Cerritos | | | | 44.4 | <2 | Abandon |

# 8.0 ALAMITOS BAY RECEIVING WATER STUDY RESULTS

Due to the extreme drought conditions during the 2006/2007 storm season, the Alamitos Bay Receiving Water Study was conducted late in the season. In fact, this event occurred outside of the wet season as defined in the NPDES permit. The City of Long Beach NPDES permit defines the wet season as October 1 through April 15. The Alamitos Bay Receiving Water Study was initiated following a storm on April 20, 2007.

## 8.1 Vertical and Horizontal Extent of the Stormwater Plume

Runoff during the April 20, 2007 storm resulted in a surface plume that extended from the lower reaches of Los Cerritos Channel to approximately 0.5 km in the northwesterly direction from the mouth of the channel and two kilometers in the southeasterly direction (Figure 8.1). No other plume was recorded in the Bay for this event. Rainfall measures at the Long Beach mass emission sites ranged from 0.25 inches to 0.65 inches over a period of roughly twelve hours from approximately 0400 hours to 1600 hours throughout the day on April 20. The Long Beach Airport recorded 0.51 inches of rainfall during the same time period. The plume characteristics of this were evaluated on the evening of April 20, 2007 from 1700 to 2058 hours.

Based upon the plume characteristics, the Los Cerritos Channel was the major source of stormwater entering Alamitos Bay. Measured surface salinity within Alamitos Bay ranged from 3.88 to 35.3 ppt. The lowest salinities were found within the lower reaches of the Los Cerritos Channel near the Pacific Coast Highway Bridge. The higher surface salinities occurred nearer the Bay entrance and the western half of Alamitos Bay. The upper reaches of Marine Stadium had near open coast salinities (Figure 8.2a), indicating that there was no plume from this portion of the watershed during this moderate event. Surface salinity near the East 2$^{nd}$ Street Bridge was also near open coast salinities (Figure 8.2l), indicating there was no freshwater source in this area.

The vertical extent of the stormwater plume was determined through the fourteen depth profiles taken in the Los Cerritos Channel and throughout Alamitos Bay (Figure 8.1). The fresher stormwater formed a surface plume that was typically from a half foot to two feet in depth. The layer was thickest and most distinct in Cerritos Channel (Casts # 6, #7 and #8, Figure 8.2f, g, h). The plume identifying characteristics were of lower salinity and higher turbidity. The structure of the plume became increasing indistinct towards the entrance to Alamitos Bay (Casts # 1 and #2, Figure 8.2a and b), and in the upper reaches of Marine Stadium (Cast #9, Figure 8.2i).

The stormwater plume within the Los Cerritos Channel had measured surface salinities ranging from 3.88 ppt near the Pacific Coast Highway Bridge to 10.5 ppt as it entered the Marine Stadium area. The stormwater plume tended to be only slightly warmer than the underlying marine waters. Surface temperatures in the plume ranged from 0.3 to 0.9 degrees centigrade lower at the surface than the deeper marine waters. Turbidity in the surface plume ranged from 16 to 43 FNU. Marine water under the plume was relatively clear with turbidity measurements typically in the range of 1 to 3 FNU.

## 8.2 Chemical Characterization

After mapping the plume, four receiving water sites within the plume were selected on the basis of salinity. The location of these sites is shown in Figure 8.3 and Table 8.1. Sampling at the receiving water sites began with a CTD profile using the YSI Sonde, which was followed by a grab sample to be sent to the chemistry lab for analysis (summarized in Table 8.2). *In situ* water quality measurements of the surface water at each receiving water quality site are summarized in Table 8.3.

Sampling was initiated at RW4 where salinity within the plume was recorded by the sonde at 24.1 ppt. Cast #2 in Figure 8.2b is associated with this receiving water site. Three additional sites were sampled with sonde recorded salinities of 19.8 ppt (RW3 and Cast #3), 10.3 ppt (RW1 and Cast #6) and 13.9 ppt (RW2 and Cast #12). Influence of stormwater would, therefore, be highest at RW1 and lowest at RW4.

Total suspended solids (TSS) increased with increasing stormwater influence although the TSS measurement at RW3 was rejected during the QA/QC review as grossly outside the possible range. It is suspected that the laboratory mislabeled a blank as the RW3 TSS sample. Total metal concentrations, for the most part, increased with decreasing salinity (or increasing stormwater influence) for each of the metals tested. Concentrations were lowest in Alamitos Bay at station RW4 and almost half those of the highest station, RW2, just outside of the Channel in the direction of the harbor. Total zinc concentrations exceeded the California Ocean Plan 2002 daily maximum concentration of 80 µg/L at stations RW1 and RW2.

With the exception of cadmium, dissolved metals also showed a clear pattern of stormwater influence. Dissolved metal concentrations increased as the salinity decreased. Dissolved copper concentrations exceeded the California Toxics Rule for Saltwater Criterion Maximum Concentration (CMC) of 4.8 µg/L at stations RW1 and RW2 and the Criterion Continuous Concentration (CCC) of 3.1 µg/L at all receiving water stations.

Organophosphate (OP) pesticides were present in low, but measurable, amounts at the receiving water stations. Malathion and chlorpyrifos (Dursban) showed a pattern of increasing concentration with increasing stormwater influence, while diazinon did not.

Aroclors and PCB congeners were not detected in any of the receiving water stations.

## 8.3 Toxicological Characterization

Water samples from the four plume sites were tested for toxicity using the sea urchin fertilization test. Samples from each of the receiving water stations were tested at five concentrations (3.1%, 6.25%, 12.5%, 25%, and 50%) and each showed negligible toxicity. (Table 8.4, Figure 8.4). All NOECs were 50% sample, and $EC_{50}$s were all >50% sample. The mean proportion of fertilized eggs in the highest (50%) sample concentrations ranged from 95.8% to 97.6% compared to laboratory control fertilization of 95.2% to 100%.

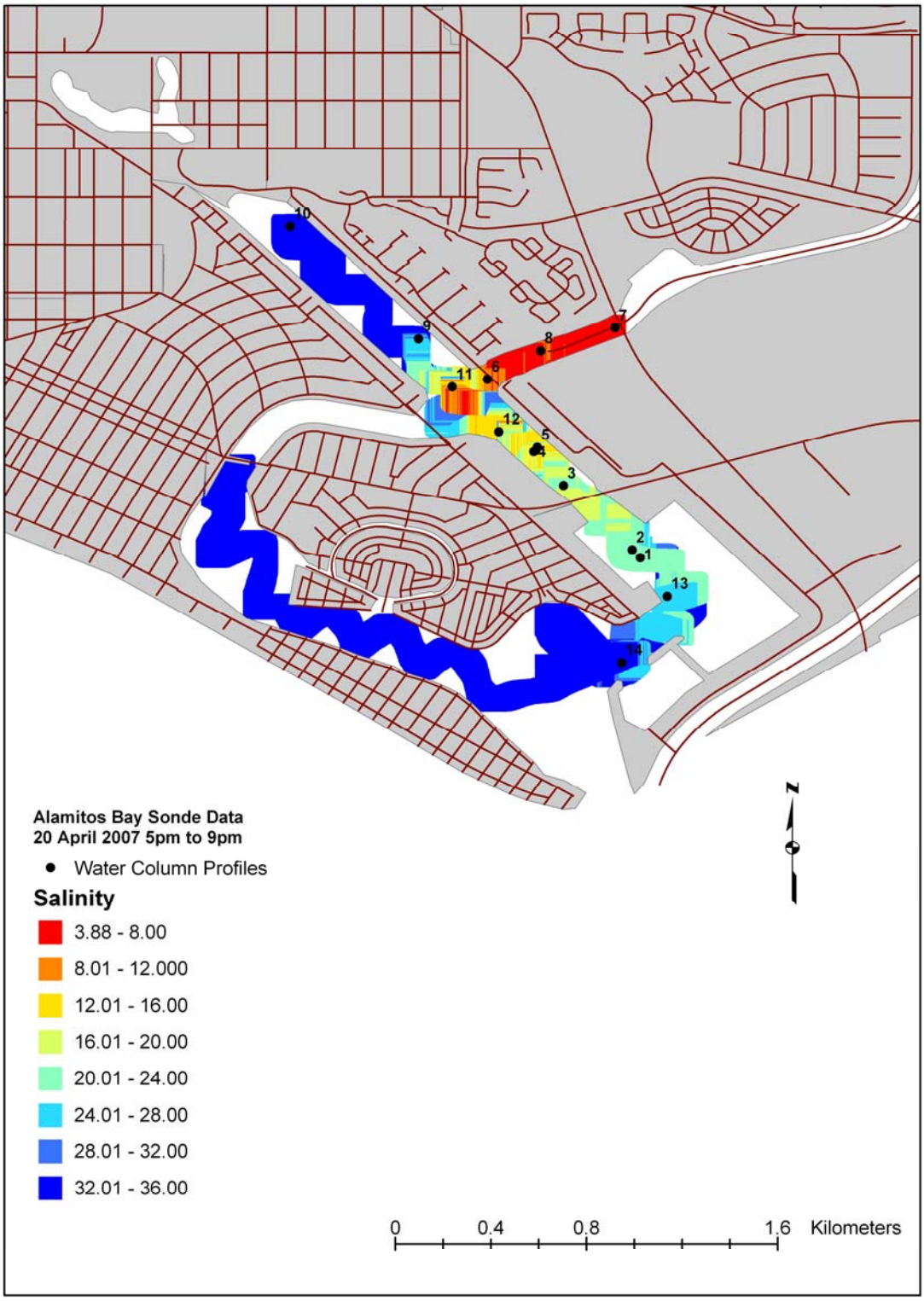



**Figure 8.1** **Map of Surface Salinity in Alamitos Bay with Locations of Fourteen Water Quality Profiling Sites, April 20, 2007.**

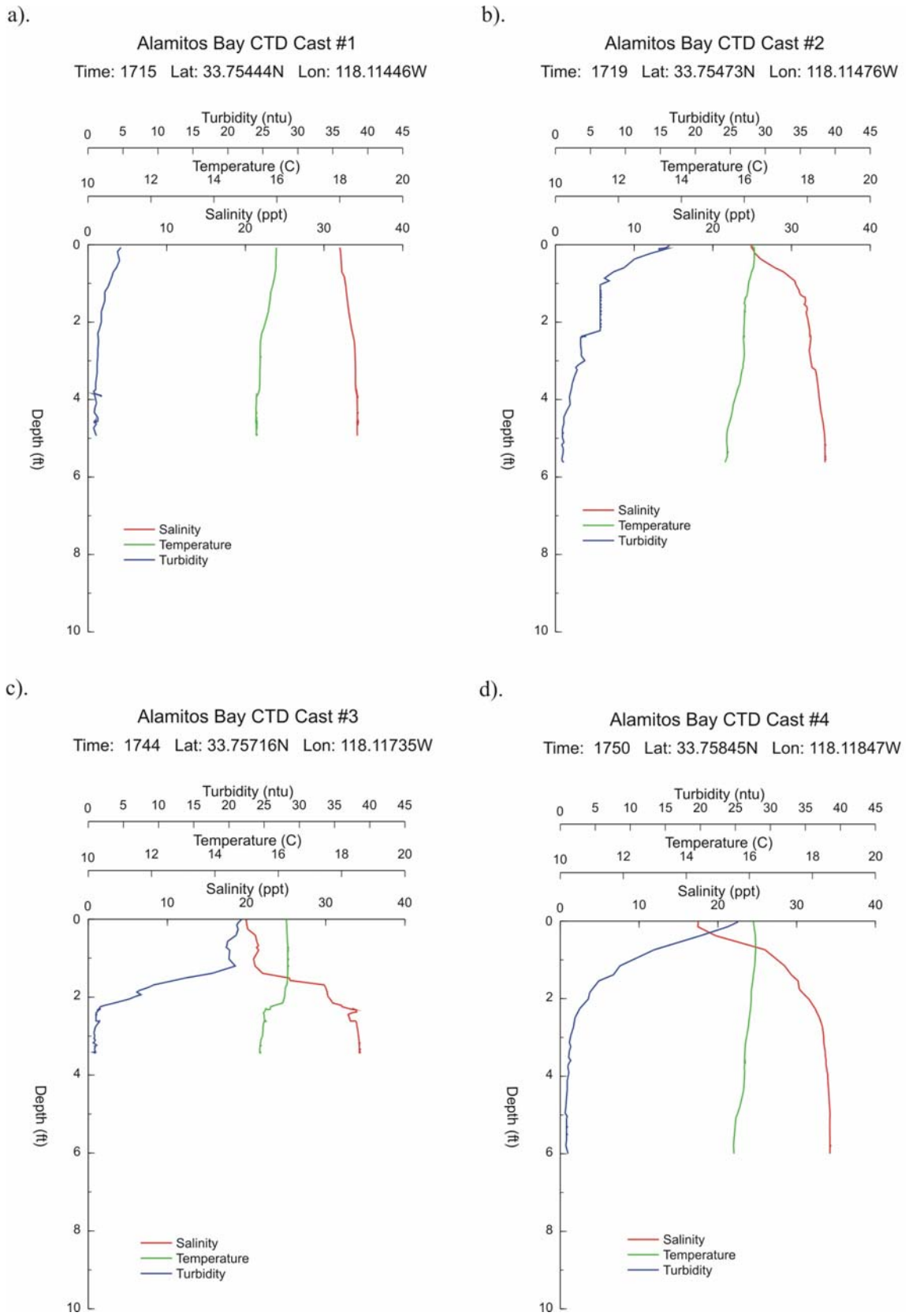



**Figure 8.2(a-d) CTD Casts taken during Alamitos Bay Receiving Water Study.** (Locations of each cast are shown on Figure 8.1)

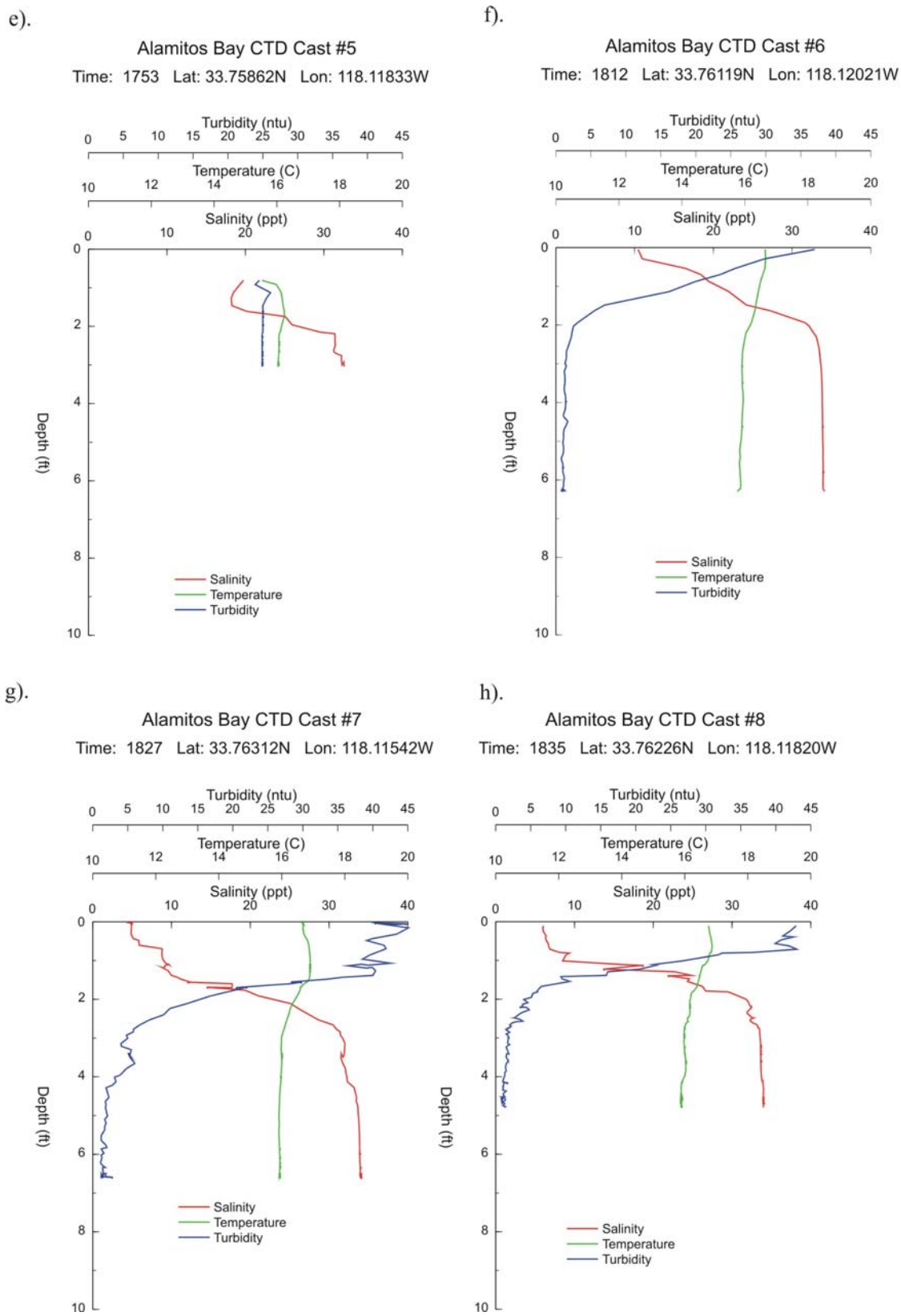



**Figure 8.2(e-h)** **CTD Casts taken during Alamitos Bay Receiving Water Study.** (Locations of each cast are shown on Figure 8.1)

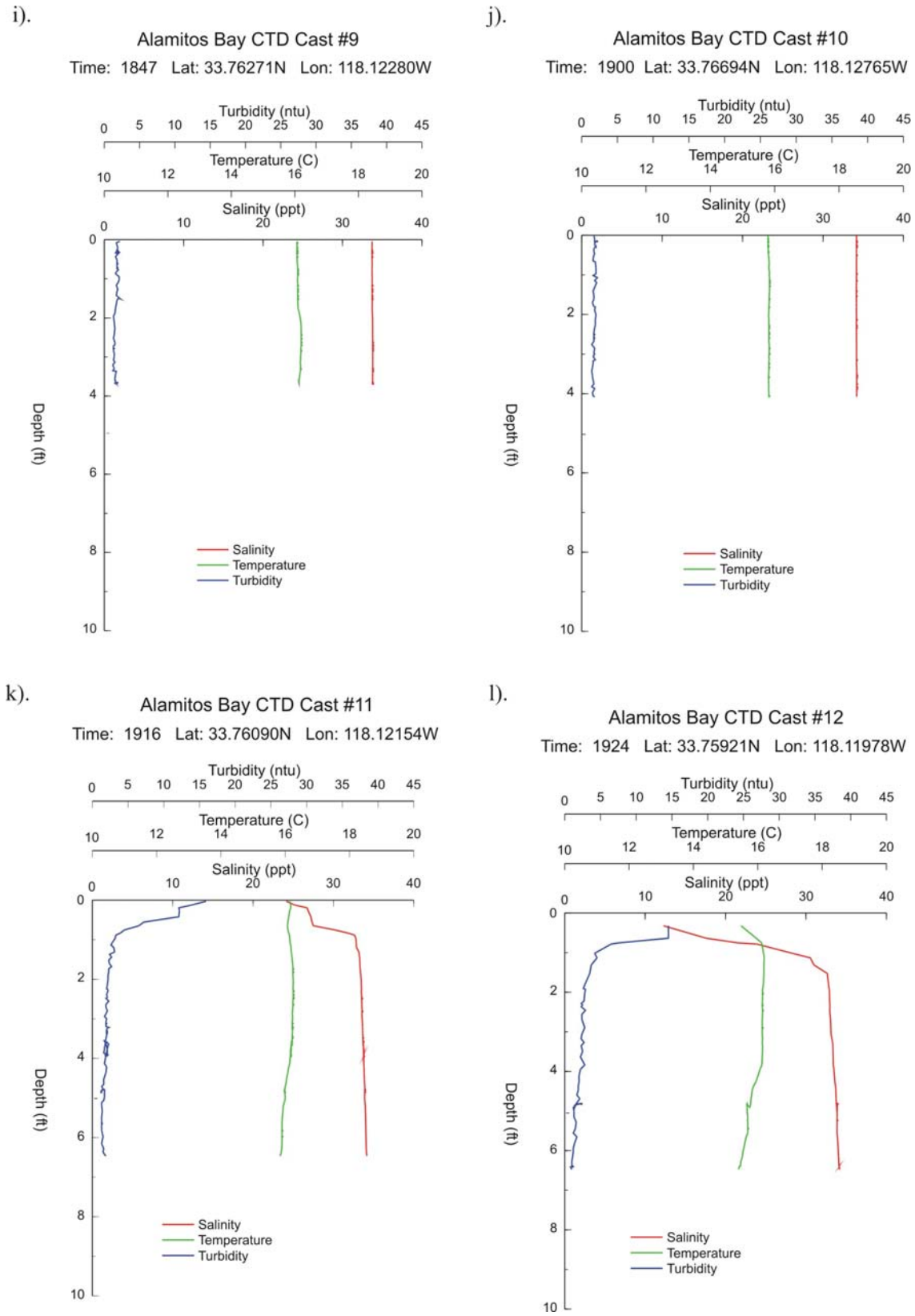
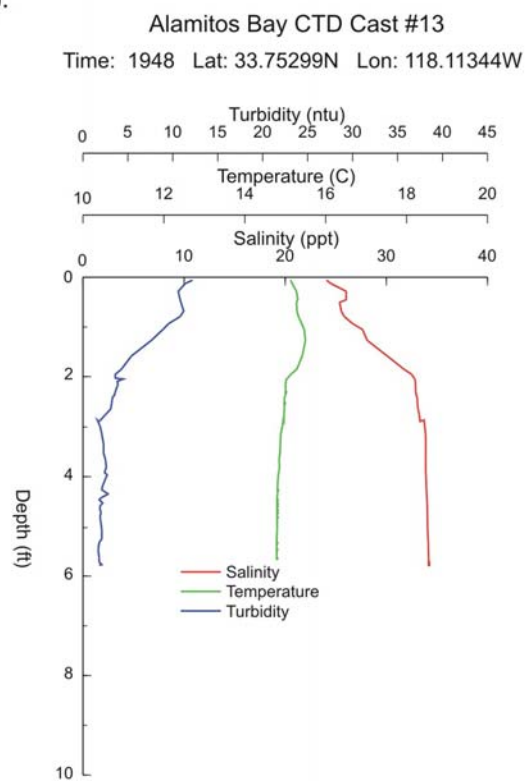



**Figure 8.2(i-l) CTD Casts taken during Alamitos Bay Receiving Water Study.** (Locations of each cast are shown on Figure 8.1)

m).




n).

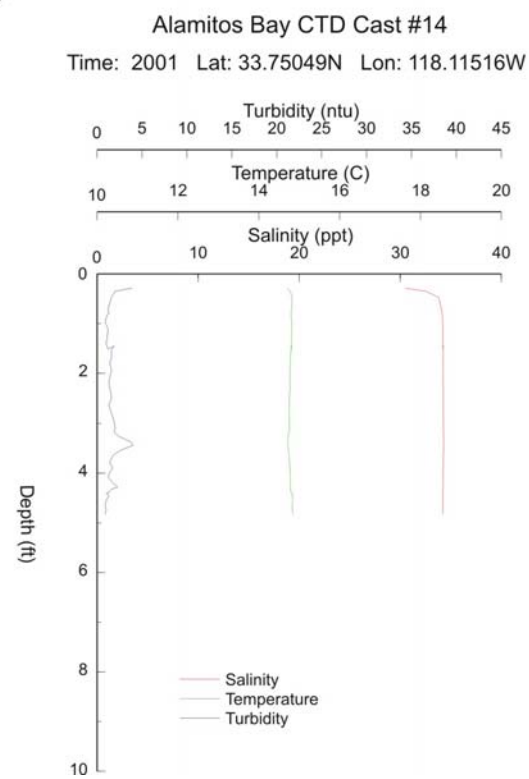



**Figure 8.2(m-n) CTD Casts taken during Alamitos Bay Receiving Water Study.** (Locations of each cast are shown on Figure 8.1)

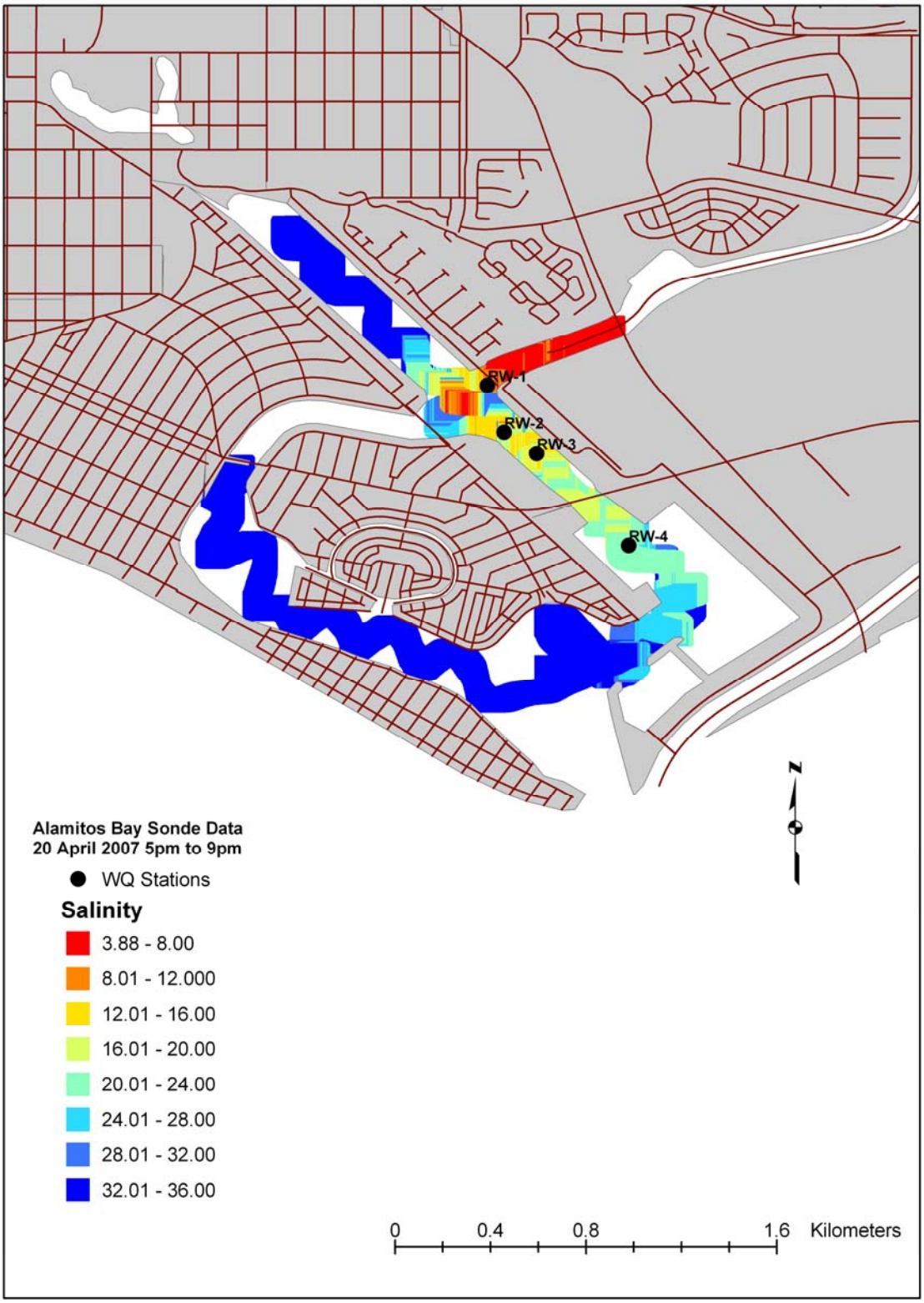



**Figure 8.3** **Map of Surface Salinity in Alamitos Bay with Water Quality Sampling Locations, April 20, 2007.**

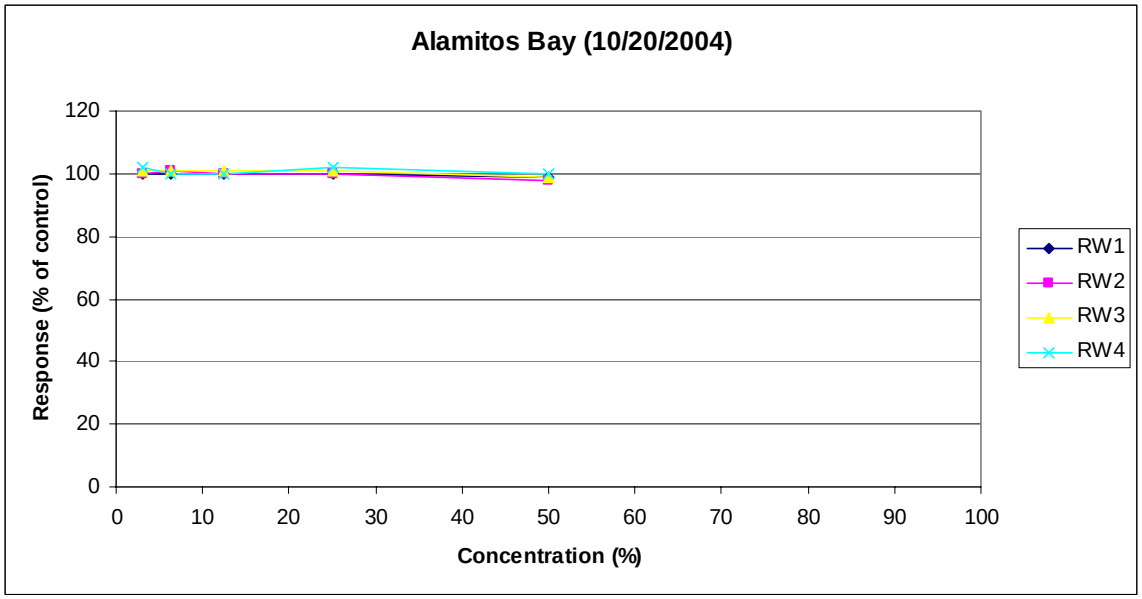



**Figure 8.4** **Toxicity Dose Response Plots for Sea Urchin Fertilization Tests using Stormwater Plume Samples collected from Alamitos Bay.**

**Table 8.1 Geographic Location and Time of Sampling for each Plume Monitoring Station in Alamitos Bay, April 20, 2007.**

| Station ID | Time (PST) | Latitude (DD.dddd)[1] | Longitude (DD.dddd) |
|---|---|---|---|
| RW-1 | 18:14 | 33.76099 | 118.12019 |
| RW-2 | 19:27 | 33.75921 | 118.11957 |
| RW-3 | 17:52 | 33.75841 | 118.11834 |
| RW-4 | 17:28 | 33.75494 | 118.11488 |

1. All positions based upon NAD83

**Table 8.2 Summary of Receiving Water Quality in Stormwater Plume Samples from Alamitos Bay.** U=measured below the detection limit.

| | Receiving Water Monitoring Sites | | | |
|---|---|---|---|---|
| **ANALYTE** | **RW1** | **RW2** | **RW3** | **RW4** |
| ***Conventionals*** | | | | |
| Total Suspended Solids (mg/L) | 36 | 24.5 | R | 13 |
| Ammonia as N (mg/L) | 0.53 | 0.44 | 0.35 | 0.30 |
| ***Total Metals (µg/L)*** | | | | |
| Cadmium | 0.171 | 0.169 | 0.121 | 0.11 |
| Copper | 17.3 | 17.8 | 13.6 | 10.8 |
| Nickel | 4.19 | 4.43 | 3.47 | 2.84 |
| Lead | 7.47 | 7.51 | 5.75 | 4.36 |
| Zinc | 93.1 | 90.7 | 71.8 | 56.9 |
| ***Dissolved Metals (µg/L)**** | | | | |
| Cadmium | 0.063 | 0.071 | 0.086 | 0.041 |
| Copper | 5.12 | 5.01 | 4.71 | 3.72 |
| Nickel | 2.92 | 2.80 | 2.29 | 1.84 |
| Lead | 0.722 | 0.713 | 0.552 | 0.380 |
| Zinc | 65.2 | 65.8 | 51.1 | 35.0 |
| ***Organophosphate Pesticides (µg/L)*** | | | | |
| Chlorpyrifos (Dursban) | 0.029 | 0.002U | 0.002U | 0.002U |
| Diazinon | 0.004U | 0.024 | 0.019 | 0.028 |
| Malathion | 0.212 | 0.146 | 0.109 | 0.090 |

U=Analyte was not detected at the associated reporting limit.
J=Analyte was detected at a concentration below the reporting limit and above the laboratory method detection limit. Reported value is considered a estimate of the true value.
R= Reported value was rejected as invalid after a review of the QA/QC and field data. The laboratory reported suspended sediment concentrations below the reporting limit of 1 mg/L. This is far below the expected range given both the field observations and turbidity measurements.

**Table 8.3** ***In Situ*** **Water Quality Data for each Receiving Water Station, April 20, 2007.**

| Station ID | Temp (°C) | SpCond (mS/cm) | Salinity (ppt) | DO (%) | DO Conc (mg/L) | pH | Turbidity (FNU) |
|---|---|---|---|---|---|---|---|
| RW-1 | 16.0 | 17.4 | 10.3 | 69 | 6.4 | 7.7 | 37.1 |
| RW-2 | 15.0 | 22.9 | 13.9 | 54 | 5.0 | 8.0 | 30.1 |
| RW-3 | 15.9 | 31.7 | 19.8 | 92 | 8.1 | 7.7 | 23.0 |
| RW-4 | 16.3 | 37.8 | 24.1 | 104 | 8.8 | 7.6 | 15.7 |

**Table 8.4** **Toxicity of Receiving Water Samples Collected at the Stormwater Plume Sites in Alamitos Bay, April 20, 2007.**

| | | Receiving Water Monitoring Sites | | | |
|---|---|---|---|---|---|
| **Test Species** | **Endpoint** | **RW1** | **RW2** | **RW3** | **RW4** |
| *S. purpuratus*-Fertilization | $EC_{50}$ | >50% | >50% | >50% | >50% |
| | NOEC | 50% | 50% | 50% | 50% |

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# 9.0 DISCUSSION

The following sections discuss the quality of stormwater and dry weather discharges from the four mass emission monitoring sites. Concentrations of contaminants measured in both stormwater and dry weather discharges are compared with various receiving water quality criteria. Temporal trends over the past eight years are examined for principal contaminants of concern. Loading rates calculated for each monitored watershed are examined to more effectively identify areas that contribute to excessive loads. Identification of such areas is intended to provide information needed to prioritize BMP implementation. Lastly, the toxicity of both stormwater and dry weather discharges is evaluated for the current year and general trends are examined over the duration of this permit.

## 9.1 Comparison to Water Quality Criteria

Numerical standards are not available for stormwater discharges. The State Board recently assembled a panel of stormwater experts from the academic and scientific communities to address the issue of the feasibility of developing numerical standards for stormwater discharges from municipal, industrial and construction activities. This group concurred that numerical standards for stormwater are still not technically feasible (Storm Water Panel, 2006). Water quality criteria or objectives, however, can provide valuable reference points for assessing the relative importance of various stormwater contaminants. Ultimately, specific beneficial uses of the receiving water body should be considered when selecting the appropriate benchmarks. Existing, potential and intermittent beneficial uses are provided in Table 9.1 for the receiving waters associated with each discharge point. Water quality criteria used as benchmarks are summarized in Table 9.2.

### 9.1.1 Wet Season Water Quality

Tables 9.3 through 9.6 provide a comparison of Event Mean Concentrations (EMCs) for each measured constituent with various water quality criteria. These benchmarks are intended to serve as a tool for interpreting the stormwater quality data and assuring beneficial uses are not impacted. Exceedances of these receiving water quality benchmarks do not necessarily indicate impairment. Other factors such as dilution, duration and transformation in the receiving waters must also be considered.

For comparative purposes, an EMC was considered to be an exceedance if the value was higher than any of the reference or benchmark values. In using these benchmarks, it is important that the source of the specific criterion is considered. For instance, metals concentrations derived from California Toxics Rule (CTR) freshwater criteria for protection of aquatic life are based upon dissolved concentrations and are often a function of hardness. Values listed in Table 9.2 are based upon a default hardness of 50 mg/L. Evaluation of any possible exceedance is based upon the actual hardness EMC for that site and event. Saltwater objectives listed for metals under the CTR are also based upon dissolved concentrations while those listed under the California Ocean Plan are based upon total recoverable measurements. Although Ocean Plan numbers are used for comparative purposes, the marine and estuarine receiving waters in the vicinity of Long Beach would only be subject the CTR saltwater values since Alamitos Bay and the coastal waters of Long Beach are considered enclosed bays and estuaries. Values provided for the Basin Plan are primarily based upon Title 22 drinking water standards. For two of the key organophosphate pesticides, the only available water quality criteria are those proposed by the California Department of Fish and Game (Siepmann and Finlayson, 2002). USEPA (2006) National Recommended Water Quality Criteria provide an additional reference for many of the nonpriority pollutants included in the monitoring program.

As noted in previous years, the pH of stormwater runoff is typically slightly acidic. This is mostly due to dissolved carbon dioxide that the rain "scrubs" from the atmosphere. Other gases such as sulfur dioxide ($SO_2$) and nitrogen oxides ($NO_x$) can cause further acidification of the rainfall. In Southern California, the National Atmospheric Deposition Program (NADP, 2005) indicates that pH associated with rainfall is typically 5.2. In contrast, rainfall in the northeastern portion of the United States is commonly much more acidic with average pH values of 4.3 to 4.5.

The water quality criteria for pH included in the Los Angeles Basin Plan (CRWQCB, Los Angeles, 1994) indicate that surface waters should be maintained in the range of 6.5 to 8.5. Due to the acidic nature of rainfall, low pH values are common but quite variable among years. Stormwater discharges with elevated pH values are less common but have occasionally occur in 2 to 5 percent of the storm events. This is often attributed to the low buffering capacity in most stormwater runoff from highly urbanized areas.

In previous years about 25% of the stormwater samples had measured pH values that were below the lower Basin Plan limits of 6.5. Due to the acid nature of rainfall, it is unusual to have stormwater with measured pH values greater than the upper Basin Plan limit of 8.5. This only happens during very small storm events. In 2005/2006, one of the samples from the Belmont Pump Station had a pH of 8.9. This year, one the two samples from the Los Cerritos Channel site also had a pH of 8.9. This elevated pH occurred in association with a rainfall of just 0.27 inches. In addition, the alkalinity of this sample was just 32 mg/L thus providing very little buffer capacity.

Grab samples taken for bacteria during storm events typically exceed Basin Plan water quality criteria but this season two sites had bacteria concentrations below the single sample criteria during the first, small storm event. Enterococcus was below the single sample criteria at Bouton Creek and both total and fecal coliform were below the single sample criteria at the Los Cerritos Channel site. The criteria for the ratio of fecal to total coliform was exceeded in all samples except for the first event at the Los Cerritos Channel site.

Benchmark reference values were commonly exceeded at least once for a total of four different total recoverable metals. These included aluminum, copper, lead, and zinc. The aluminum drinking water quality criteria of 1000 ug/L was exceeded in one of the two samples from both the Belmont Pump Station (Table 9.3) and Bouton Creek (Table 9.4) and all samples from the Los Cerritos Channel (Table 9.5) and Dominguez Pump Station (Table 9.6). Concentrations of total recoverable copper and zinc in runoff from all mass emission sites exceeded Ocean Plan criteria during all storm events. Concentrations of total recoverable lead also exceeded Ocean Plan criteria during all storm events at all sites except for the first small event at the Los Cerritos Channel site.

Total nickel exceeded Ocean Plan water quality criteria during the final event of the wet season in runoff from the Los Cerritos Channel. Exceedance of Ocean Plan nickel criteria at this site has always been associated with elevated TSS concentrations. This exceedance occurred in association with the second monitored event in the Los Cerritos Channel which also had a TSS concentration of 280 mg/L.

In 1993 (USEPA, 1993) EPA recognized that, in most cases, measurement of metals in the dissolved form provided the most accurate assessment of potential stress to aquatic ecosystems. As a result water quality criteria promulgated by EPA as the "California Toxics Rule" (CTR; USEPA, 2000) were based upon the dissolved fraction for both freshwater and saltwater. The saltwater criteria included in the CTR are applicable in bays and estuaries of California.

Benchmark reference values have been frequently exceeded for dissolved forms of copper, lead and zinc throughout the life of the permit (Kinnetic Laboratories, Inc., 2000, 2001, 2002, 2003, 2004, 2005, and 2006). Dissolved copper was again found to exceed both CTR freshwater and saltwater criteria at all sites

during all events. Concentrations of dissolved lead frequently exceed the CTR freshwater criterion but typically don't exceed the CTR saltwater criteria. This year three out of seven (43%) stormwater samples exceeded the CTR freshwater criteria but none exceeded the CTR saltwater criterion. Dissolved zinc exceeded both the CTR freshwater and saltwater criteria in 43% percent of stormwater samples from the mass emission sites.

The near absence of measurable levels of diazinon and chlorpyrifos remains to be a significant trend. Diazinon was only detected in association with a single storm event at the Los Cerritos Channel monitoring station but concentrations did not exceed the available criteria (0.08 ug/L; Siepmann and Finlayson, 2002).

Malathion, another organophosphate pesticides, is still being utilized as a residential pesticide and was detected in 63% of the stormwater composites. In all cases, concentrations exceeded EPA Recommended Water Quality Criteria of 0.1 ug/L in both freshwater and saltwater. Concentrations, however, were never high enough to exert a toxic response from the *Ceriodaphnia* (waterflea) toxicity tests. Malathion is far less toxic to daphnids with reported $LC_{50}$s for ranging from 1.14 to 3.18 ug/L (TDC, 2003).

As noted last year, the triazine pesticides continue to be uncommon in stormwater runoff. When detected, these compounds are present at very low concentrations. The infrequent presence of these compounds in stormwater runoff and the low concentrations when they are detected suggests that this group of organic compounds should be considered for elimination from the analytical suite.

### 9.1.2 Dry Season Water Quality

Water quality of dry weather discharges has been generally consistent over the past eight years. Dry season water quality has not tended to vary greatly between sites or sampling dates. In general, the concentrations of suspended particulates and total recoverable metal concentrations are low in dry weather runoff. Trace metals are predominantly in the dissolved form. Hardness is also consistently high which tends to mitigate the effects of the dissolved metals (Tables 9.7 through 9.9). As a result, most trace metals were below CTR freshwater criteria during both dry weather sampling events.

As in all previous years, copper remains the primary constituent of concern in dry weather discharges. It has not relatively unusual for dissolved copper to exceed the CTR freshwater criterion due to the elevated hardness of dry weather discharges. This year, none of the six dry weather samples exceeded the CTR freshwater criterion. The CTR saltwater criterion for dissolved copper, however, was exceeded in five out of the six samples. Highest concentrations (7.5 ug/L and 12 ug/L) were once again encountered in dry weather flows from the Los Cerritos Channel mass emission station. In addition, both measured concentrations of total copper in the Los Cerritos Channel dry weather samples exceeded Ocean Plan criteria.

## 9.2 Temporal Trends of Stormwater Contaminants

We have continued to examine temporal trends for selected trace metals, two organophosphate pesticides, TSS and bacteria. One organophosphate, malathion, was added to the graphics examining temporal trends since this compound is becoming more common due to the reduced availability of chlorpyrifos and diazinon. The metals and organic compounds included in this assessment are those that are 1) often detected in both stormwater and dry weather discharges and/or 2) are suspected to be primary sources of toxicity (Figures 9.1 through 9.13). Time series are presented for total and dissolved concentrations of five trace metals including cadmium, copper, nickel, lead and zinc. Due to the typically large differences between total and dissolved lead concentrations, a separate graphic is included to detail changes in

dissolved lead over time. Time series are also provided for two important organophosphate pesticides, chlorpyrifos and diazinon, which have been implicated as major sources of toxicity. Temporal comparisons of bacteria include total and fecal coliform as well as enterococcus (Figures 9.14 through 9.17). The figures include all wet and dry weather data for the past eight years at each monitoring site. Periods of dry weather are indicated by the shaded areas.

The addition of only two storm events during the past wet season provides limited information in terms of assessing long term trends. With the exception of both diazinon and chlorpyrifos, there has been no evidence of substantial and consistent increasing or decreasing concentrations of trace metals, TSS or bacteria over the past eight years. The following trends continue:

- Dissolved concentrations of cadmium, copper, and nickel do not vary substantially between wet and dry weather periods.
- Concentrations of dissolved zinc and lead are often higher during storm events than during dry weather sampling events. Elevation in dissolved zinc has often been associated with increasing toxicity in the sea urchin fertilization test.
- Concentrations of total copper, lead and zinc are consistently higher in association with storm flows.
- The decline in concentrations of chlorpyrifos and diazinon in stormwater at all sites remains one of the most significant temporal trends. These compounds are now rarely detected and, when detected, are now present at low concentrations that do not exhibit toxicity in the more sensitive bioassay tests.
- Based upon all eight years of monitoring, stormwater discharges from the Dominguez Gap Pump Station continue to have the lowest concentrations of total metals.
- Fecal indicator bacteria typically exceed Basin Plan water quality criteria during both wet and dry weather monitoring (Figures 9.14 through 9.17). Concentrations of indicator bacteria are often slightly less in dry weather conditions than observed during wet weather conditions. This is most apparent in Bouton Creek where the dry weather concentrations of both total and fecal coliform bacteria are below Basin Plan criteria about 75% of the time.

The variability of the concentrations of pollutants cannot be overemphasized. The Event Mean Concentrations (EMCs) of most constituents have demonstrated a tremendous degree of variability. EMCs are strongly influenced by antecedent conditions, annual rainfall patterns, storm magnitude and intensity as well as a number of known and unknown factors. Substantial and consistent changes in EMCs such as seen for diazinon and chlorpyrifos will be necessary to develop any degree of confidence with respect to long term increases or decreases in concentrations and loads. Simple linear regression models have been used in other stormwater programs to examine trends but this approach is not recommended since they can lead to misleading conclusions.

## 9.3 Loading Rate Assessment

Estimates of pollutant loading rates were developed for selected constituents at each site by normalizing loads to a unit of 1000 acres. By normalizing the loads, direct comparisons can be made between drainage areas to assist in differentiating potential problem areas. This facilitates comparisons of large watersheds such as that of the Los Cerritos Channel with much smaller watersheds.

For illustration purposes, loading rates were developed for copper, lead, zinc, and diazinon (Figures 9.18 through 9.21). This analysis has continued to demonstrate the effectiveness of the infiltration basin located just upstream of the Dominguez Pump Station. The infiltration basin has typically been able to prevent or substantially reduce stormwater discharges to the Los Angeles River since monitoring began in

early 2001. During the 2006/2007 monitoring season, the area of the infiltration basin was severely reduced. Due to the extremely dry year, discharges were still observed during only a single event. Data from this one event indicated that very low loading rates despite the significantly reduced area of the infiltration basin.

With only two storm events during the past year, changes in loading rates among sites are difficult to assess although loading rates for copper, lead and zinc were among the lowest measured since 2001. Historical differences in loading rates for copper, lead, and zinc among the four sites have generally remained consistent. The Los Cerritos Channel site tends to have the highest loading rates of these metals and the Dominguez Pump Station consistently has the lowest loading rates. Loading rates for the metals are generally comparable at the Belmont Pump and Bouton Creek sites.

In the case of diazinon, loading rates were observed to plummet following the 2004/2005 storm season and have remained low since that time. As noted in the following sections, this decline has had a major impact on reducing stormwater toxicity to *Ceriodaphnia* (waterflea).

## 9.4 Stormwater Toxicity

Two wet weather samples were analyzed at each of three stations for toxicity during the monitoring period. All six of those samples were tested with water fleas and sea urchins (12 total bioassays).

Two storms were collected over a period of only two months. The first storm was sampled in mid-February, and the second storm was sampled in mid-April.

- There was no toxicity to *Ceriodaphnia* in the Belmont Pump samples in either storm. Sea urchin toxicity was noteworthy in the February sample where both chronic and acute toxicity were severe. Only minor toxicity to urchins was seen in the April sample.
- The Bouton Creek samples showed no toxicity to water fleas in either storm. Minor sea urchin toxicity was detected in the first storm of the year (in February), and moderate toxicity to urchins was observed in the April storm sample.
- Samples from the Los Cerritos Channel station showed no measurable toxicity to *Ceriodaphnia* in samples from either storm. Severe toxicity to sea urchins was detected in the first storm, and only minor urchin toxicity was seen in the second (April) storm.

The toxicity of the wet weather samples to *Ceriodaphnia* at all stations was comparable to that in the 2005/2006 monitoring period. Urchin toxicity was markedly elevated at the Belmont Pump and Los Cerritos Channel stations during the first storm of 2006/2007. During the previous monitoring period high urchin toxicity was seen at Belmont and Bouton during wet weather sampling (Figure 9.22). The Belmont Pump and Los Cerritos Channel samples collected in the first storm both contained >32 $TU_c$ of toxicity to sea urchins, and the Los Cerritos Channel sample also showed high acute toxicity (44 $TU_a$).

Both the Belmont Pump and Los Cerritos Channel samples showed higher urchin toxicity than that measured in 2004/2005 and 2005/2006, though previous monitoring years had demonstrated equally high toxicity. Toxicity to the water flea was generally absent at all three stations during this monitoring period. Toxicity to urchins of Bouton Creek samples was lower than that seen in 2005/2006 and comparable to that seen in late storms of previous monitoring periods.

### 9.4.1 Dry Weather Toxicity

Neither the September 2006 nor the May 2007 dry weather discharge samples collected from Belmont Pump station produced any decrease in daphnid survival or reproduction. Results from the 2004/2005

and 2005/2006 monitoring periods also showed the absence of measurable toxicity. There was no measurable decrease in sea urchin fertilization in the September 2006 sample, and only a minor decrease in the May 2007 Belmont Pump samples. The previous two monitoring periods showed no dry weather toxicity to sea urchins at Belmont.

The salinity of the dry weather sample collected from Bouton Creek in September 2006 was 5.8 ppt. This elevated salinity was expected to have a potential to influence water flea toxicity data. This sample showed moderate lethal and reproductive toxicity to water fleas. The survival NOEC was 25% sample and the LC50 was 38.9% sample. The NOEC for reproduction was also 25% sample and the $EC_{50}$ was 37.6% sample. In May 2007 there was much greater elevation of sample salinity (11.1 ppt). This concentration of salts in the sample was considered to be beyond the tolerance of the water fleas, and the *Ceriodaphnia* bioassay was not performed on this sample. The magnitude of the water flea toxicity in the September 2006 sample was somewhat higher than that seen in the August 2005 dry weather test even though both samples showed salinity elevation of approximately the same magnitude.

Neither the September 2006 nor the May 2007 dry weather samples from Bouton Creek were measurably toxic to sea urchins, with $TU_c$ values of 2 and $TU_a$ values of <2. Likewise there was no measurable toxicity in the Bouton Creek dry weather samples from the previous monitoring period (2005/2006).

The September 2006 dry weather sample from Los Cerritos Channel produced no lethal toxicity (1 $TU_c$), but did cause minor reproductive toxicity (2$TU_c$) to water fleas. The May 2007 dry weather sample showed no toxicity to water fleas. The magnitude of dry weather toxicity to water fleas was generally comparable to that seen in the 2005/2006 dry weather samples, and all were less toxic than most previous spring dry weather samples.

There was no measurable sea urchin toxicity in the Los Cerritos Channel dry weather samples in September 2006. The May 2007 sample showed minor (4 $TU_c$) toxicity to urchins. Acute toxicities were <2 $TU_a$ in both samples. The magnitude of dry weather toxicity to urchins was comparable to that shown in 2005/2006

In the 2000/2001 and 2001/2002 monitoring periods, dry weather samples collected in the late spring generally tended to be less toxic than stormwater samples collected in those respective winters. These toxicity results were cited to support the indication that "there are significant differences in the composition of stormwater and dry weather discharge from the City of Long Beach" (Kinnetic Laboratories Inc. and Southern California Coastal Water Research Project, July 2002)

Data from the 2002/2003 monitoring period indicated that the magnitude of toxicity of spring dry weather samples was less than wet weather toxicity at the Belmont Pump station. At the Bouton Creek station, spring dry weather and wet weather toxicities were of similar magnitude, while at the Los Cerritos Channel station spring dry weather discharge showed generally greater toxicity than stormwaters, with particularly elevated toxicity to sea urchins in the May 2003 collection.

Toxicity results from the 2003/2004 monitoring period suggested that at the Belmont Pump Station, wet weather toxicity to sea urchins was greater than spring dry weather toxicity, while toxicity to water fleas was absent. Bouton Creek samples were more toxic to water fleas during both dry weather sampling periods than during storms, probably due in large part to elevated sample salinity during dry weather. Los Cerritos Channel samples generally showed no toxicity to sea urchins during both wet and dry weather (except for the second storm). Toxicity to water fleas was much enhanced in the spring dry weather sample.

During the 2004/2005 monitoring period toxicity to water fleas at Belmont Pump was very low during both wet and dry weather periods, with only the last wet weather sample showing measurable toxicity. Urchin toxicity at Belmont was present during three of four storms, but there was no measurable toxicity in either dry weather sample. Bouton Creek samples were measurably toxic to water fleas in the spring dry weather sample, but not in any storm sample or in the fall dry weather sample. Neither of the Bouton Creek dry weather samples was toxic to sea urchins, while moderate urchin toxicity was seen in the first and fourth storm samples. Toxicity to water fleas of dry weather Los Cerritos Channel samples was generally higher than that of wet weather samples. Only the first storm of the season produced *Ceriodaphnia* toxicity at Cerritos, while both late spring and early fall dry season samples showed sufficient toxicity to trigger water flea TIEs. In contrast, sea urchins showed no measurable dry weather toxicity while showing reduced fertilization in three of four wet weather samples from the Los Cerritos Channel.

During the 2005/2006 monitoring period, toxicity to water fleas at Belmont Pump was very low during both wet and dry weather periods, with only the seasonal first flush wet weather sample showing measurable toxicity. Urchin toxicity at Belmont was present during all four storms collected from this station, but there was no measurable toxicity in either dry weather sample.

Results of the 2006/2007 monitoring at Belmont Creek showed no measurable water flea toxicity in either wet or dry weather. Substantial toxicity to sea urchins was seen in the first storm, but not in the second storm. In dry weather samples, minor toxicity was detected in the September 2006 sample, but none was found in the May 2007 sample

Bouton Creek water was measurably toxic to water fleas in the fall 2006 sample, but not in any storm sample. Salinity in the spring 2007 dry weather was elevated to a level where water flea testing was not performed. Neither of the Bouton Creek dry weather samples was toxic to sea urchins, while moderate urchin toxicity was seen in both storm samples.

Neither wet weather nor dry weather samples from Cerritos Channel produced measurable toxicity to water fleas. Sea urchins showed substantial wet weather toxicity in February and minor toxicity in the April storm. Dry weather toxicity to sea urchins was absent in the September sample and minor in the May sample.

Toxicity data from the current and recent monitoring periods, then, do not support the hypothesis that spring, dry weather samples, collected after the storm season has passed, show consistently decreased toxicity.

In a very limited way, data from the current monitoring period may support the suggestion of a species-related toxicity difference with respect to wet and dry weather samples, with urchin tests showing more toxicity in wet weather samples and water fleas showing more toxicity in dry weather samples.

- Sea urchins at the Belmont and Cerritos stations showed 4-32 $TU_c$ of toxicity in wet weather samples versus 2-4 $TU_c$ of toxicity in both dry weather samples. At the Bouton Creek station the wet-dry difference in urchin toxicity is consistent, with 4-8 $TU_c$ of toxicity in both storm samples versus 2 $TU_c$ in each of the dry weather samples.

- Stormwater toxicity to water fleas was not observed in any stormwater samples from any of the three stations. Dry weather toxicity was only slightly more evident in water fleas, with 2 $TU_c$ of reproductive toxicity at Cerritos in September and 4 $TU_c$ of both lethal and reproductive toxicity at Bouton in September. It is likely that the dry weather effects at Bouton may be explained by the elevated salinity of the sample.

### 9.4.2 Temporal Toxicity Patterns

The toxicity data from the previous six monitoring periods suggest that seasonal flushing may be an important factor affecting the variability in stormwater toxicity. Current data from the 2006/2007 monitoring period for *Ceriodaphnia* do not, however, support that thesis since there was no water flea toxicity observed in either storm at any of the three stations. The fact that this was an extremely dry year with only two collectable storms may have contributed to the apparently anomalous data. There is more support for the importance of seasonal flushing when considering sea urchin toxicity data.

As mentioned above, water flea bioassays documented sample toxicity in none of six wet weather samples collected during the period. Both seasonal first flush samples collected on February 11, 2006 and late season samples collected on April 20, 2007 showed no measurable lethal or reproductive toxicity from the Belmont Pump, Bouton Creek or Los Cerritos Channel stations.

Sea urchin bioassays showed very high toxicity in the February, 2006 storm samples from the Belmont Pump (>32 $TU_c$ and 5.4 $TU_a$) and the Los Cerritos Channel ( >32 $TU_c$ and 44 $TU_a$) stations, while the Bouton Creek samples were much less toxic (4 $TU_c$ and <2 $TU_a$). In the April 2007 storm, Belmont and Los Cerritos Channel samples showed much reduced toxicity (4 $TU_c$ and <2 $TU_a$) while the toxicity of the Bouton Creek samples actually increased somewhat (8 $TU_c$ and <2 $TU_a$).

Thus the idea that seasonal flushing is importantly affecting stormwater toxicity is not supported by the current year's water flea test data but is given limited support by the sea urchin data. There was no wet weather toxicity to *Ceriodaphnia* in either of the storm samples. The distribution of sea urchin toxicity was somewhat problematic, with peak toxicities at two stations occurring in runoff from the first storm and elevated toxicity at the third station in samples from the second storm. It is unfortunate that the TIEs performed on the February samples from Belmont Pump and Cerritos Channel yielded no information.

### 9.4.3 Comparative Sensitivity of Test Species

There were a total of six wet weather samples tested for toxicity with both water fleas and sea urchins. Toxicity was detected to sea urchins in all six of those samples, the sea urchin fertilization test being the most sensitive toxicity test method in all (100%) of those samples.

There were six dry weather discharge samples tested using water fleas and sea urchins. Of those samples two showed minor toxicity to sea urchins and two showed minor effects on water flea survival and/or reproduction. Of the four dry weather samples showing toxicity two were somewhat toxic to water fleas in the September 2006 samples and two were somewhat toxic to urchins in the May 2007 samples. This suggests approximately equal sensitivity of the two test organisms to dry weather. Note, however, that the *Ceriodaphnia* toxicity observed in the September Bouton Creek sample probably reflected osmotic stress from the elevated salinity of that sample. Bouton Creek salinity was even higher in the May samples, and water fleas were not tested.

This pattern of sensitivity (sea urchin>water flea) in stormwaters was similar to that observed during the five previous monitoring programs and in a study of urban stormwater toxicity in San Diego (Southern California Coastal Water Research Project, 1999). The current data suggest that species sensitivity to dry weather discharge samples appeared to be approximately equal (water flea=sea urchin). In 2004/2005 and 2005/2006 there appeared to be greater sensitivity of urchins to dry weather samples. This dry weather species sensitivity has varied over the course of the monitoring program. In 2001/2002, urchins were generally the more sensitive species in dry weather samples, while in both 2002/2003 and 2003/2004 the two species showed approximately equal sensitivities to dry weather discharge.

### 9.4.4 Relative Toxicity of Stormwater

Table 9.10 compares the frequency and magnitude of stormwater toxicity from the Long Beach stations in 2006/2007 with that of stormwater samples from Long Beach in previous years and with toxicity in other southern California watersheds. The data suggest a slight increase from the previous three monitoring periods in the frequency of Long Beach stormwater toxicity to sea urchins. The magnitude of 2006/2007 toxicity seems similar to previous years.

The frequency of toxicity to water fleas in 2006/2007 was zero, less than that seen in previous years and reflecting the trend towards lower frequency that began in the 2003/2004 monitoring year. The magnitude of toxic responses was obviously lower than that seen previously, but continued the trend toward reduction in magnitude seen in the previous four monitoring periods..

We might expect results from Chollas Creek and Ballona Creek to be similar to Long Beach results, as these samples were obtained from smaller highly urbanized watersheds, relative to the samples from the Los Angeles and San Gabriel Rivers. The Chollas/Ballona data, showing frequency of sea urchin toxicity ranging from 85-100%, suggest comparability for Long Beach samples from the first two monitoring periods. Table 9.10, however, indicates a decreased frequency of urchin toxicity during the 2002/2003, 2003/2004 and 2004/2005 monitoring periods. Last year (2005/2006) and during the current monitoring program, however, the frequency of urchin toxicity returned to pre-2002 levels.

Toxicity in Long Beach samples, as in those from other watersheds, is variable among storms and stormwater toxicity is most often detected using the sea urchin fertilization test.

### 9.4.5 Toxicity Characterization

The TIE testing program for this monitoring period was effectively unsuccessful. Phase I TIEs were initiated on two wet weather samples. These two wet-weather sea urchin TIEs were abandoned because baseline toxicity essentially disappeared from the sample.

Correlation analysis of the toxicity and chemistry data provides an additional test of the association between stormwater toxicity and chemical contamination. The data from all storms in all monitoring periods from 2001/2002 through 2005/2006 were pooled for the correlation analyses. The correlation analyses generally confirm the conclusion from the previous study years, that the toxic responses measured in this study are related to the chemical composition of the stormwater samples. The toxic responses of sea urchins and/or water fleas were significantly correlated with increased concentrations of several stormwater constituents, including dissolved metals, hardness, TSS, TDS and TOC (Table 9.11). Dissolved copper, nickel and zinc were significantly correlated with toxicity to both species, while dissolved lead was correlated with water flea toxicity.

In last years report, copper showed the strongest correlation with urchin fertilization closely followed by nickel and zinc. Lead showed a weaker but still significant correlation with urchin effects. The current years correlations closely mirror those of last year, with copper showing the strongest correlation, nickel following closely and zinc being less, though significantly, correlated. Data from 2003/2004 and 2002/2003 were similar to those from last year, but differed from monitoring data from earlier study years, which showed significant correlations only with dissolved copper and zinc.

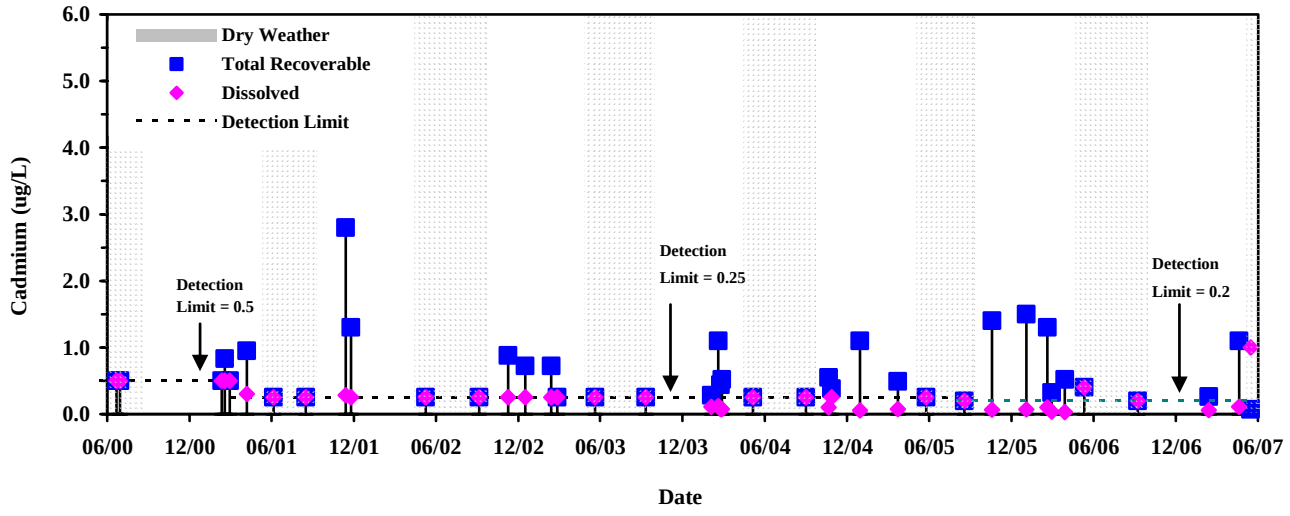
A third method, comparing the measured and predicted toxic units of the samples was used to assess the importance of zinc, copper, and pesticides as a cause of the toxicity of Long Beach stormwater (Figures

9.23 through 9.24). The predicted acute toxicity of the sample was calculated from the measured concentrations of the chemical constituents and their corresponding $EC_{50}$ or $LC_{50}$.

There were two samples that contained less predicted toxicity than that which was observed in sea urchin bioassays. The Belmont Pump sample of 12 February 2007 contained about 2.6 predicted $TU_a$s of zinc and an additional 0.6 $TU_a$s of copper, while bioassays showed 5.4 $TU_a$s of observed toxicity. Even more dramatically, the Los Cerritos sample of 12 February 2007 showed 44 $TU_a$s of observed toxicity, while chemical analysis predicted a total of 3 TUs of combined zinc and copper toxicity. Chemical analysis of the remaining four stormwater samples predicted more acute toxicity than was actually observed. The Bouton Creek samples from both storms and the Belmont and Cerritos samples from the 12 April 2007 storm produced no measurable acute toxicity. These samples contained between 2.6 and 4.0 $TU_a$s of predicted toxicity.

It is probably significant that the lack of measurable toxicity of stormwaters to *Ceriodaphnia* is correlated with the absence of measurable organophosphates from the samples. Both correlation analyses and predicted vs observed toxic unit comparisons highlight the lack of both toxic effects and chemically measured OP pesticides in the 2006-2007 storm water samples. Water fleas are known to be highly sensitive to both diazinon ($LC_{50}$ = 450 ng/L) and chlorpyrifos ($LC_{50}$ = 80 ng/L).

a)

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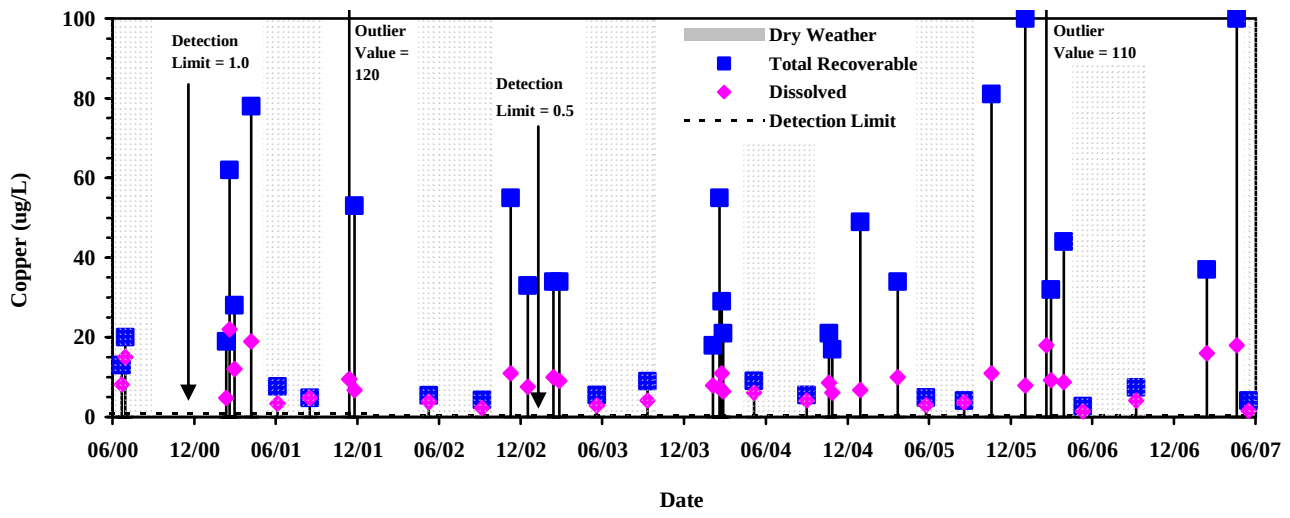


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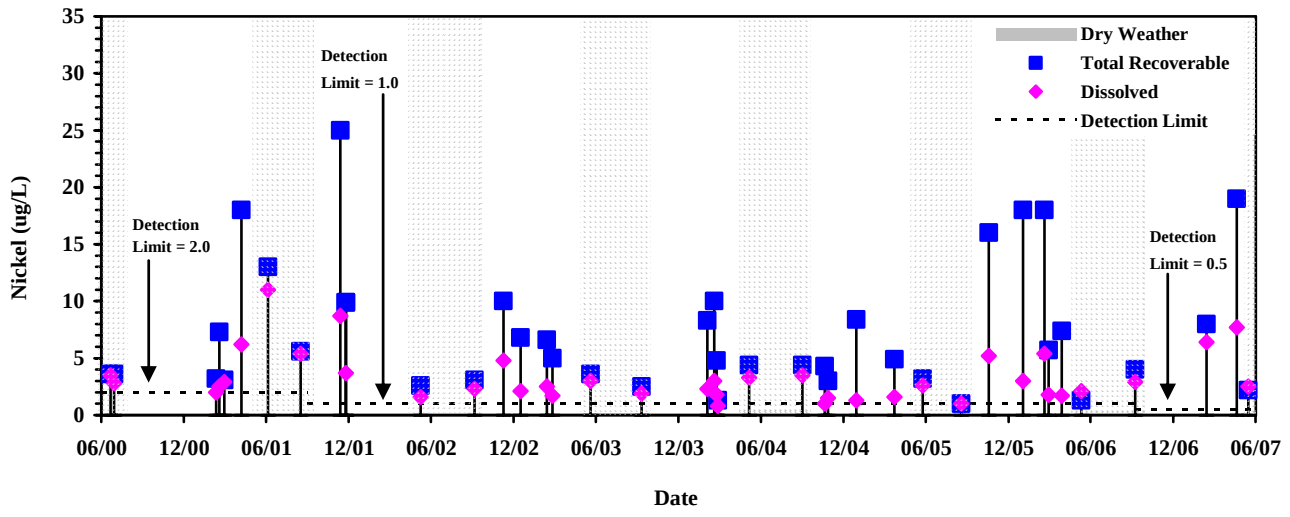
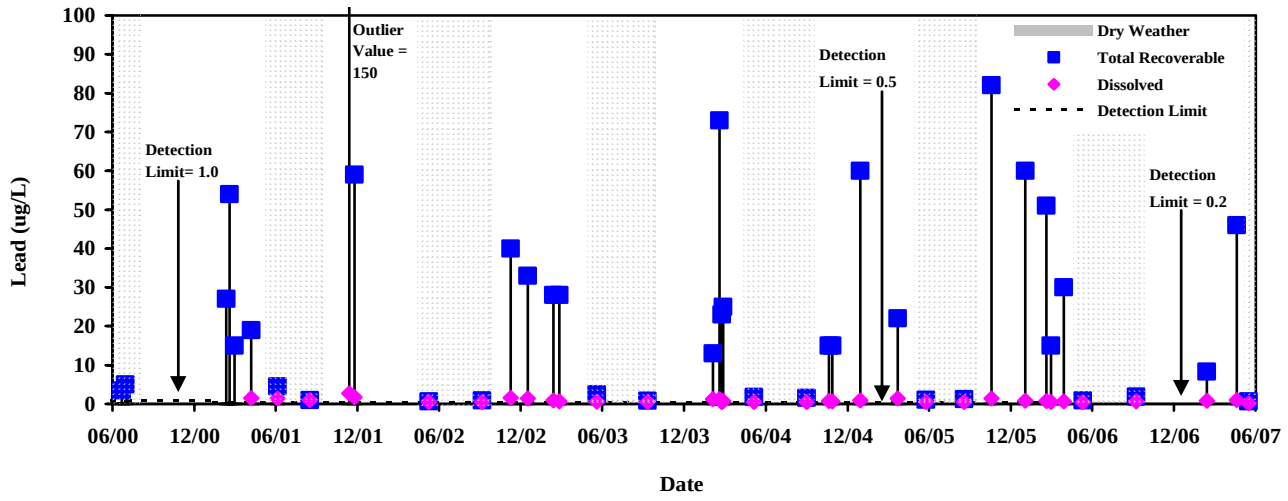



**Figure 9.1 Belmont Pump Station Chemistry Results: a) Cadmium; b) Copper; c) Nickel**

a)

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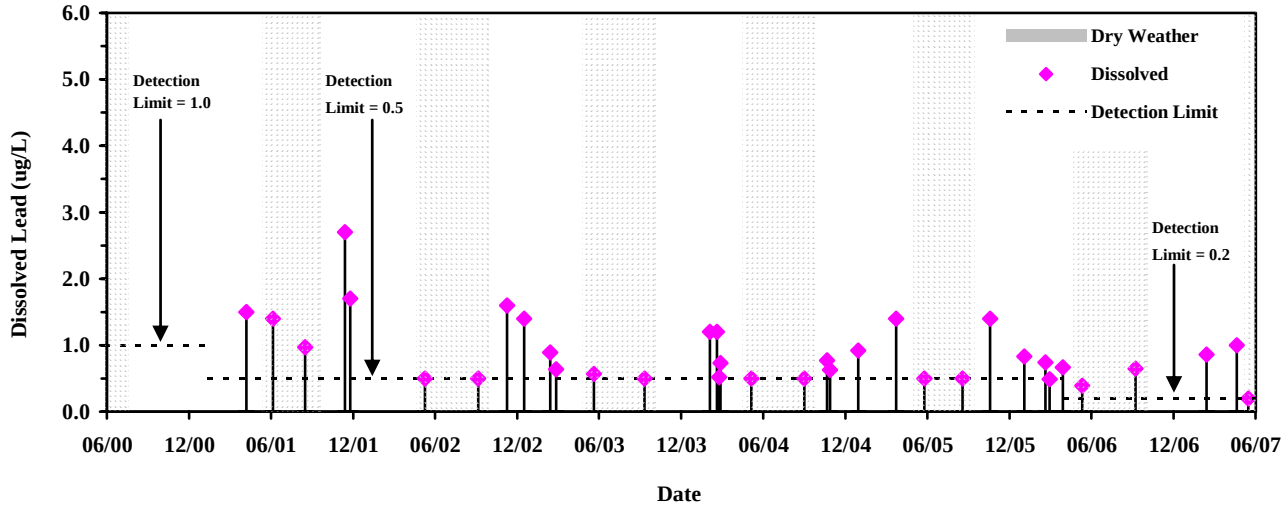


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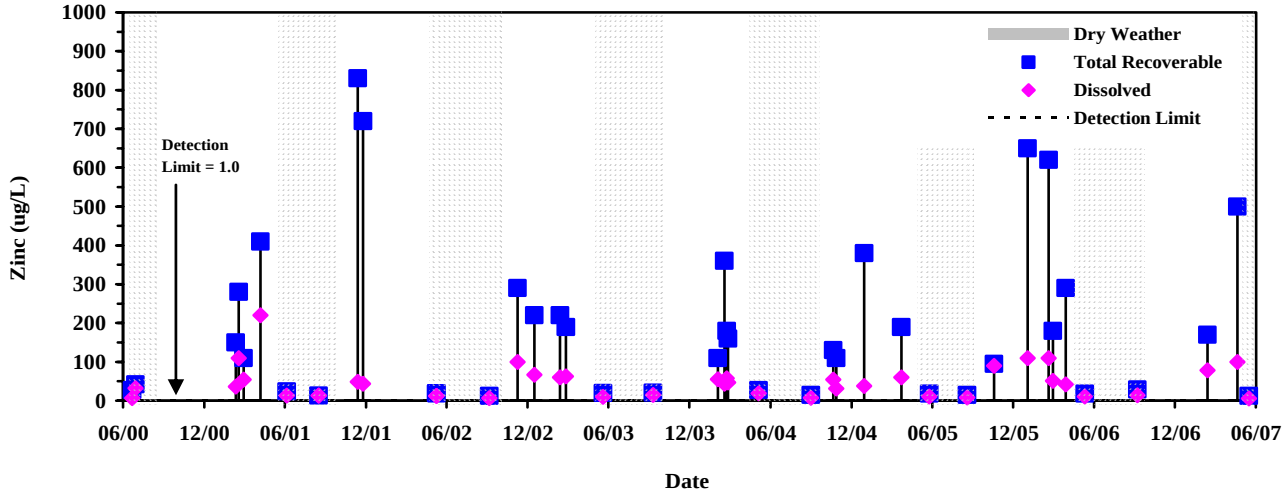
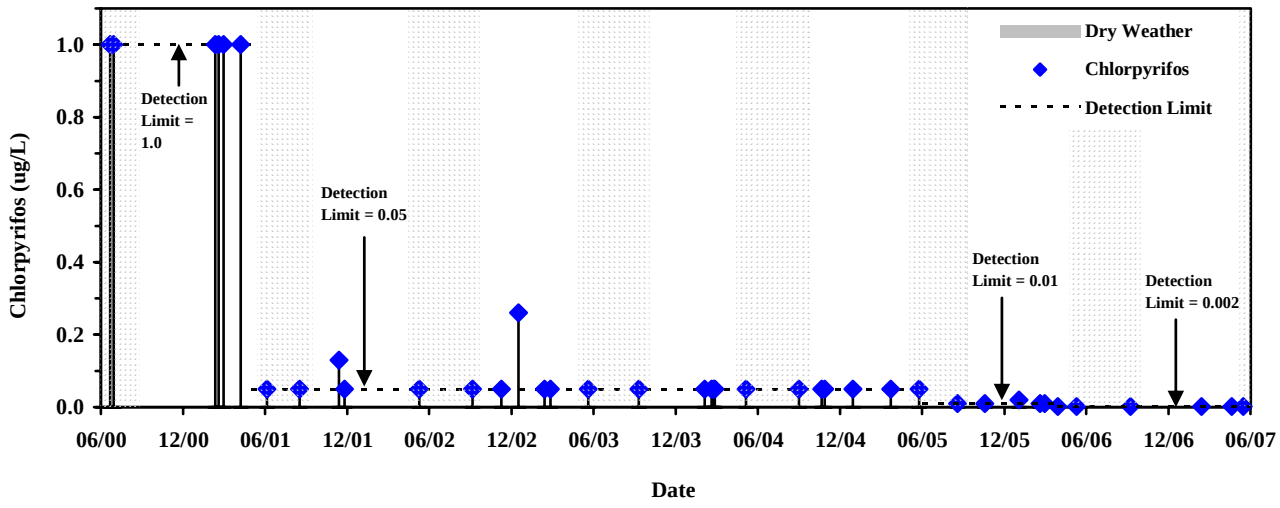



**Figure 9.2** **Belmont Pump Station Chemistry Results: a) Lead (total and dissolved); b) Lead (dissolved only); c) Zinc**

a)

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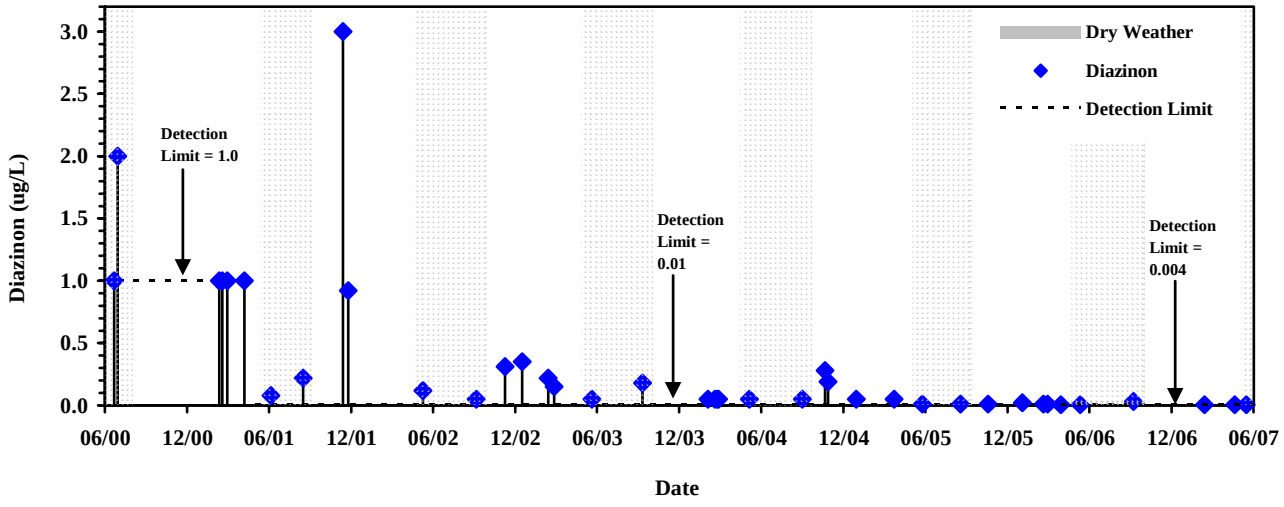


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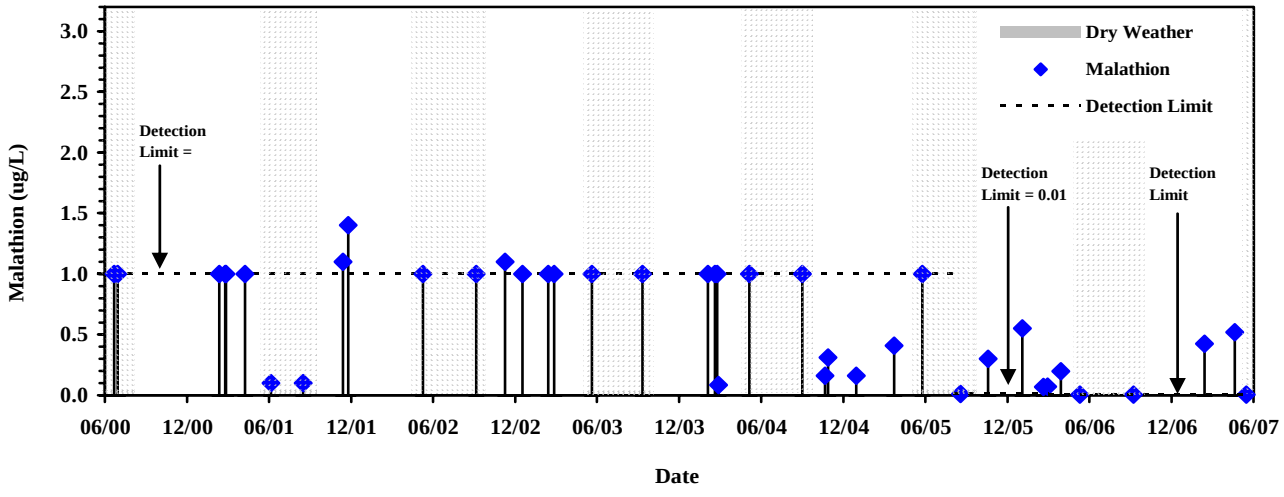
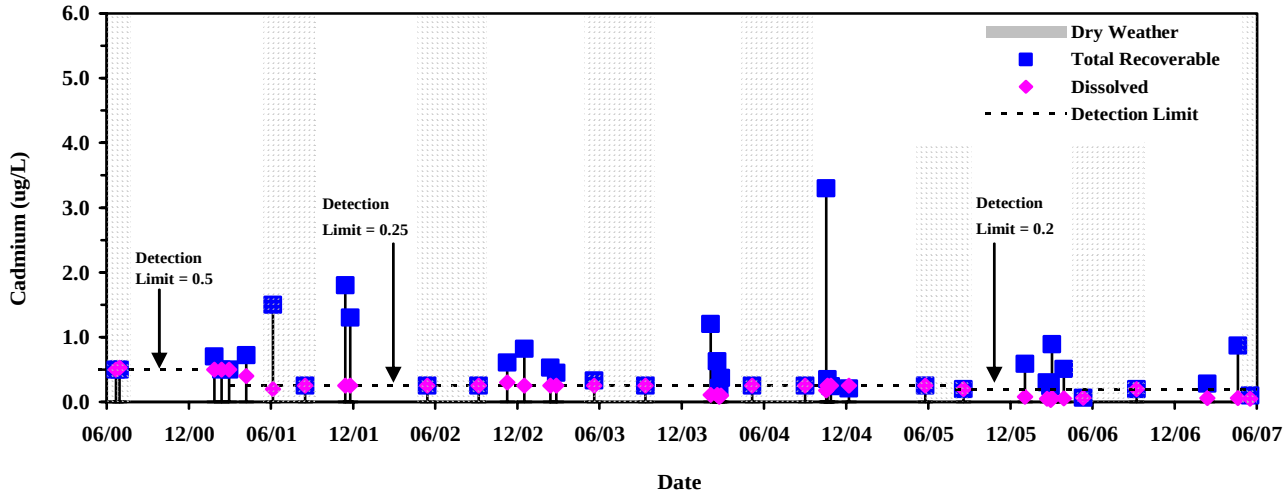



**Figure 9.3 Belmont Pump Station Chemistry Results: a) Chlorpyrifos; b) Diazinon; c) Malathion**

a)

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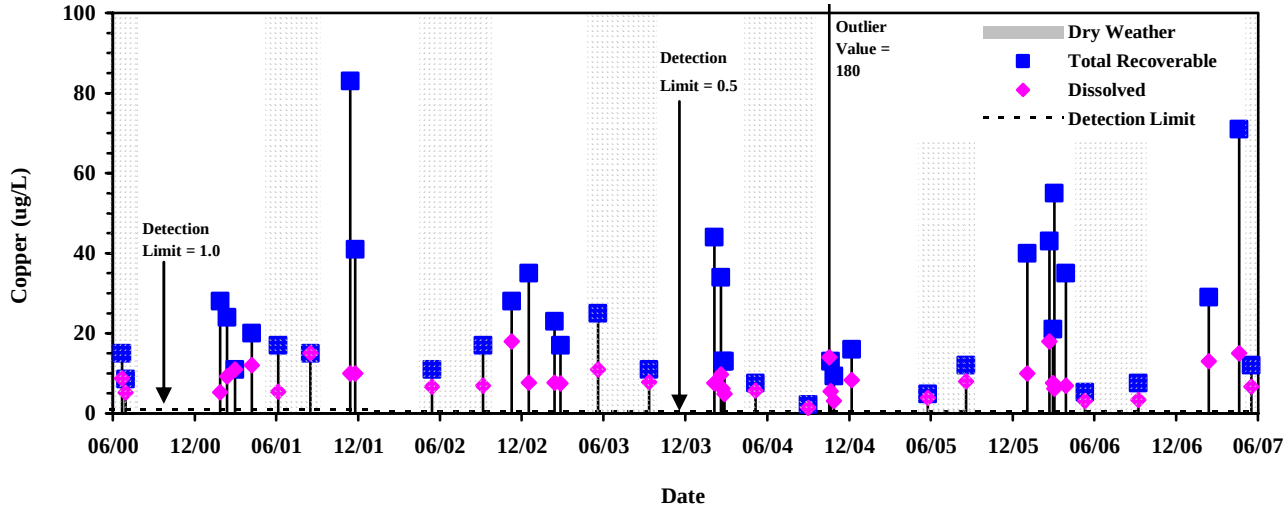


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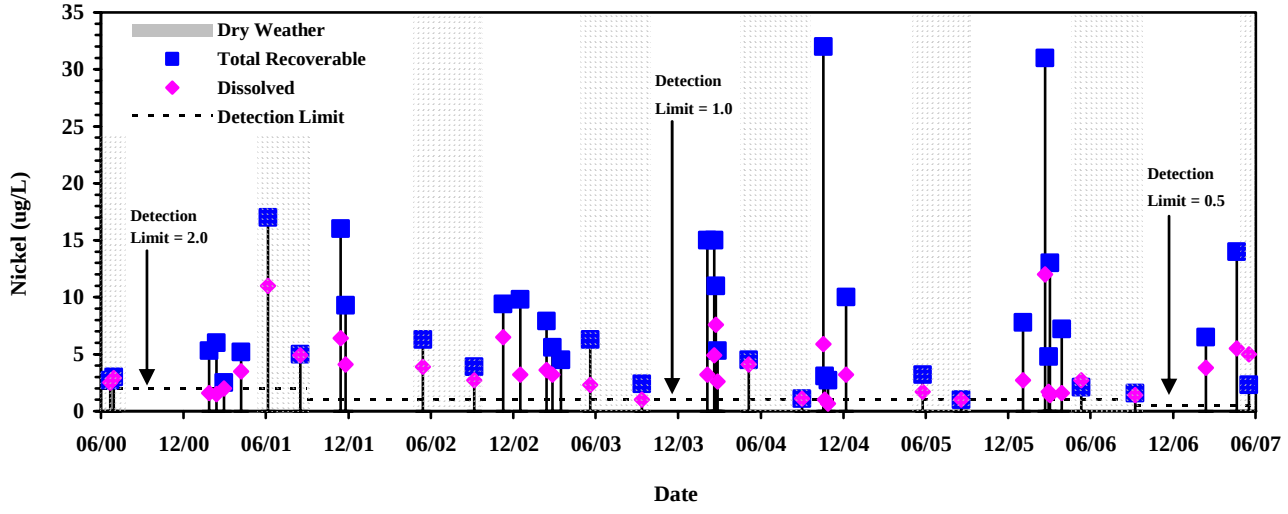
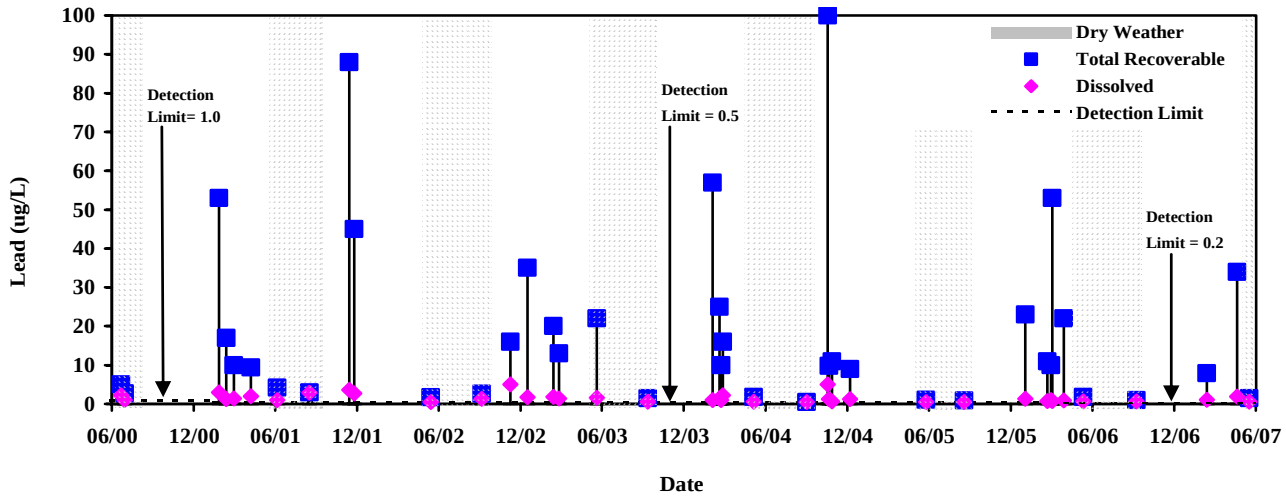



**Figure 9.4 Bouton Creek Chemistry Results: a) Cadmium; b) Copper; c) Nickel**

a)

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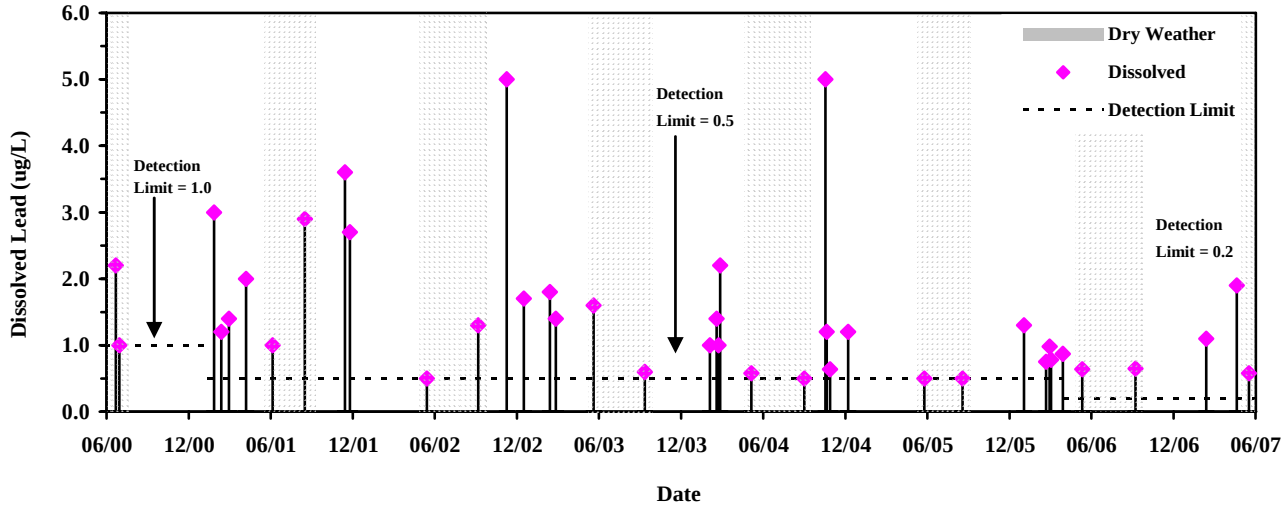


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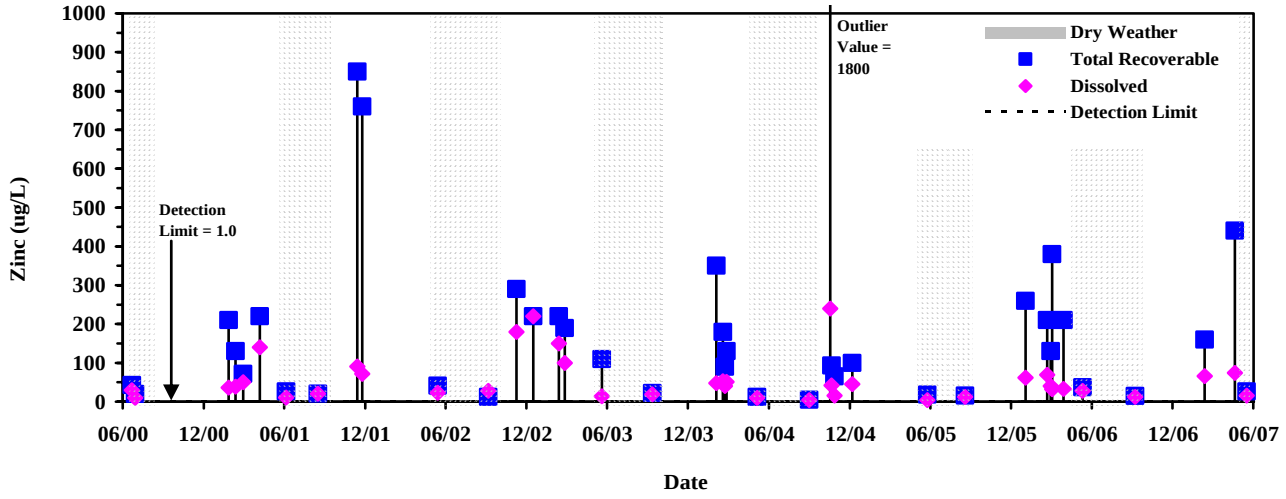
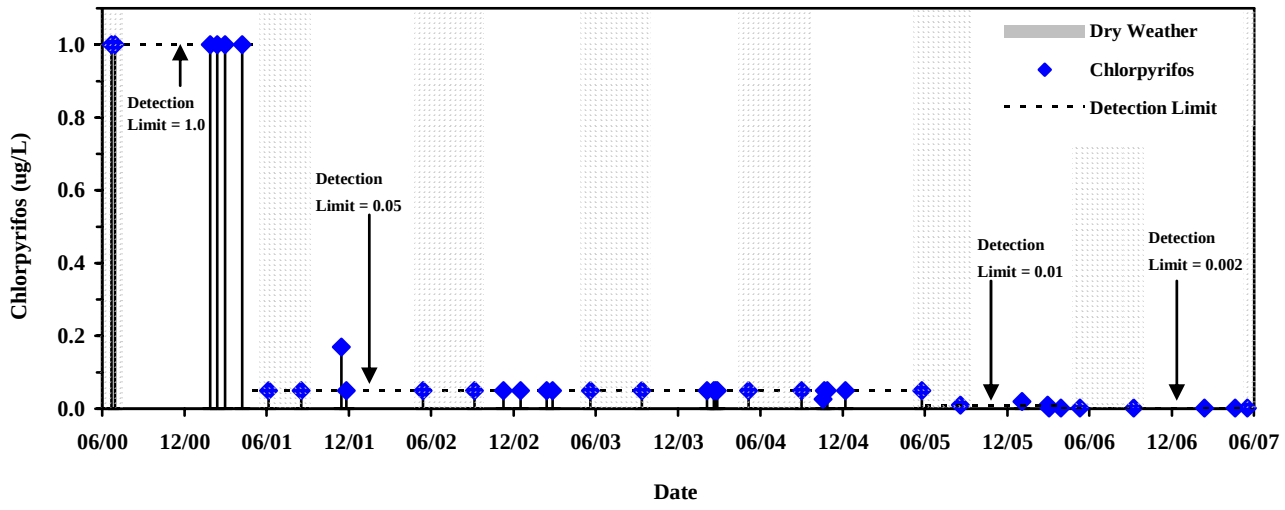



**Figure 9.5** **Bouton Creek Chemistry Results: a) Lead (total and dissolved); b) Lead (dissolved only); c) Zinc**

a)

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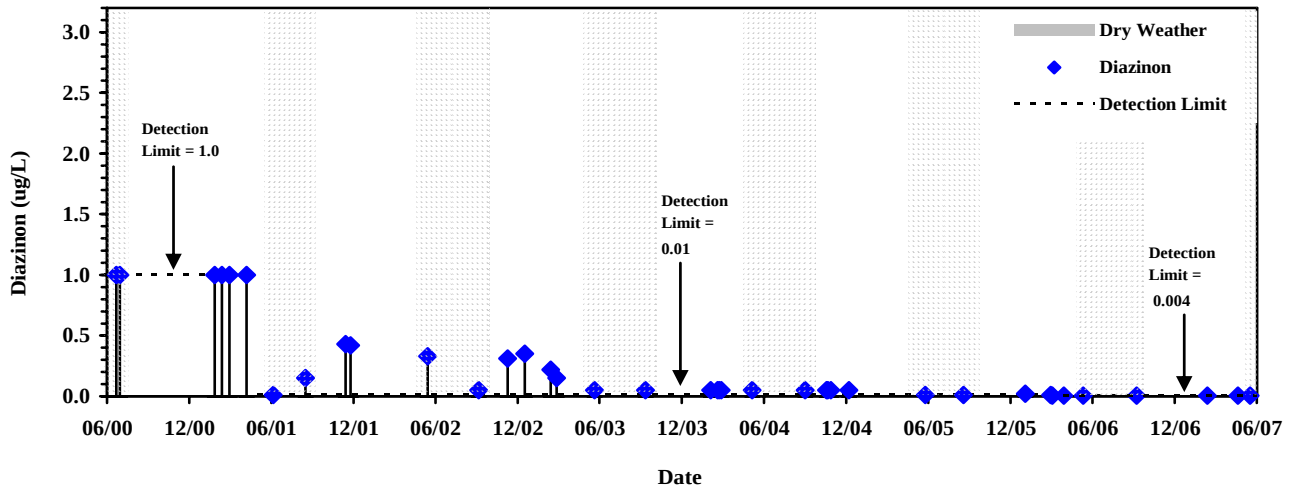


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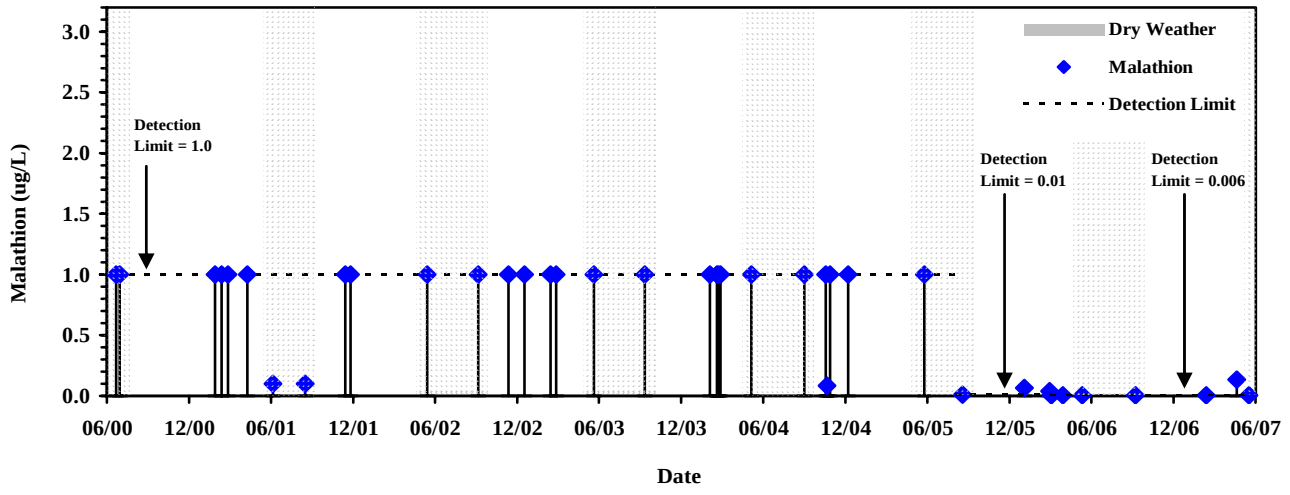
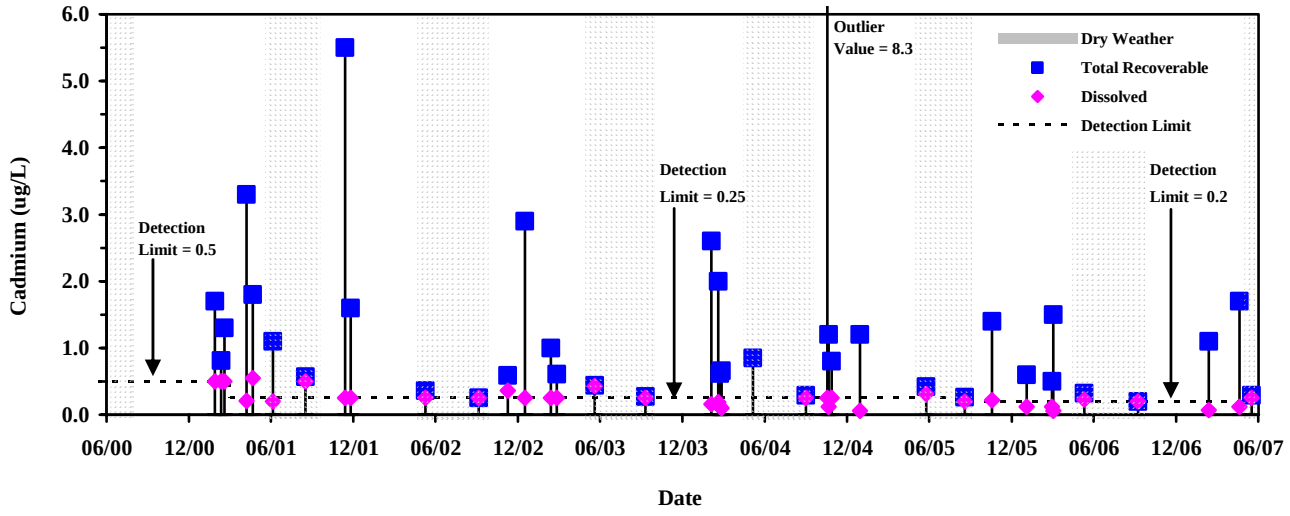



**Figure 9.6 Bouton Creek Chemistry Results: a) Chlorpyrifos; b) Diazinon; c) Malathion**

a)

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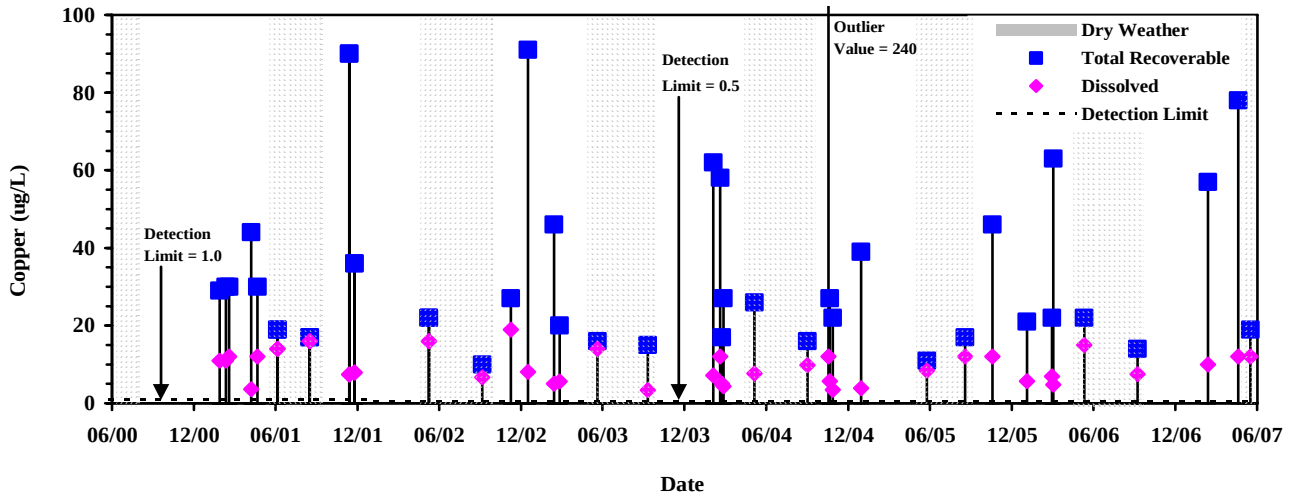


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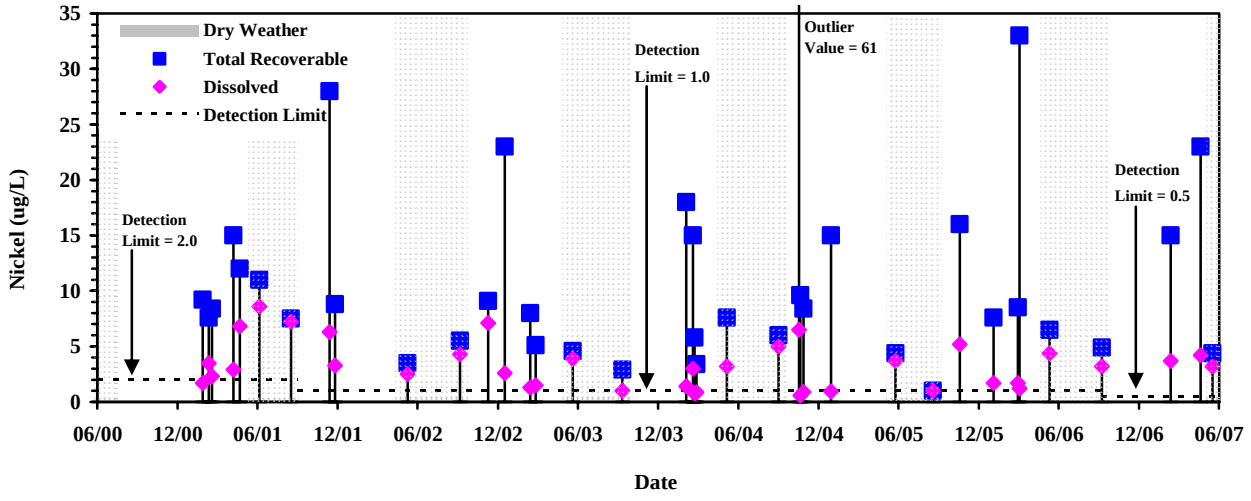
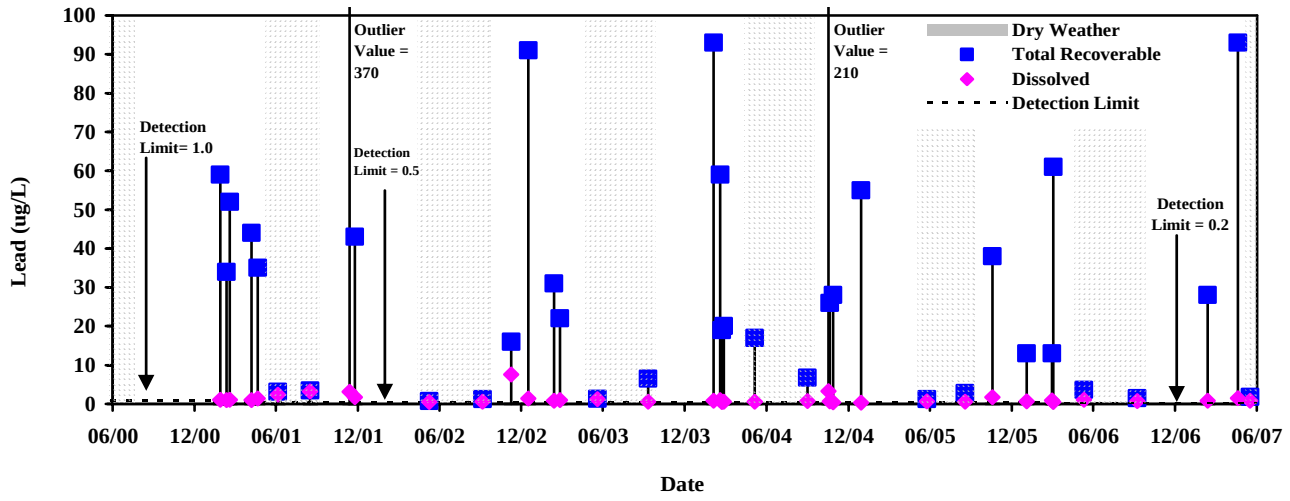



**Figure 9.7 Los Cerritos Channel Chemistry Results: a) Cadmium; b) Copper; c) Nickel**

a)

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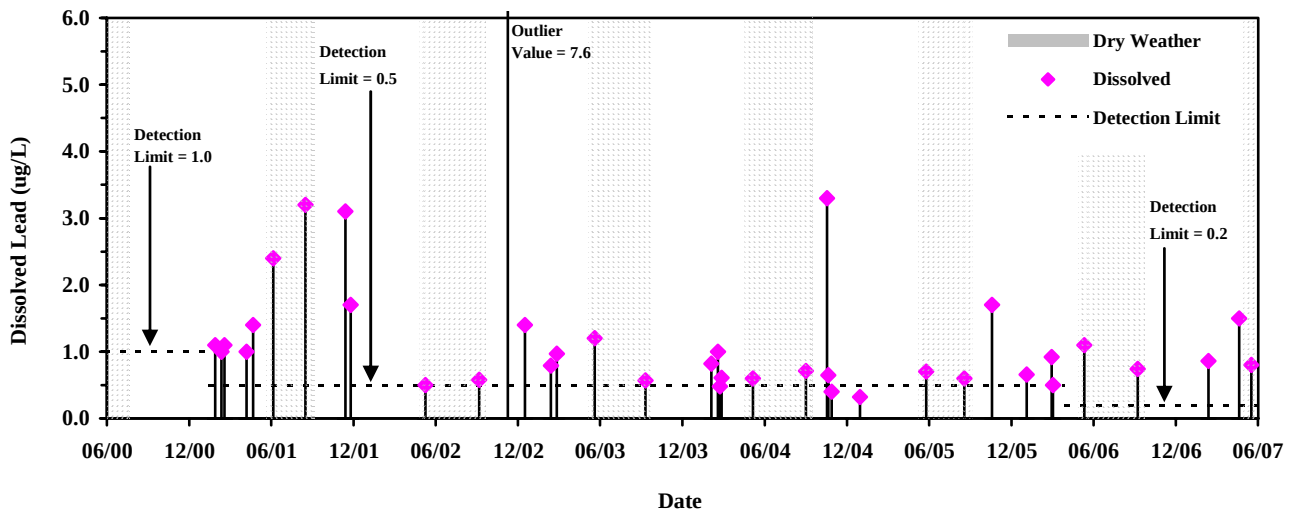



c)

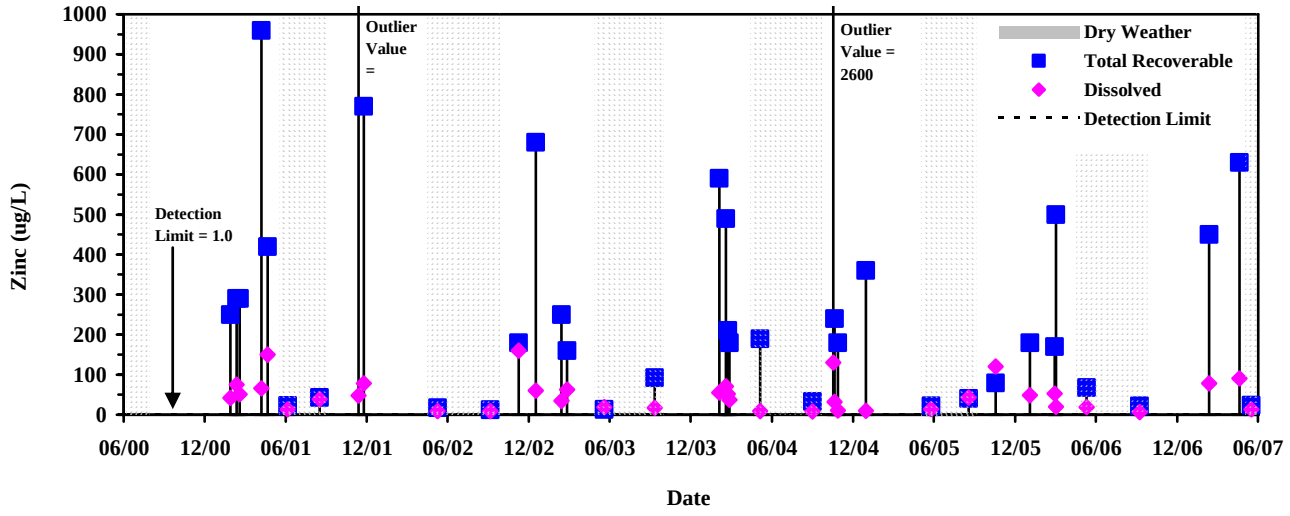
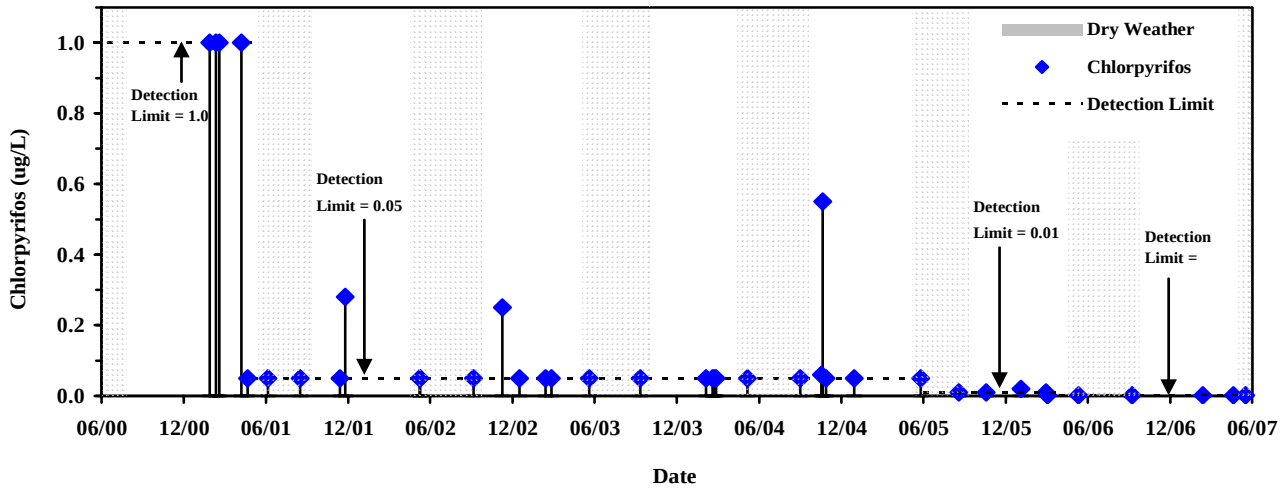



**Figure 9.8** **Los Cerritos Channel Chemistry Results: a) Lead (total and dissolved); b) Lead (dissolved only); c) Zinc**

a)

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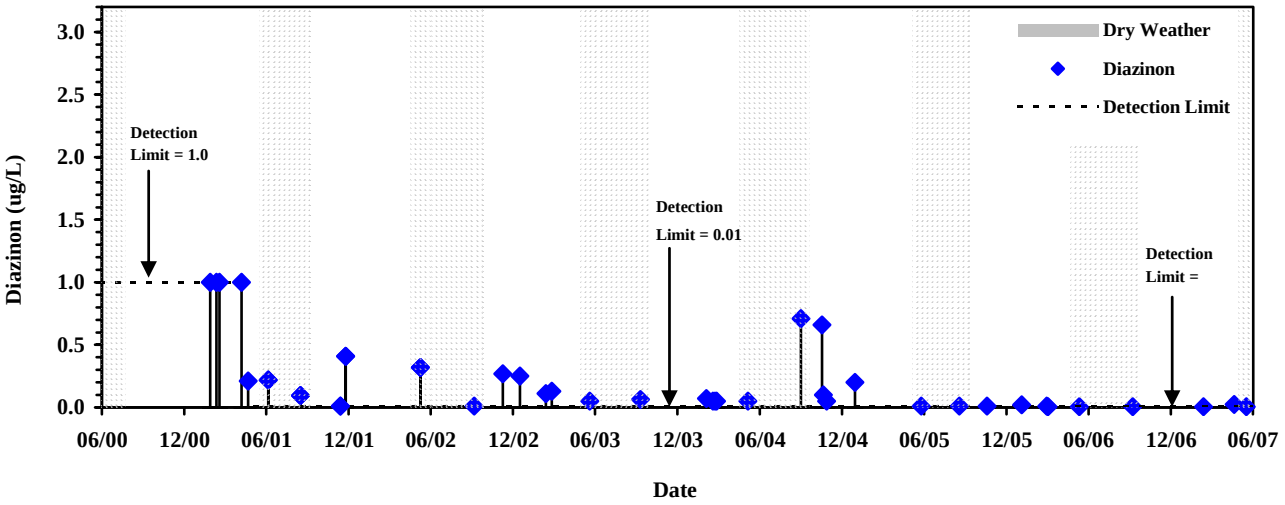


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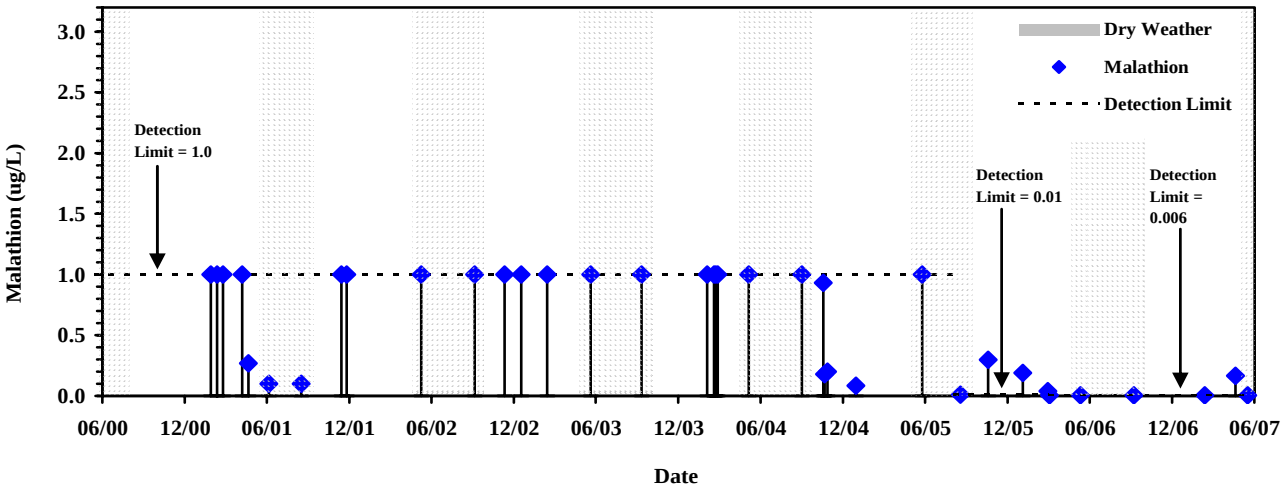
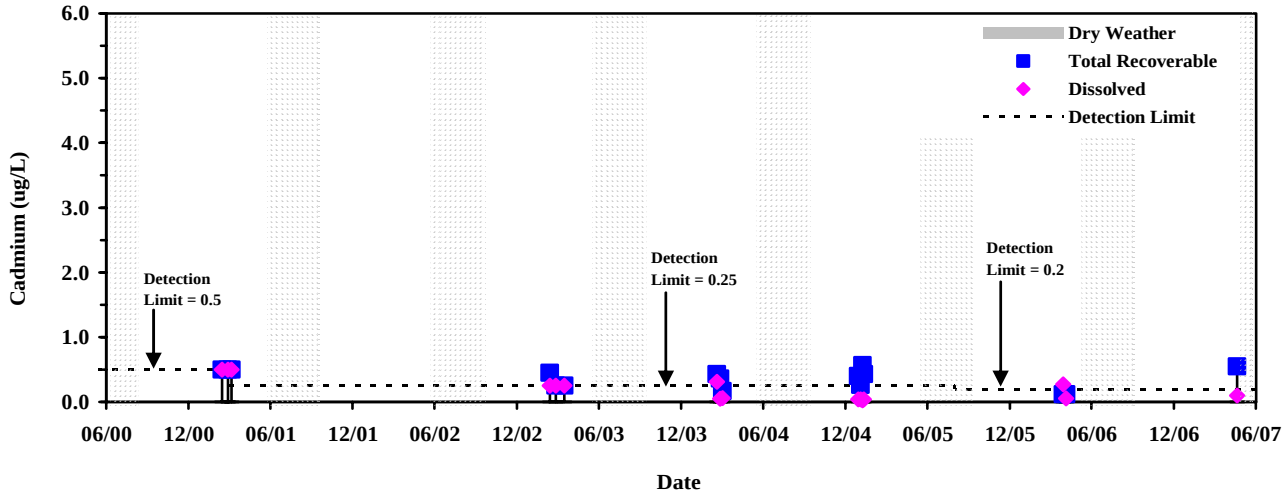
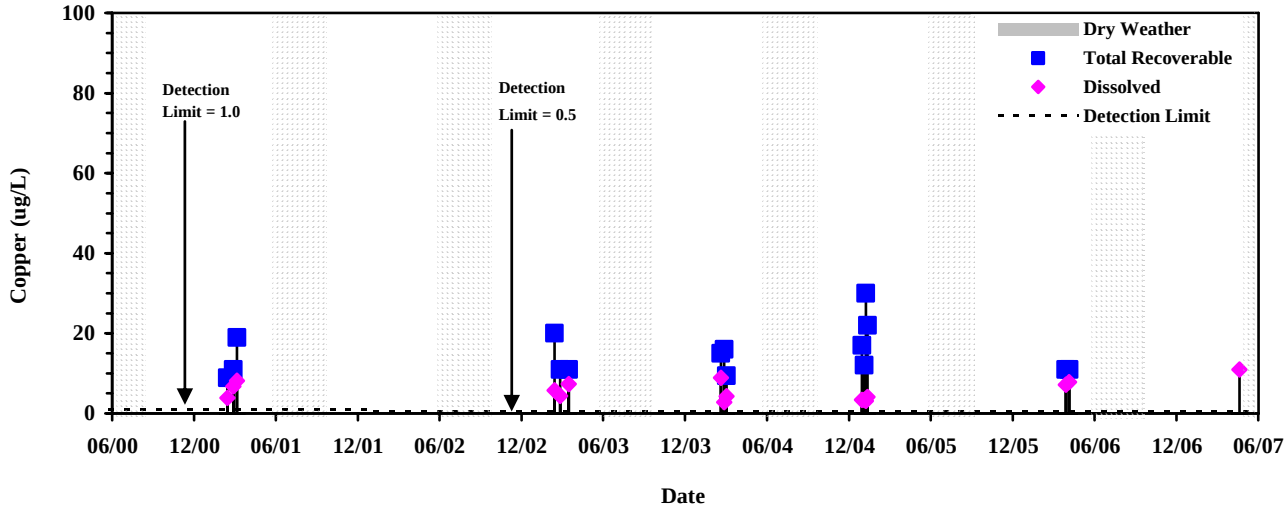



**Figure 9.9 Los Cerritos Channel Chemistry Results: a) Chlorpyrifos; b) Diazinon; c) Malathion**

a)




b)

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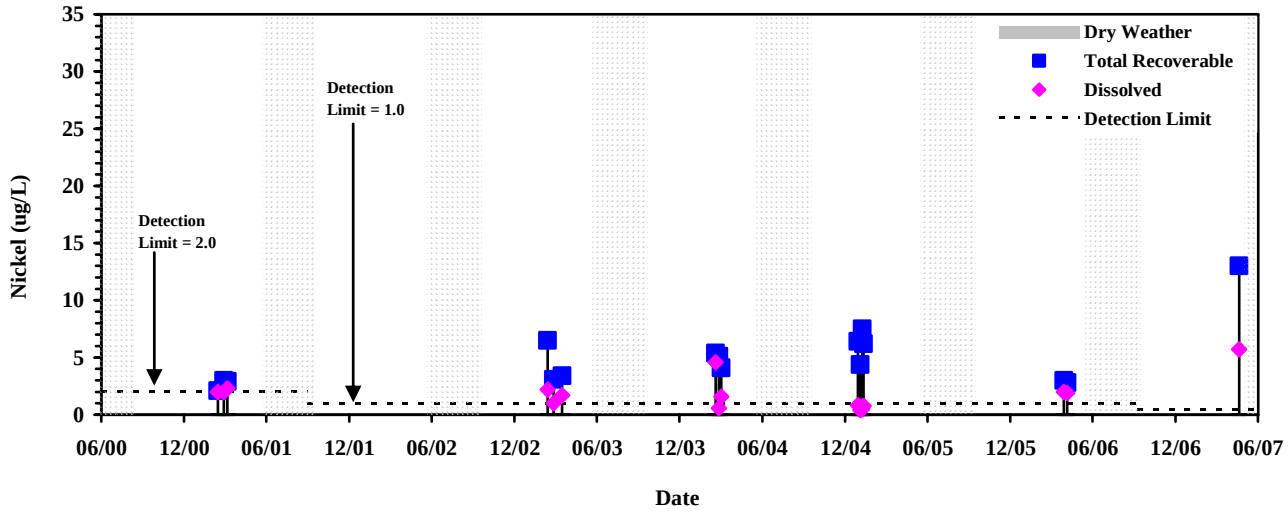
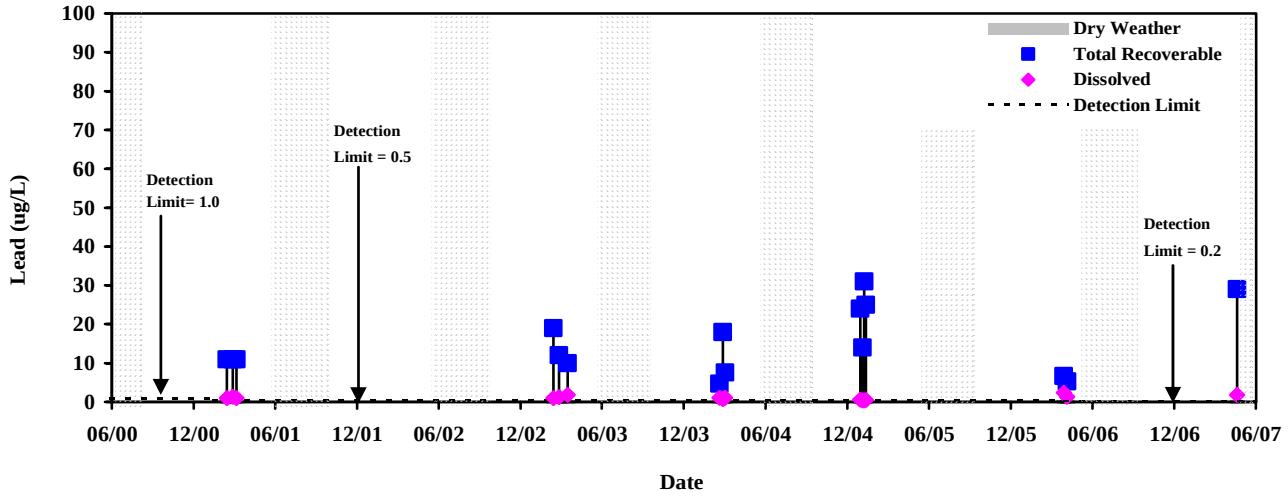
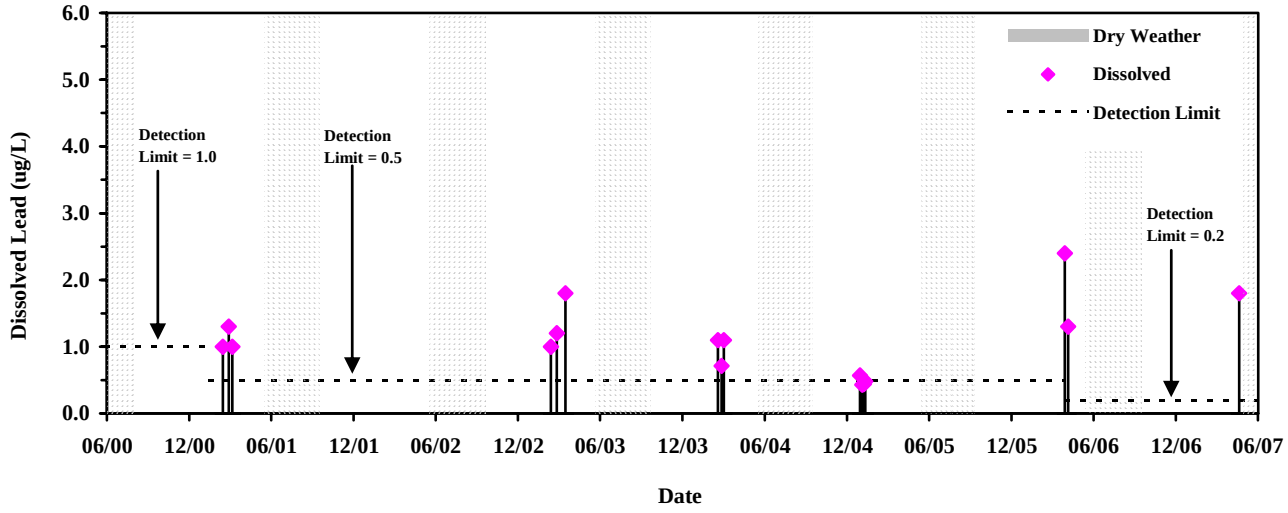



**Figure 9.10 Dominquez Gap Chemistry Results: a) Cadmium; b) Copper; c) Nickel**

a)




b)




c)

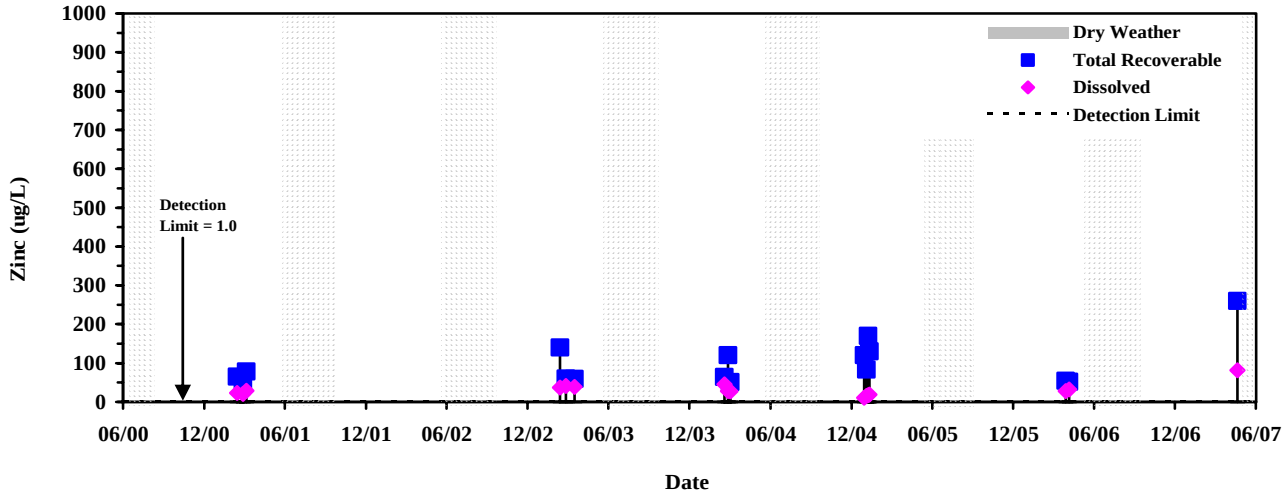
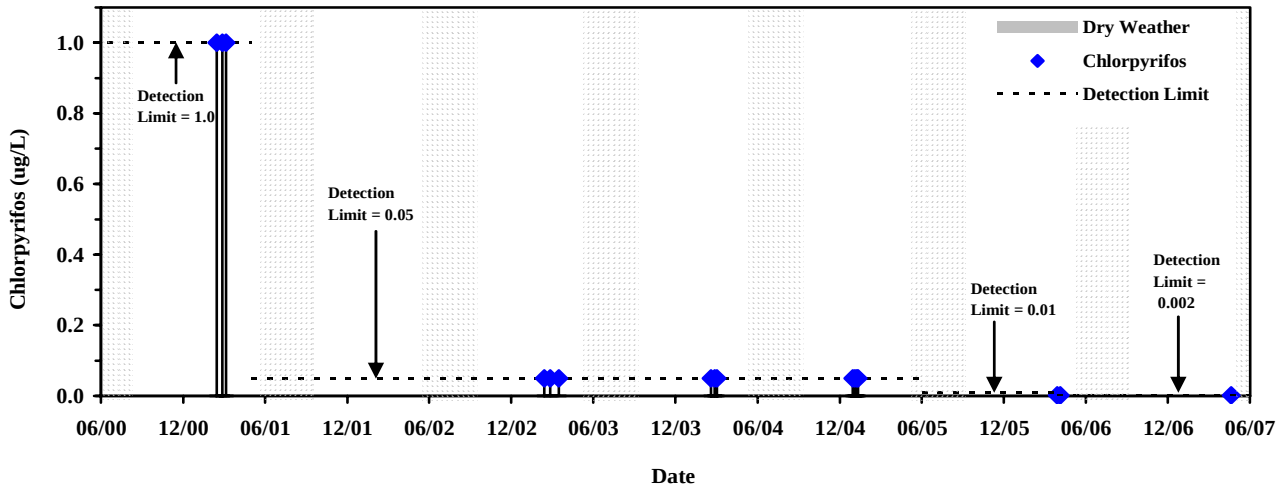
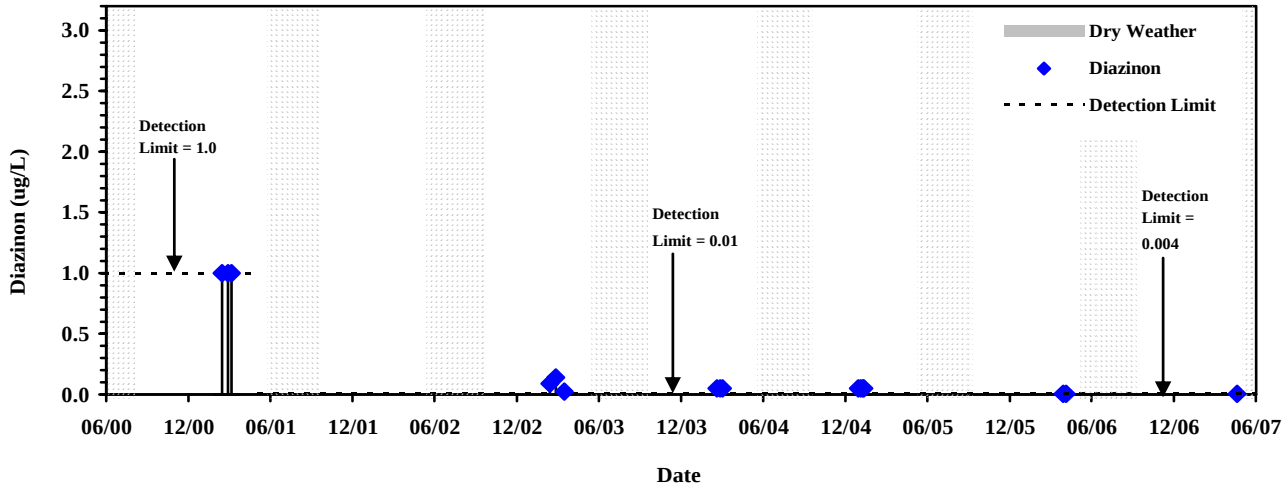



**Figure 9.11 Dominquez Gap Chemistry Results: a) Lead (total and dissolved); b) Lead (dissolved only); c) Zinc**

a)




b)




c)

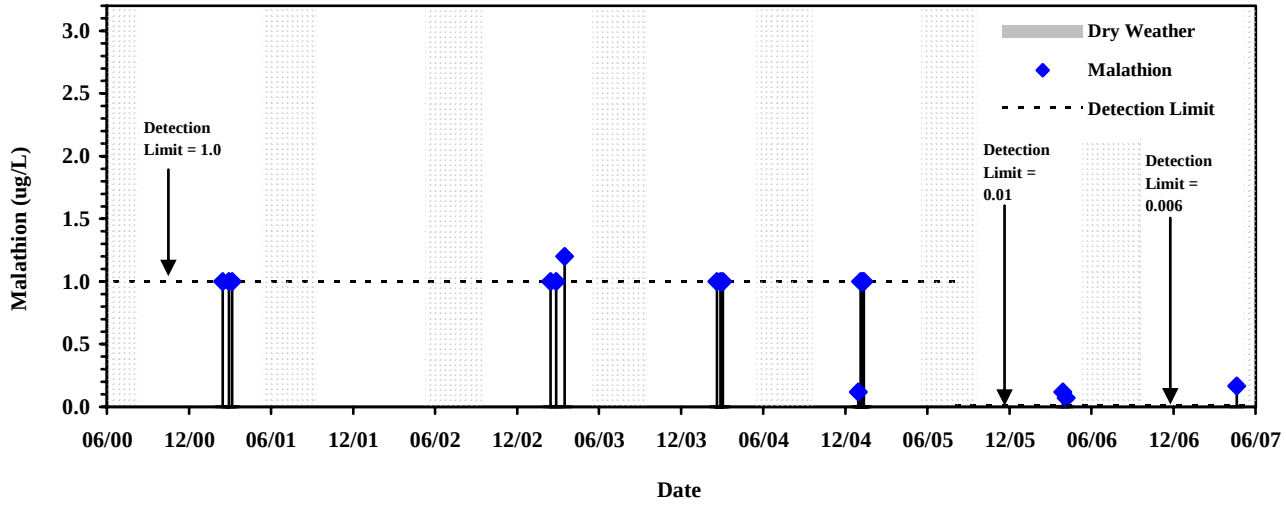
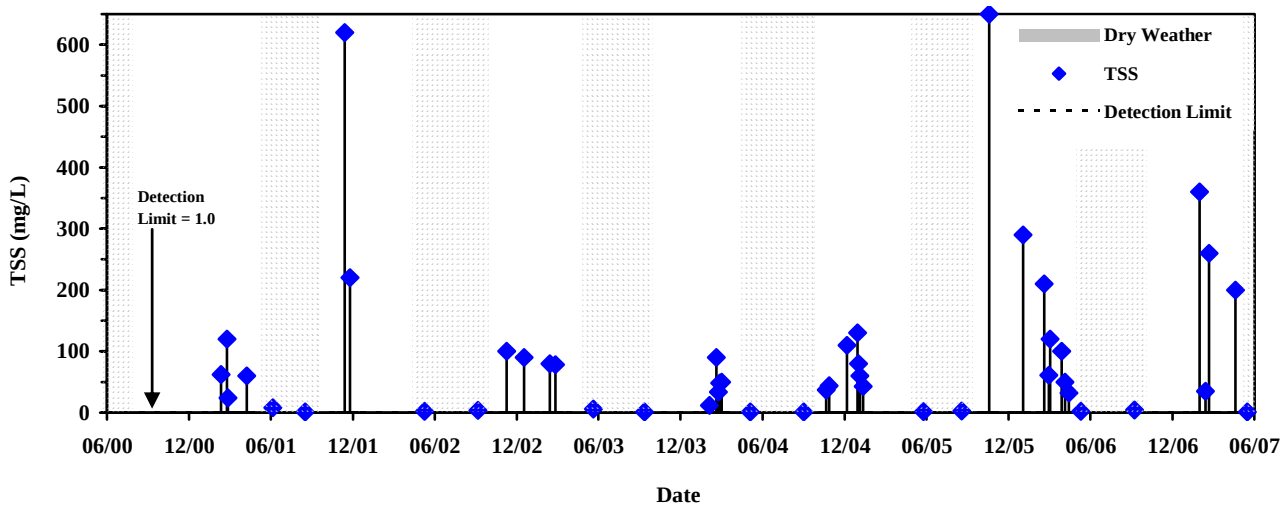
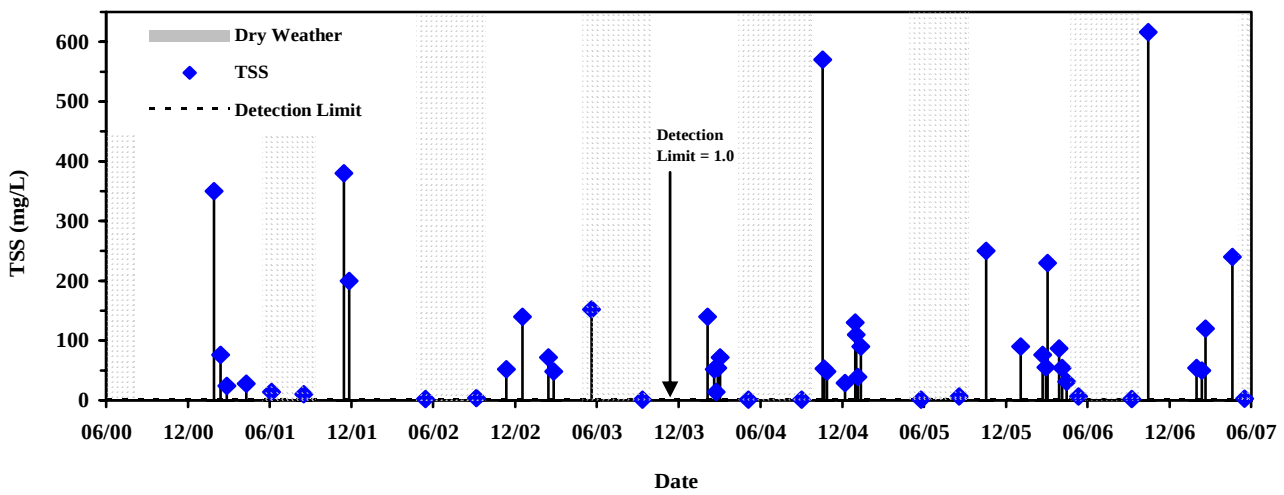



**Figure 9.12 Dominquez Gap Chemistry Results: a) Chlorpyrifos; b) Diazinon; c) Malathion**

a) **Belmont Pump**




b) **Bouton Creek**




c) **Los Cerritos Channel**

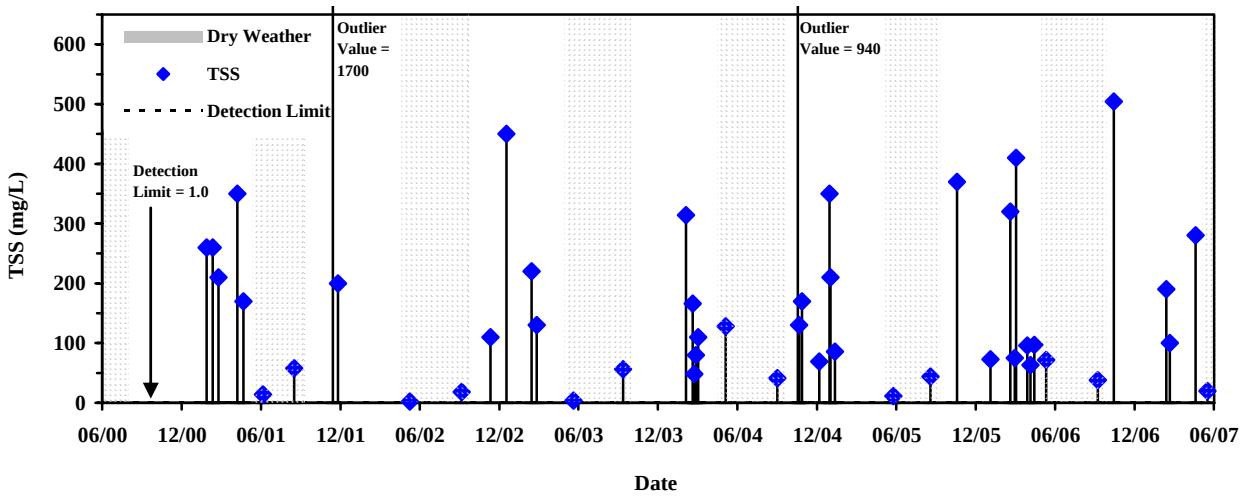



**Figure 9.13 TSS Results.**

d) **Dominguez Gap**

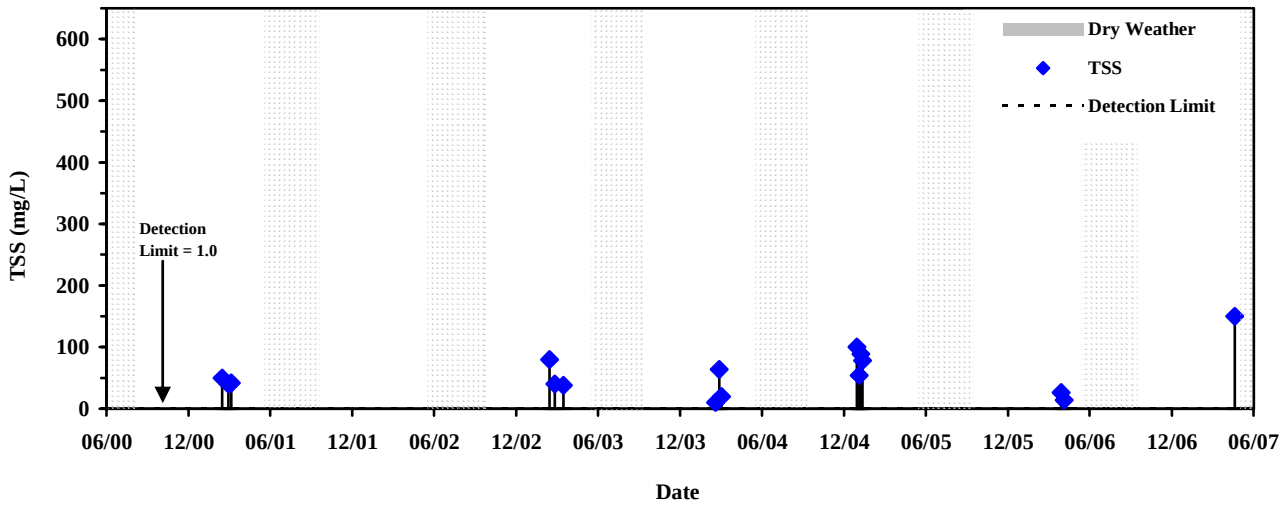



**Figure 9.13(continued) TSS Results.**

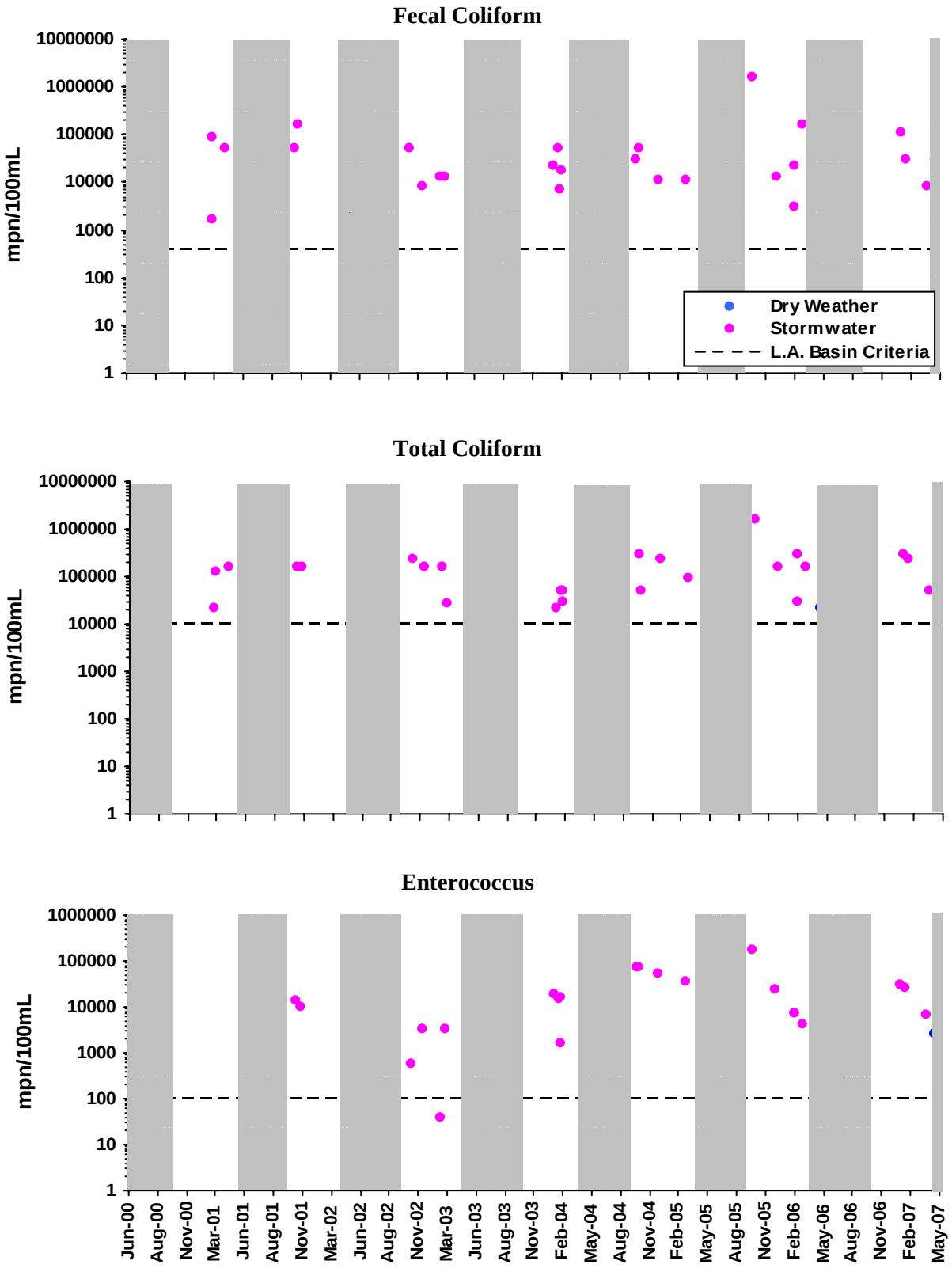



**Figure 9.14** **Belmont Pump Station bacteria concentrations for 2000 through 2007.** The dashed lines indicate the species-specific, single sample criteria based on the L.A. Basin Plan.

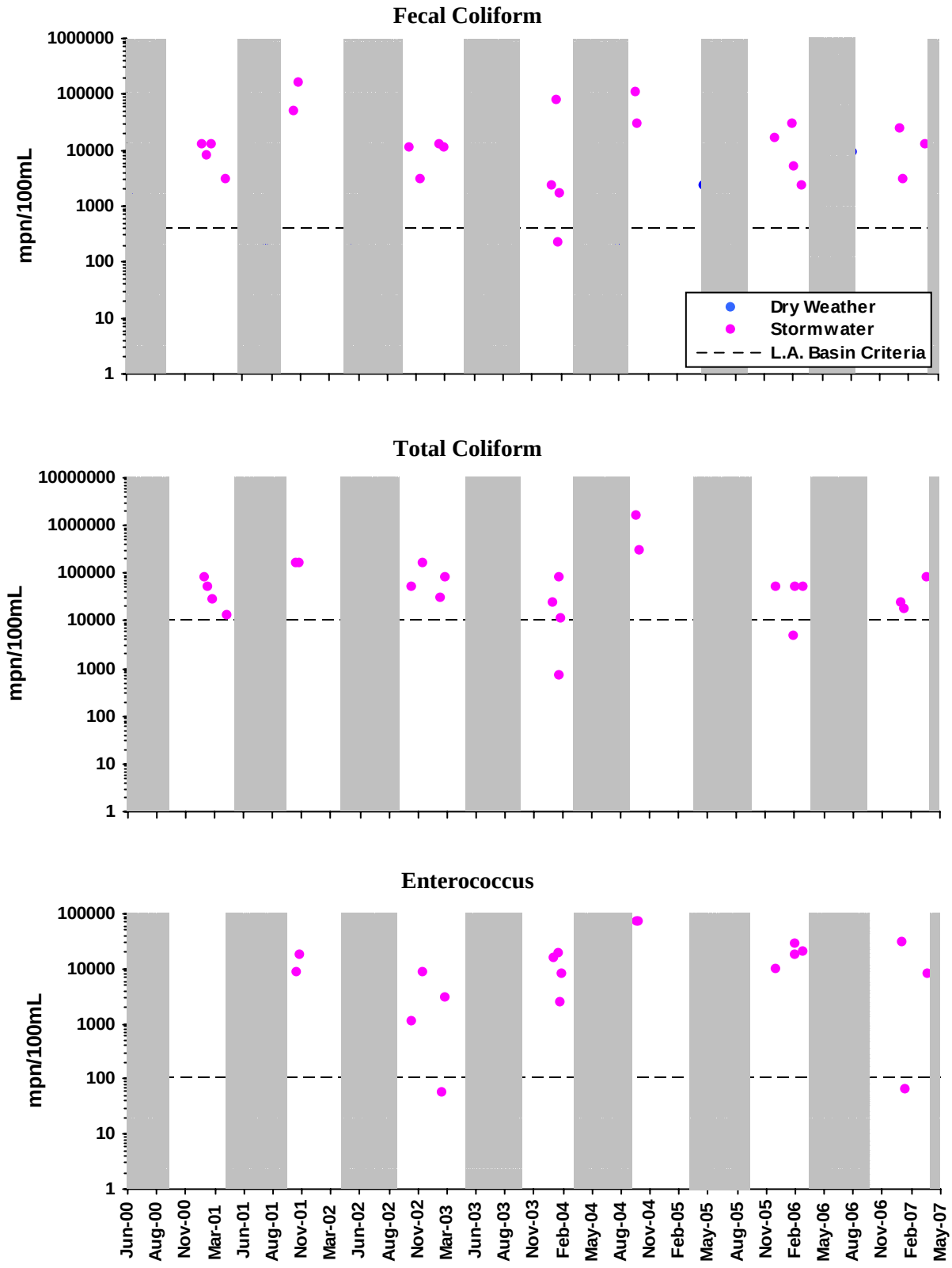



**Figure 9.15** **Bouton Creek bacteria concentrations for 2000 through 2007.** The dashed lines indicate the species-specific, single sample criteria based on the L.A. Basin Plan.

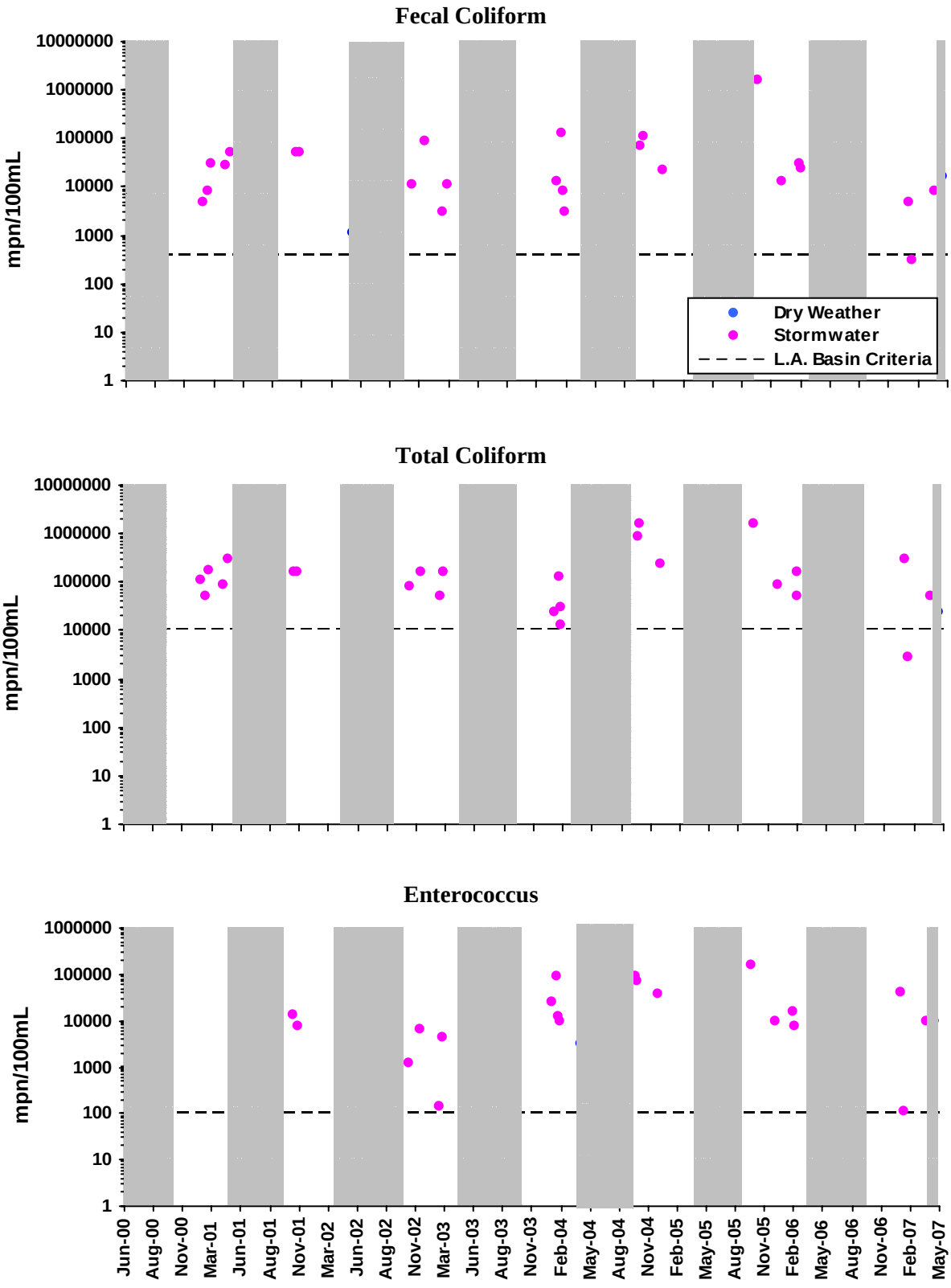



**Figure 9.16** **Los Cerritos Channel bacteria concentrations for 2000 through 2007.** The dashed lines indicate the species-specific, single sample criteria based on the L.A. Basin Plan.

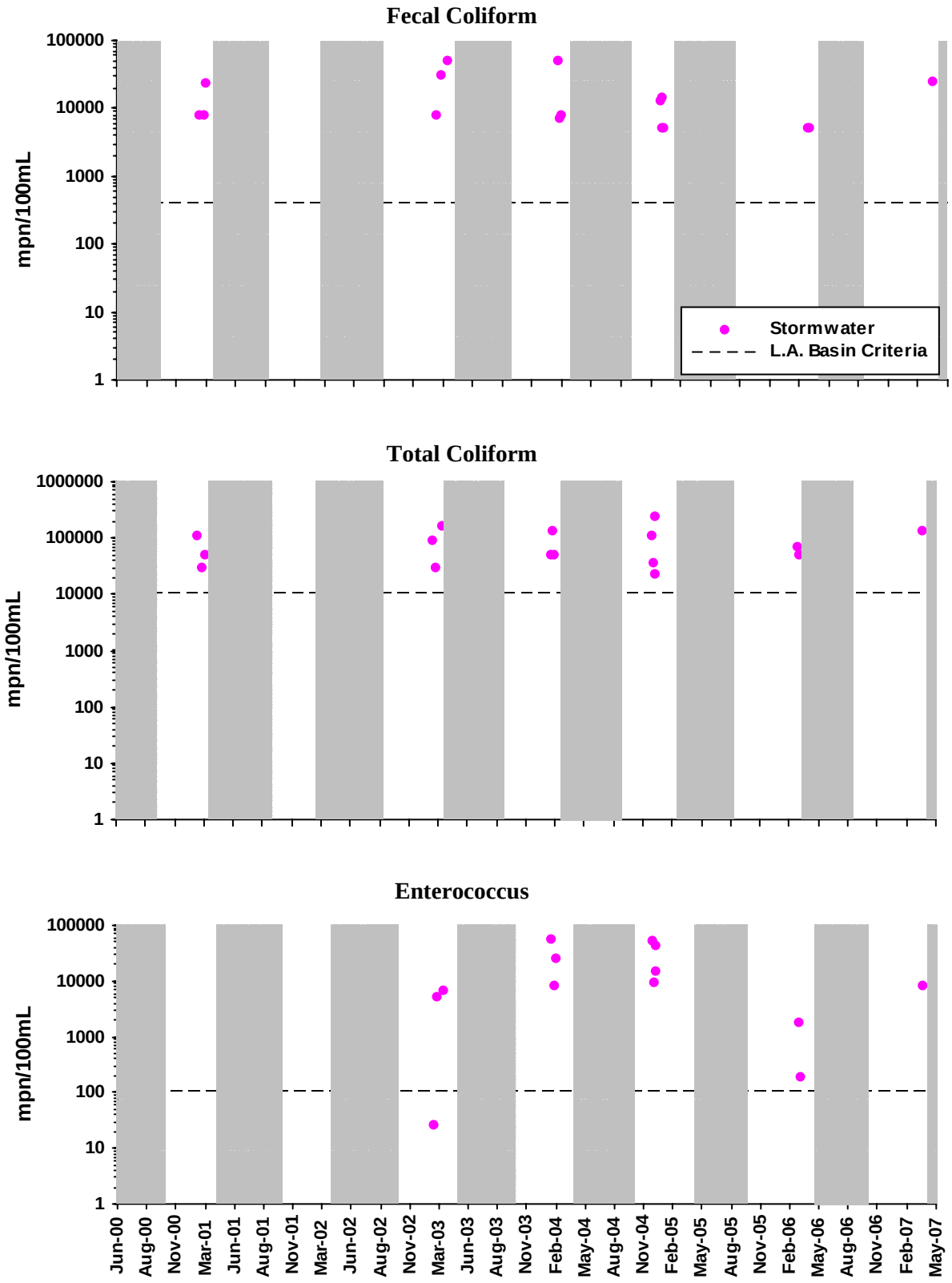



**Figure 9.17** **Dominguez Gap bacteria concentrations for 2000 through 2007.** The dashed lines indicate the species-specific, single sample criteria based on the L.A. Basin Plan.

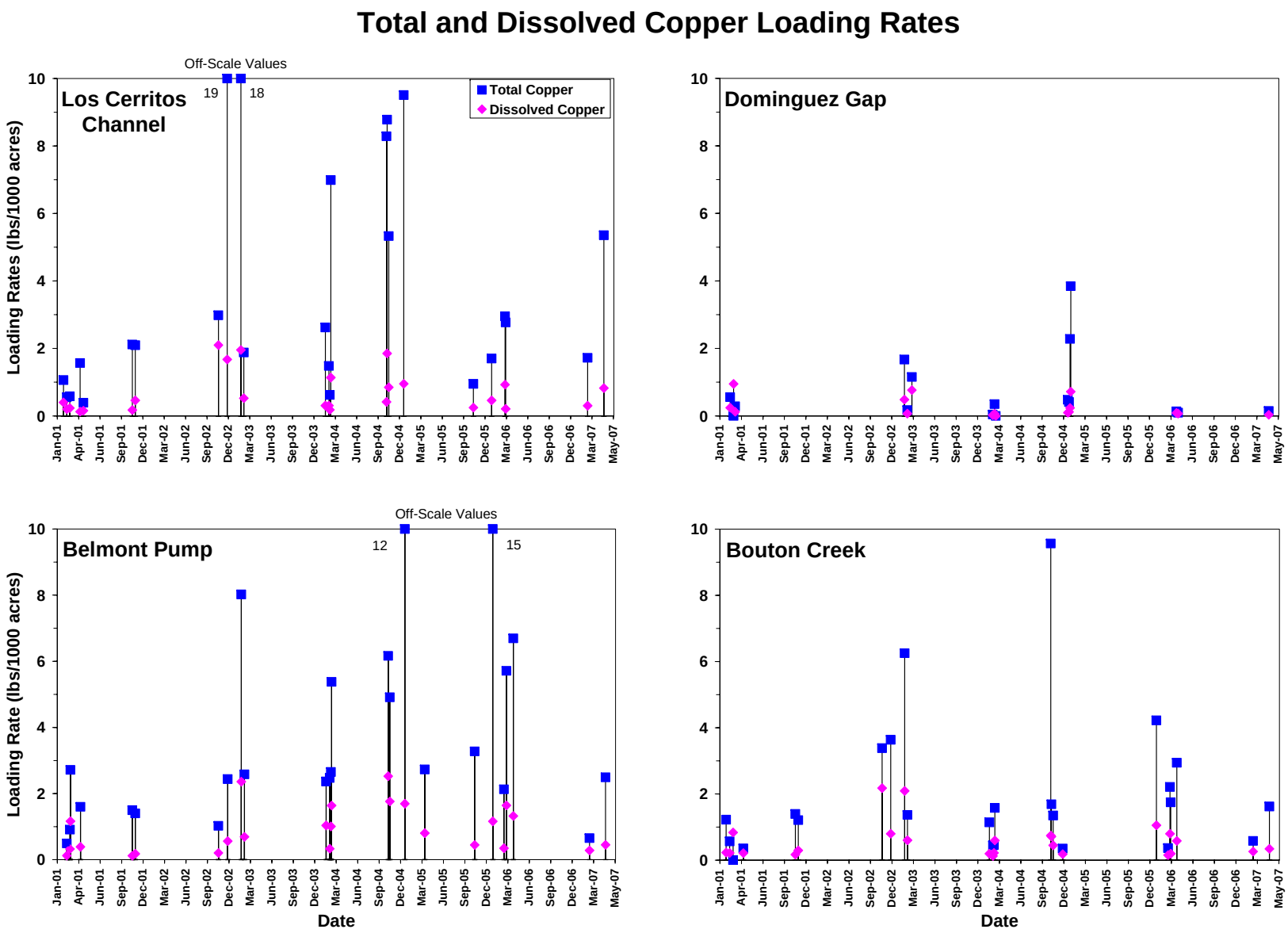



**Figure 9.18 Total and Dissolved Copper Loading Rates Calculated for all Monitored Storm Events, 2001-2007.**

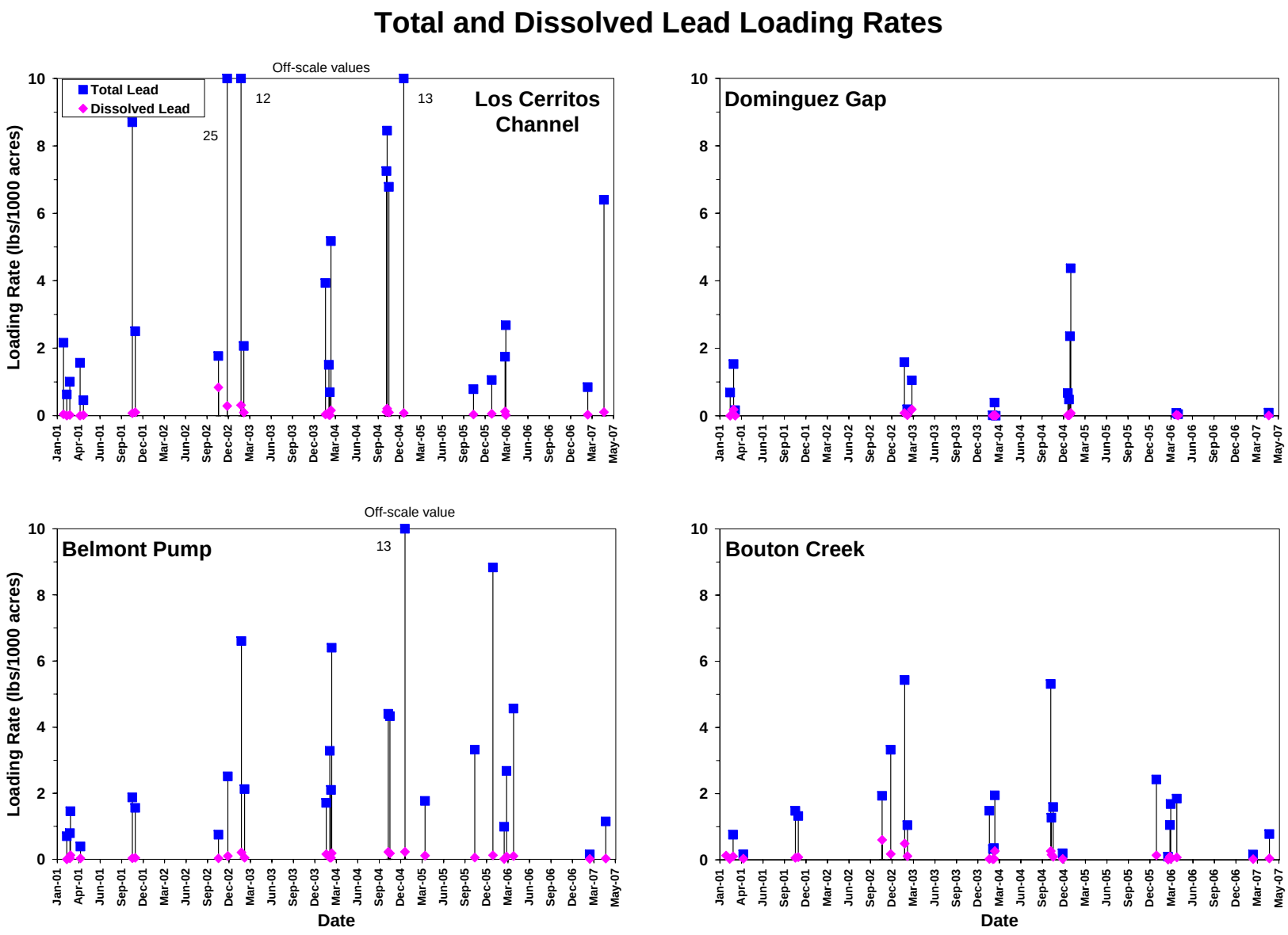



**Figure 9.19 Total and Dissolved Lead Loading Rates Calculated for all Monitored Storm Events, 2001-2007.**

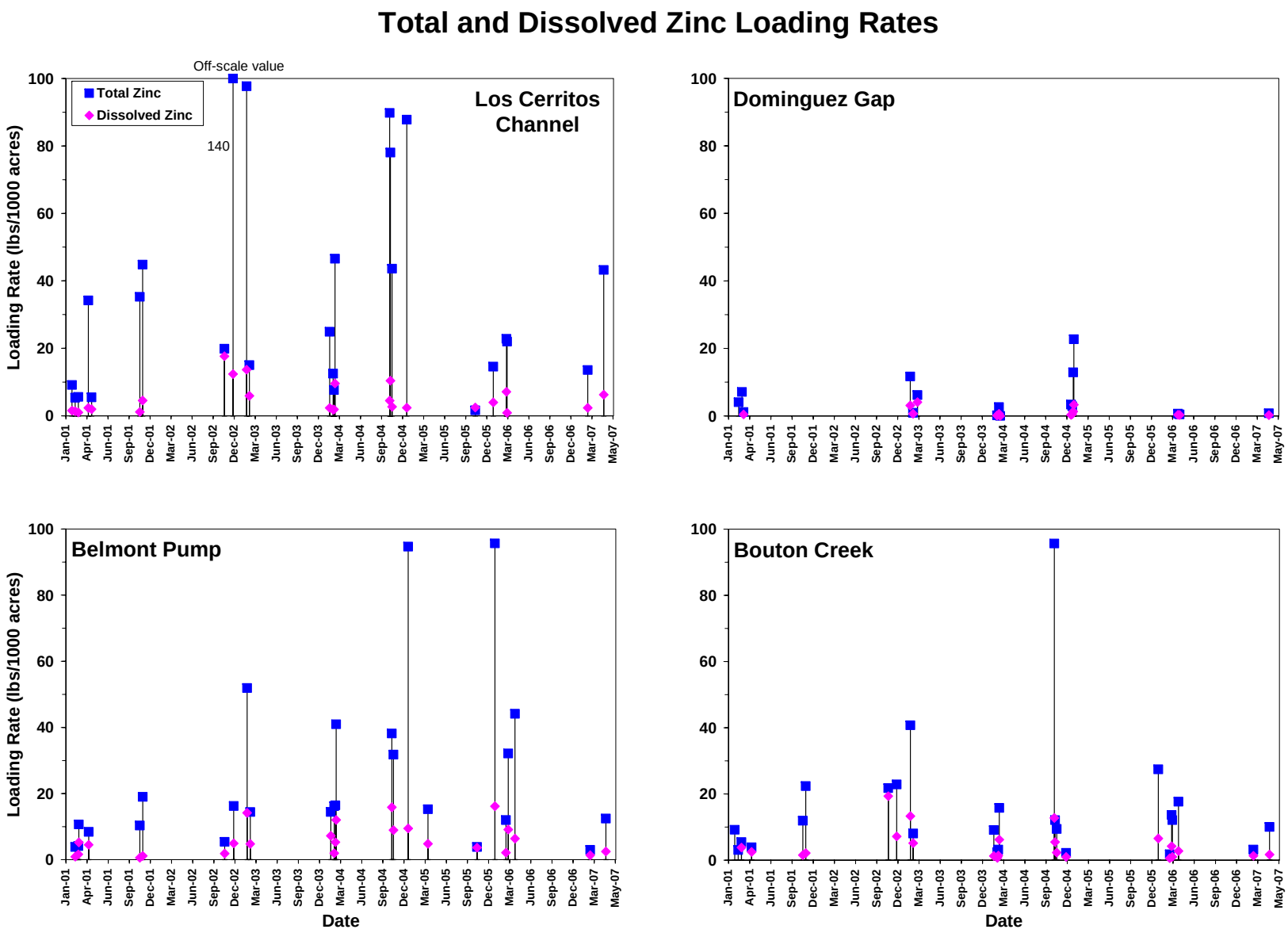



**Figure 9.20 Total and Dissolved Zinc Loading Rates Calculated for all Monitored Storm Events, 2001-2007.**

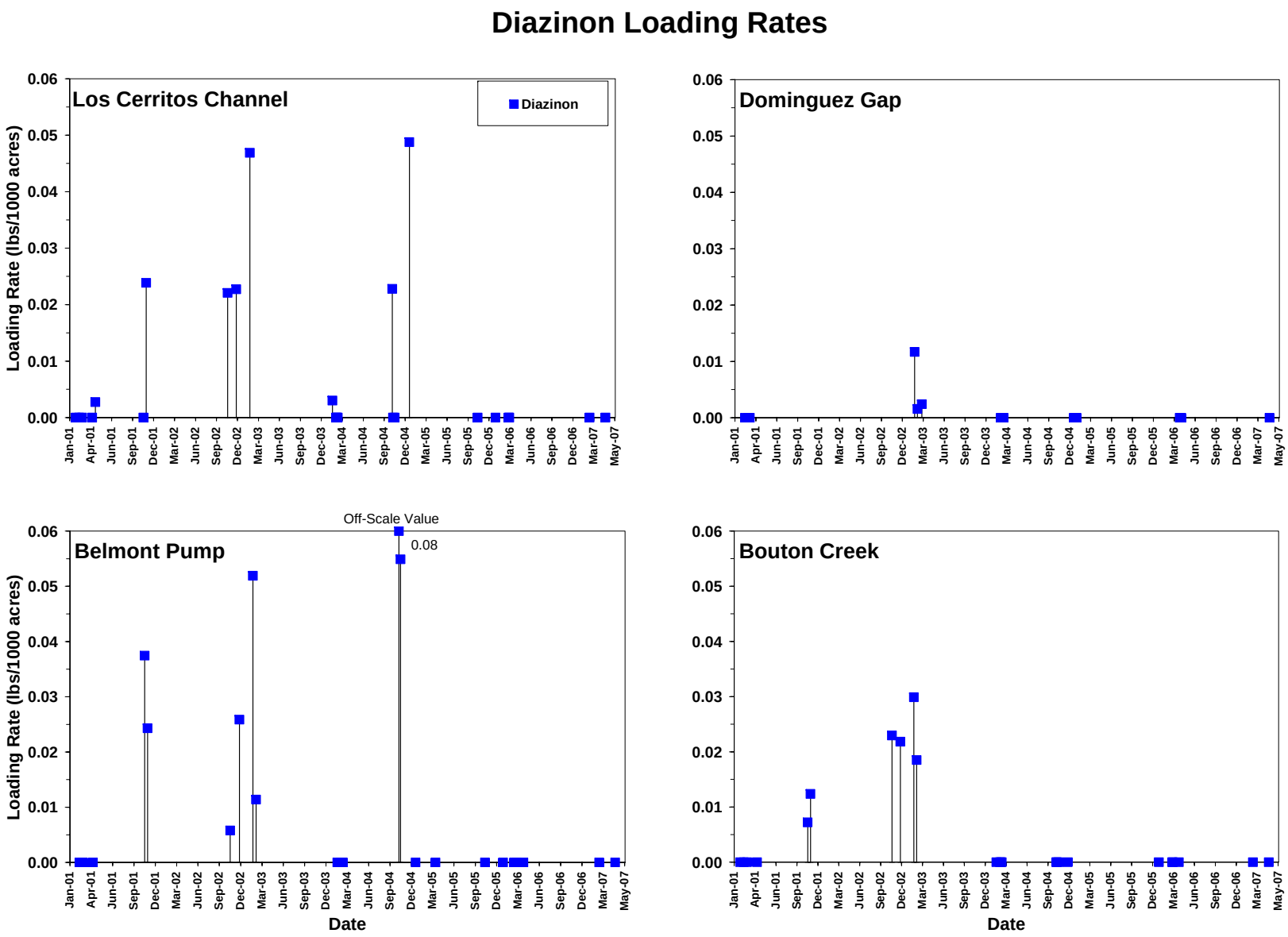



**Figure 9.21 Diazinon Loading Rates Calculated for all Monitored Storm Events, 2001-2007.**

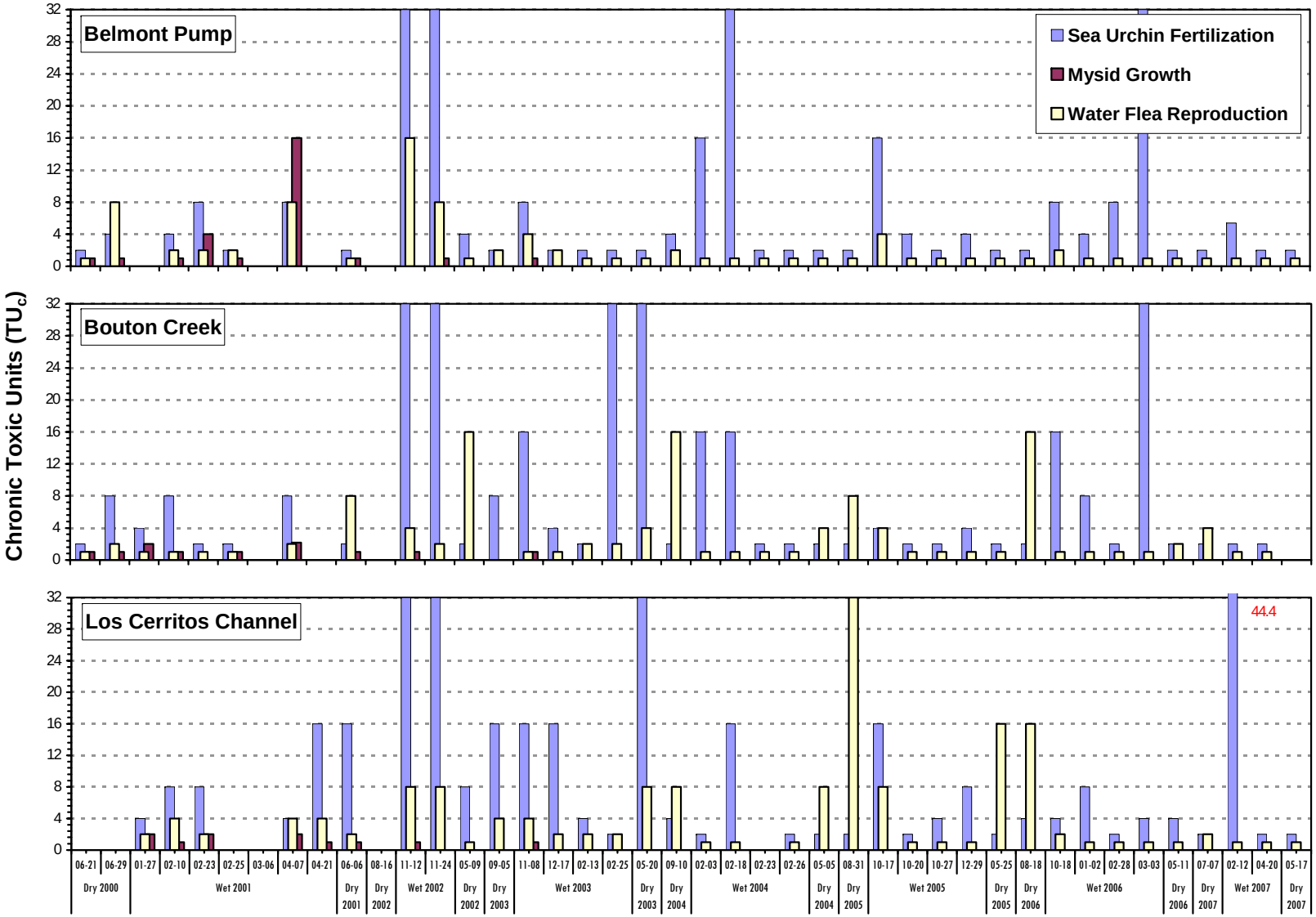



**Figure 9.22 Summary of Wet and Dry Weather Toxicity Results for all Long Beach Samples.**

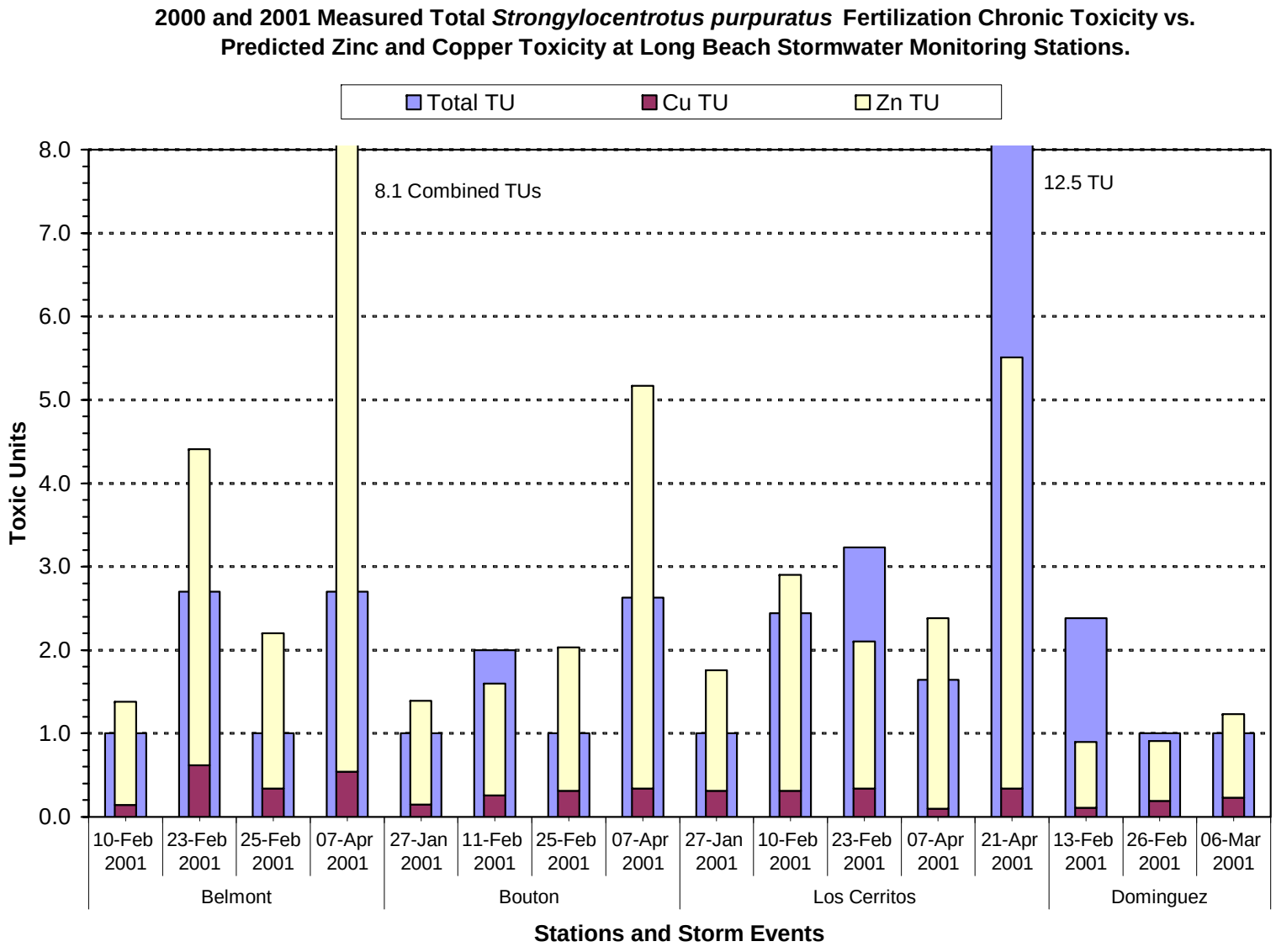



**Figure 9.23a** **Comparison of Measured (Total) Toxic Units for the Sea Urchin Fertilization Test and Toxic Units Predicted from the Dissolved Concentrations of Copper and Zinc in the Test Samples.** Measured toxic units are based on the $EC_{50}$ ($100/EC_{50}$). A value of 1 toxic unit was assigned to low/non-toxic samples have an estimated $EC_{50}$>100%

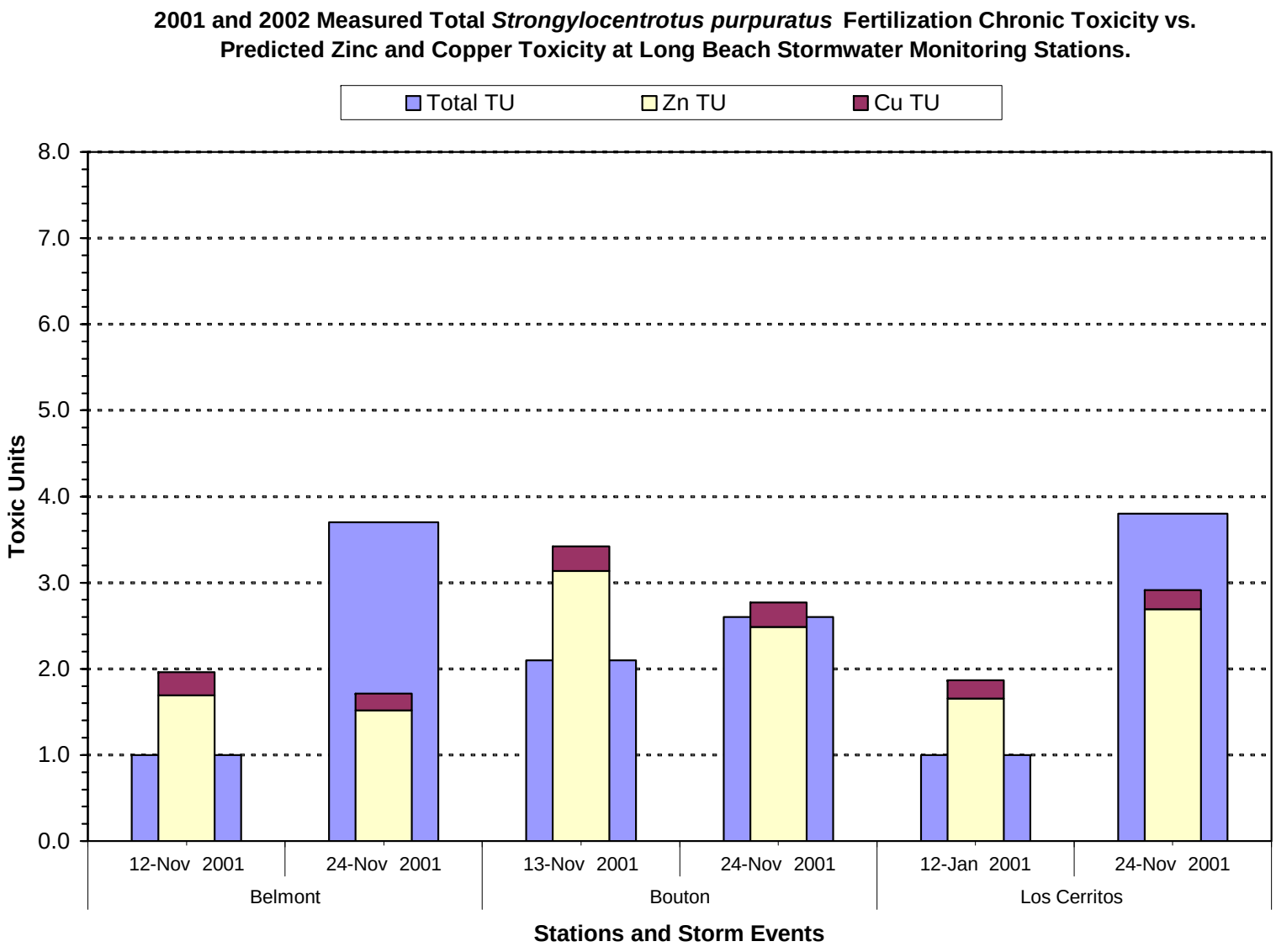



**Figure 9.23b Comparison of Measured (Total) Toxic Units for the Sea Urchin Fertilization Test and Toxic Units Predicted from the Dissolved Concentrations of Copper and Zinc in the Test Samples.** Measured toxic units are based on the $EC_{50}$ ($100/EC_{50}$). A value of 1 toxic unit was assigned to low/non-toxic samples have an estimated $EC_{50}$>100%

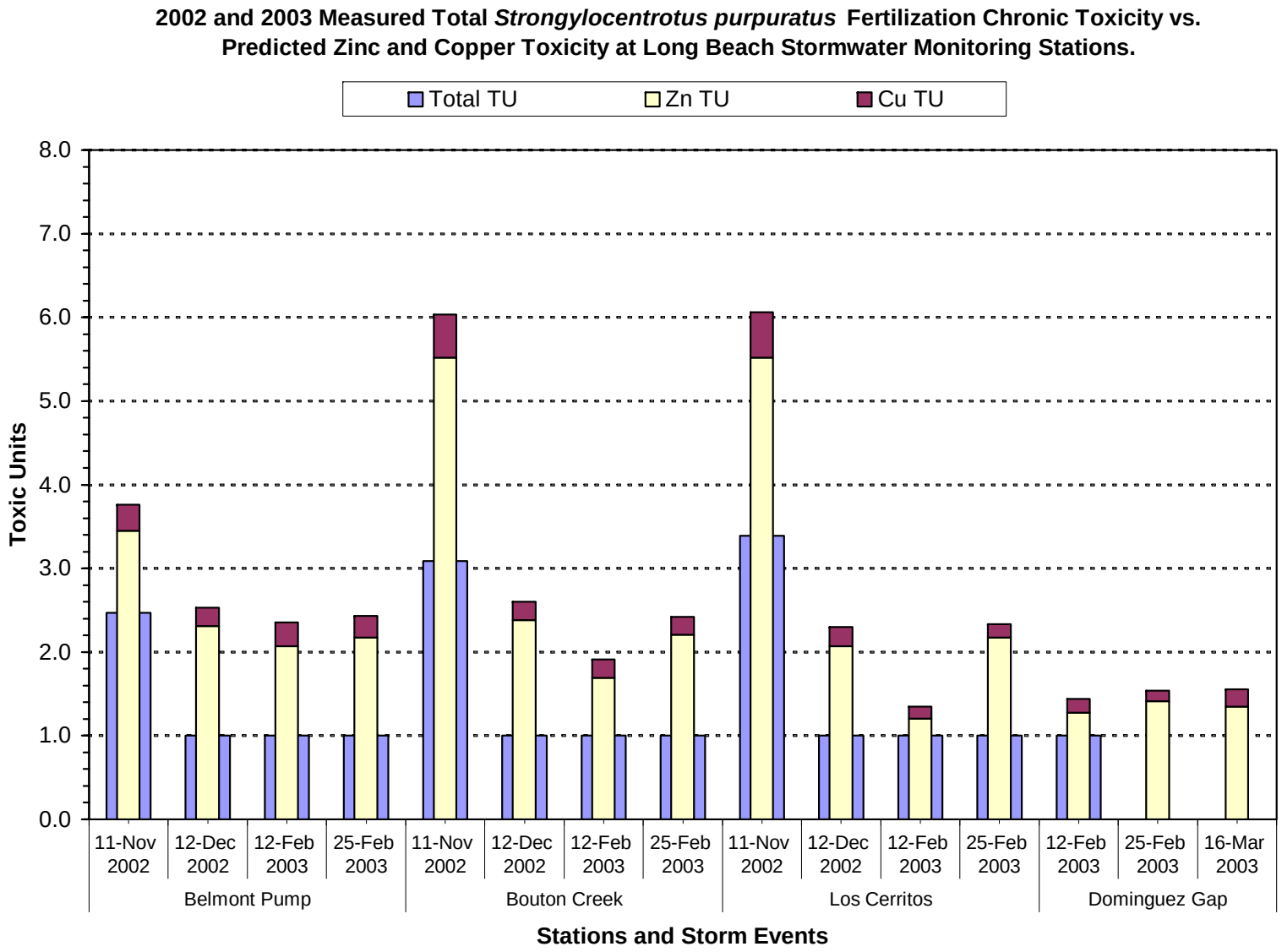



**Figure 9.23c** **Comparison of Measured (Total) Toxic Units for the Sea Urchin Fertilization Test and Toxic Units Predicted from the Dissolved Concentrations of Copper and Zinc in the Test Samples.** Measured toxic units are based on the $EC_{50}$ ($100/EC_{50}$). A value of 1 toxic unit was assigned to low/non-toxic samples have an estimated $EC_{50}$>100%

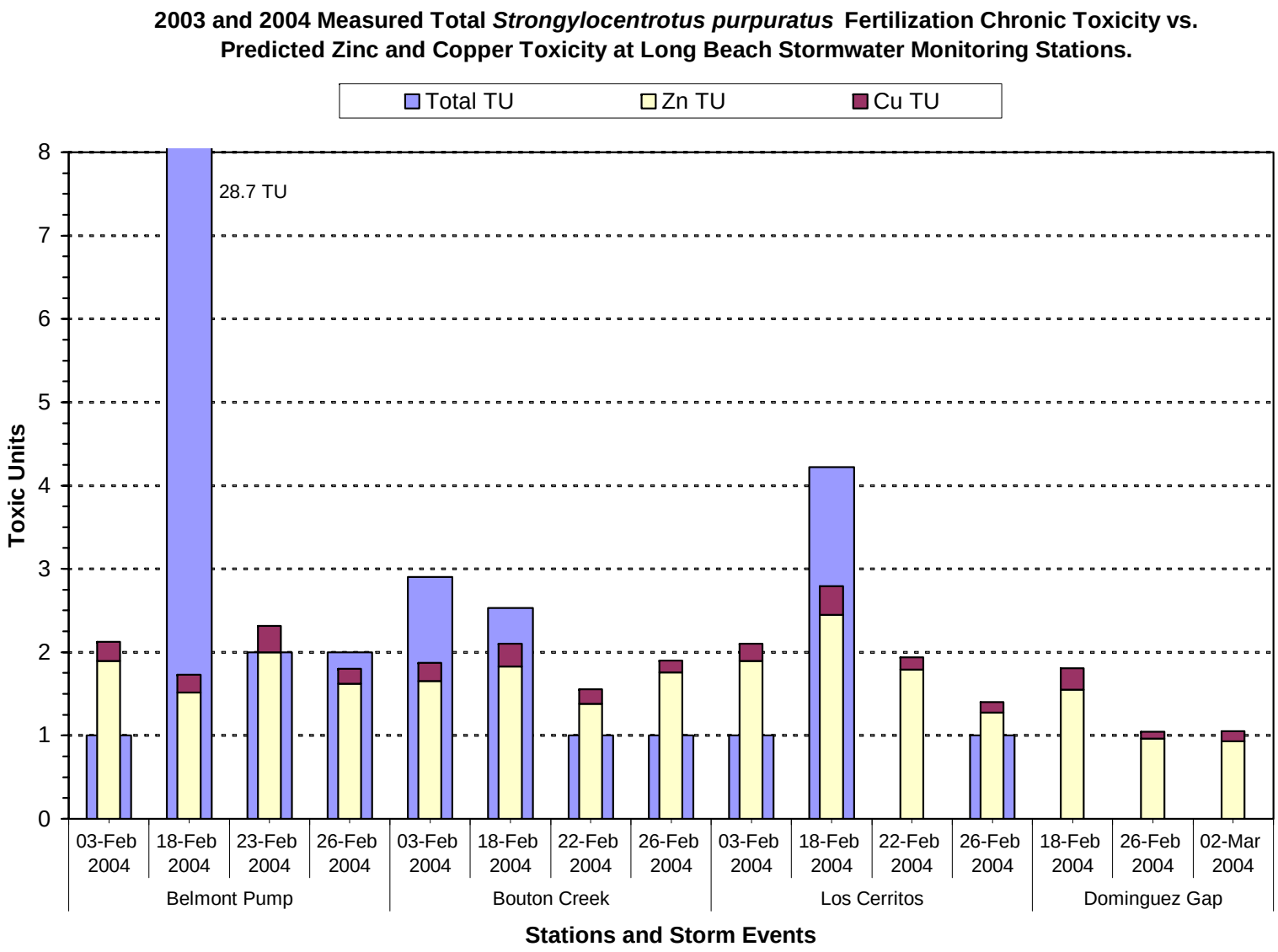



**Figure 9.23d** **Comparison of Measured (Total) Toxic Units for the Sea Urchin Fertilization Test and Toxic Units Predicted from the Dissolved Concentrations of Copper and Zinc in the Test Samples.** Measured toxic units are based on the $EC_{50}$ ($100/EC_{50}$). A value of 1 toxic unit was assigned to low/non-toxic samples have an estimated $EC_{50}$>100%

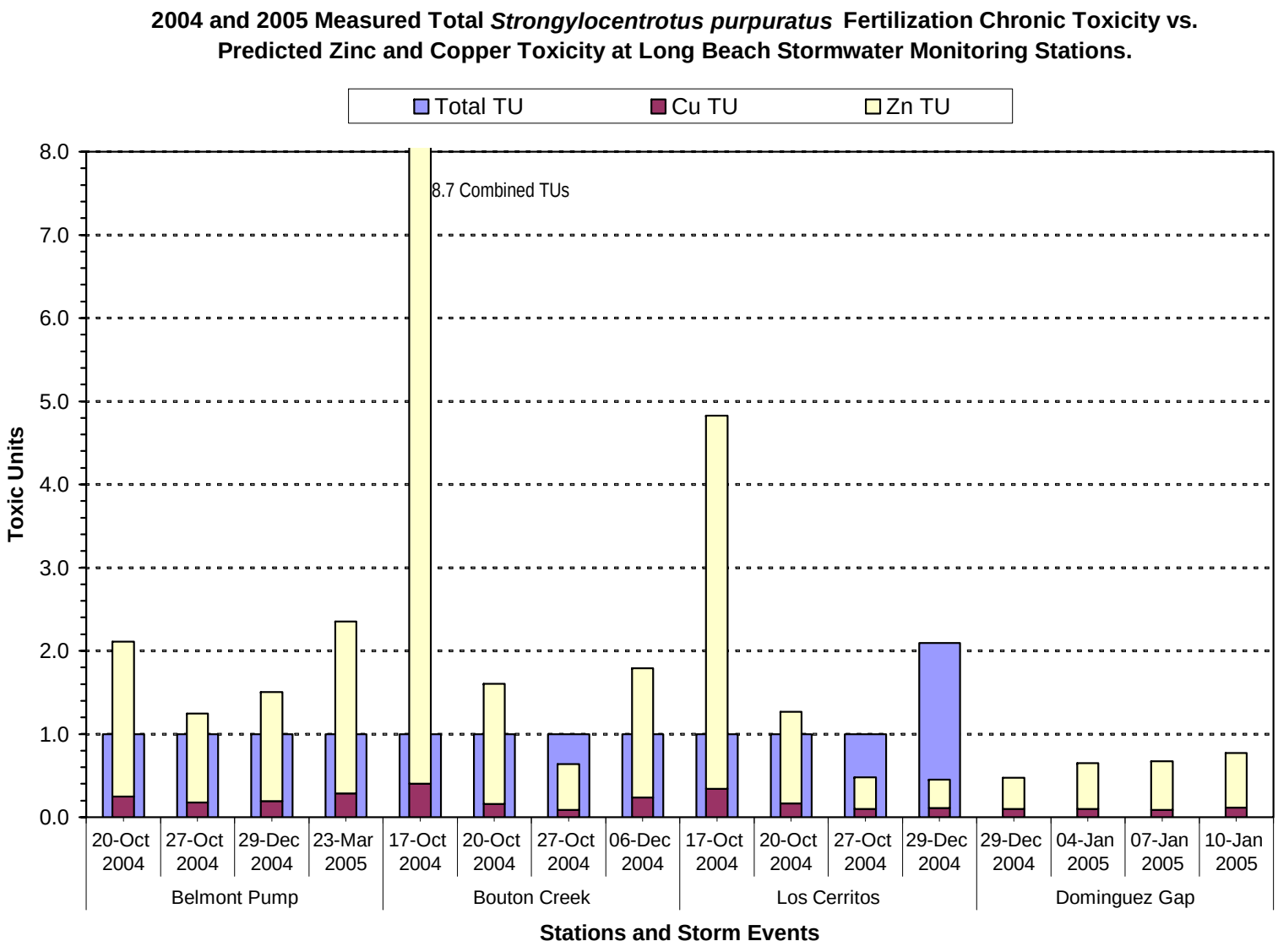



**Figure 9.23e** **Comparison of Measured (Total) Toxic Units for the Sea Urchin Fertilization Test and Toxic Units Predicted from the Dissolved Concentrations of Copper and Zinc in the Test Samples.** Measured toxic units are based on the $EC_{50}$ ($100/EC_{50}$). A value of 1 toxic unit was assigned to low/non-toxic samples have an estimated $EC_{50}$>100%

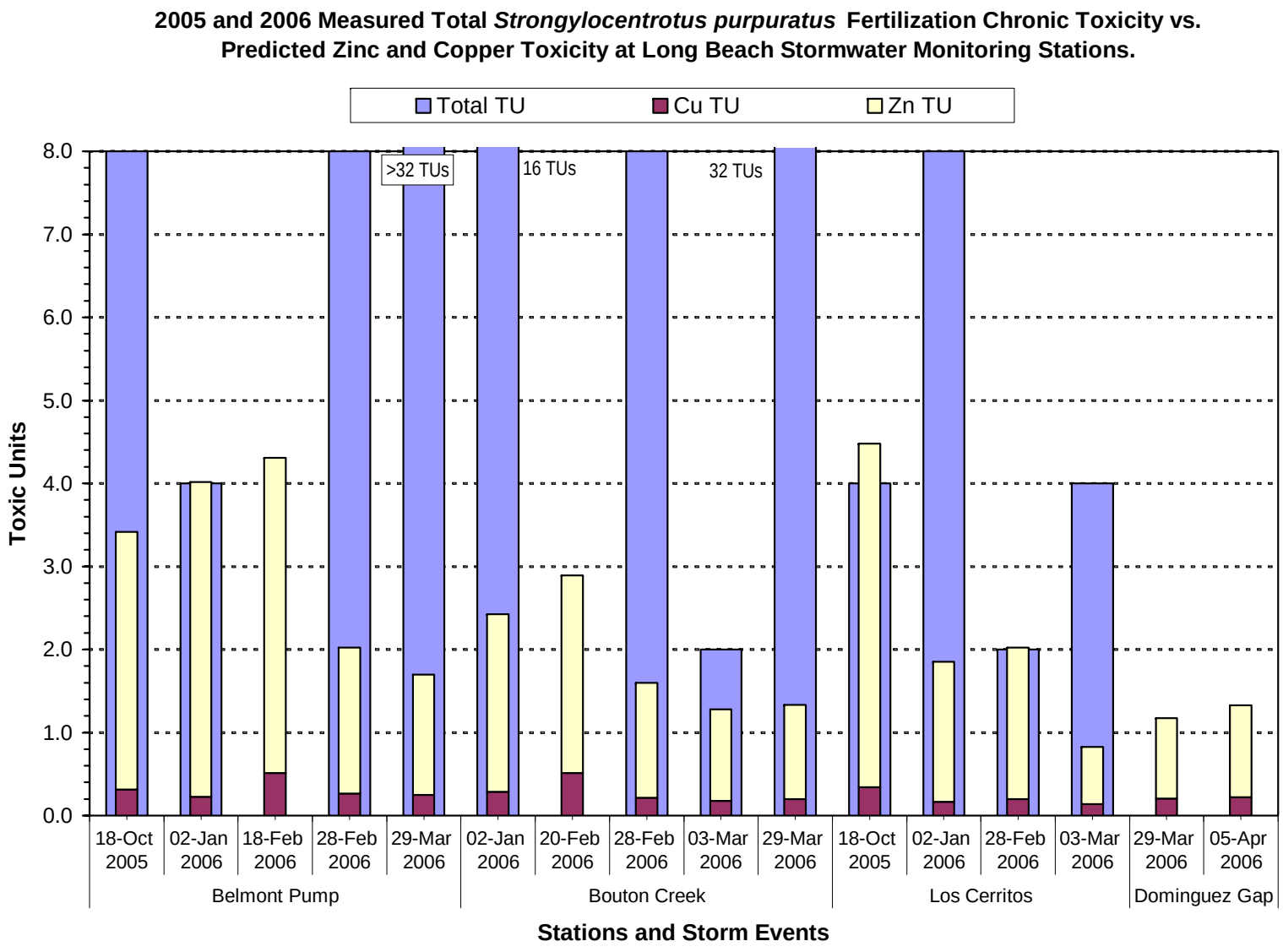



**Figure 9.23f** **Comparison of Measured (Total) Toxic Units for the Sea Urchin Fertilization Test and Toxic Units Predicted from the Dissolved Concentrations of Copper and Zinc in the Test Samples.** Measured toxic units are based on the $EC_{50}$ ($100/EC_{50}$). A value of 1 toxic unit was assigned to low/non-toxic samples have an estimated $EC_{50}$>100%

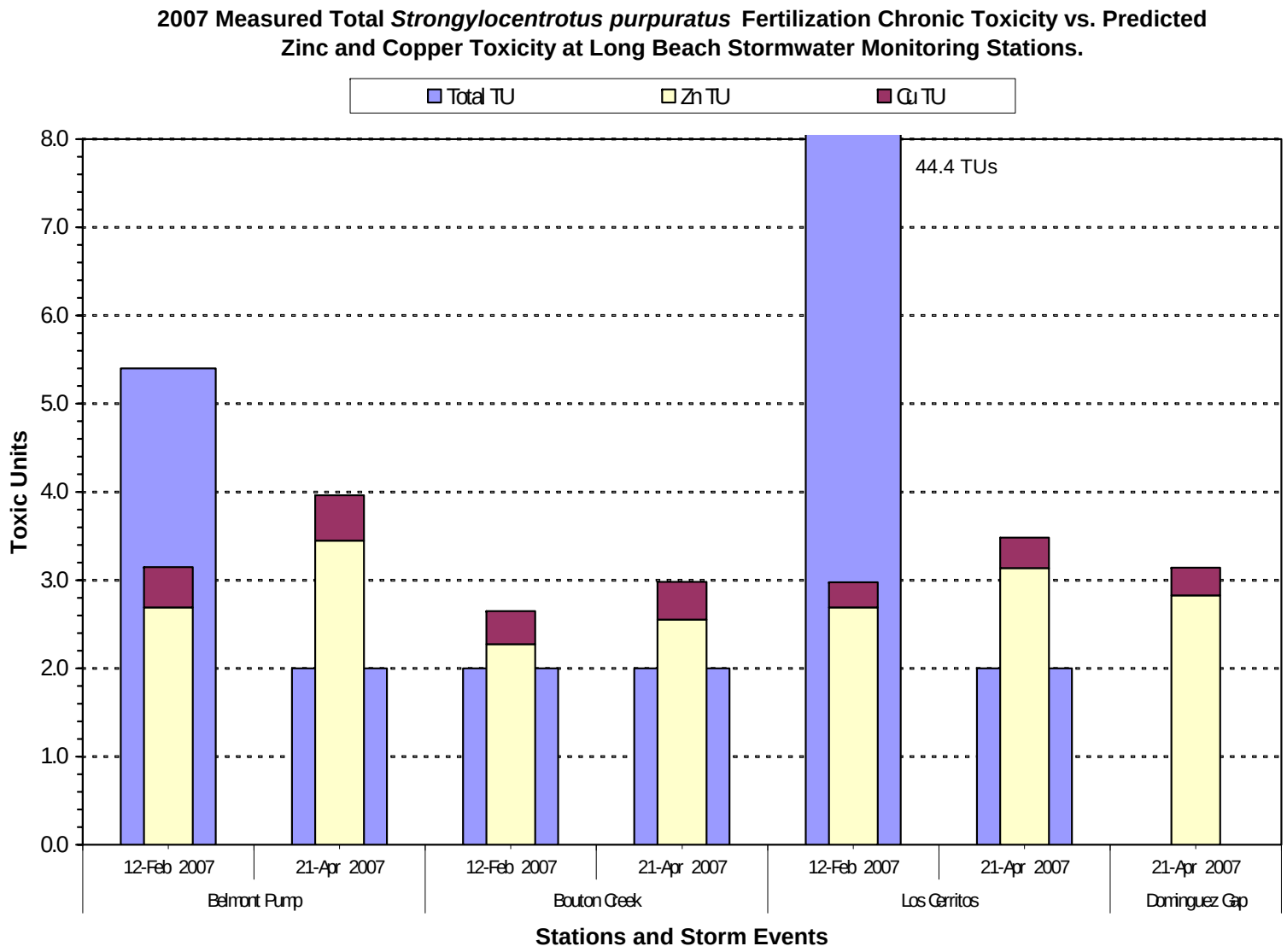



**Figure 9.23g** **Comparison of Measured (Total) Toxic Units for the Sea Urchin Fertilization Test and Toxic Units Predicted from the Dissolved Concentrations of Copper and Zinc in the Test Samples.** Measured toxic units are based on the $EC_{50}$ ($100/EC_{50}$). A value of 1 toxic unit was assigned to low/non-toxic samples have an estimated $EC_{50}$>100%

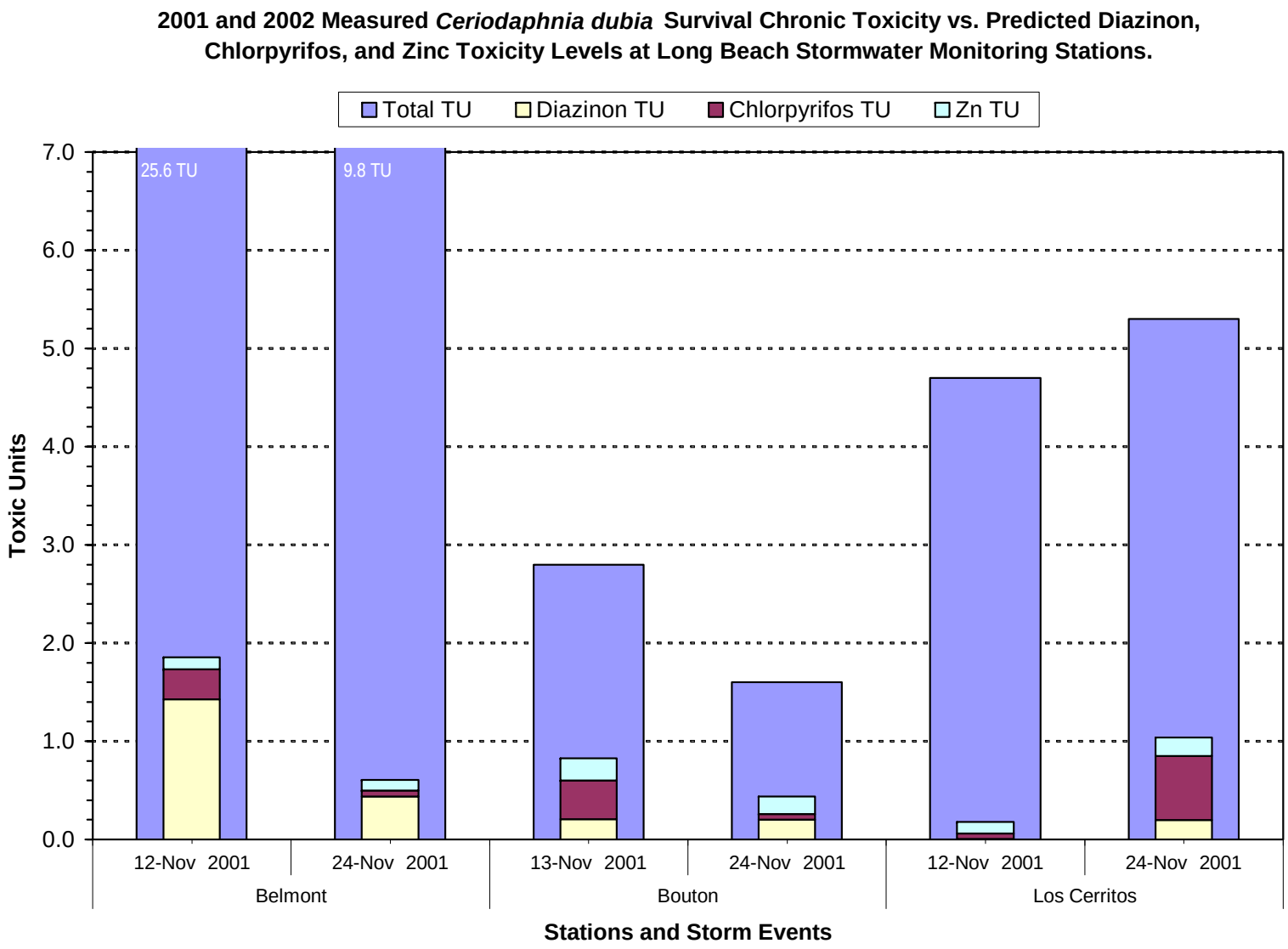



**Figure 9.24a** **Comparison of Measured (Total) Toxic Units for the Water Flea Survival Test and Toxic Units Predicted from the Concentrations of Chlorpyrifos, Diazinon, and Dissolved Zinc in the Test Samples.** Measured toxic units are based on the $EC_{50}$ ($100/EC_{50}$). A value of 1 toxic unit was assigned to low/non-toxic samples have an estimated $EC_{50}$>100%.

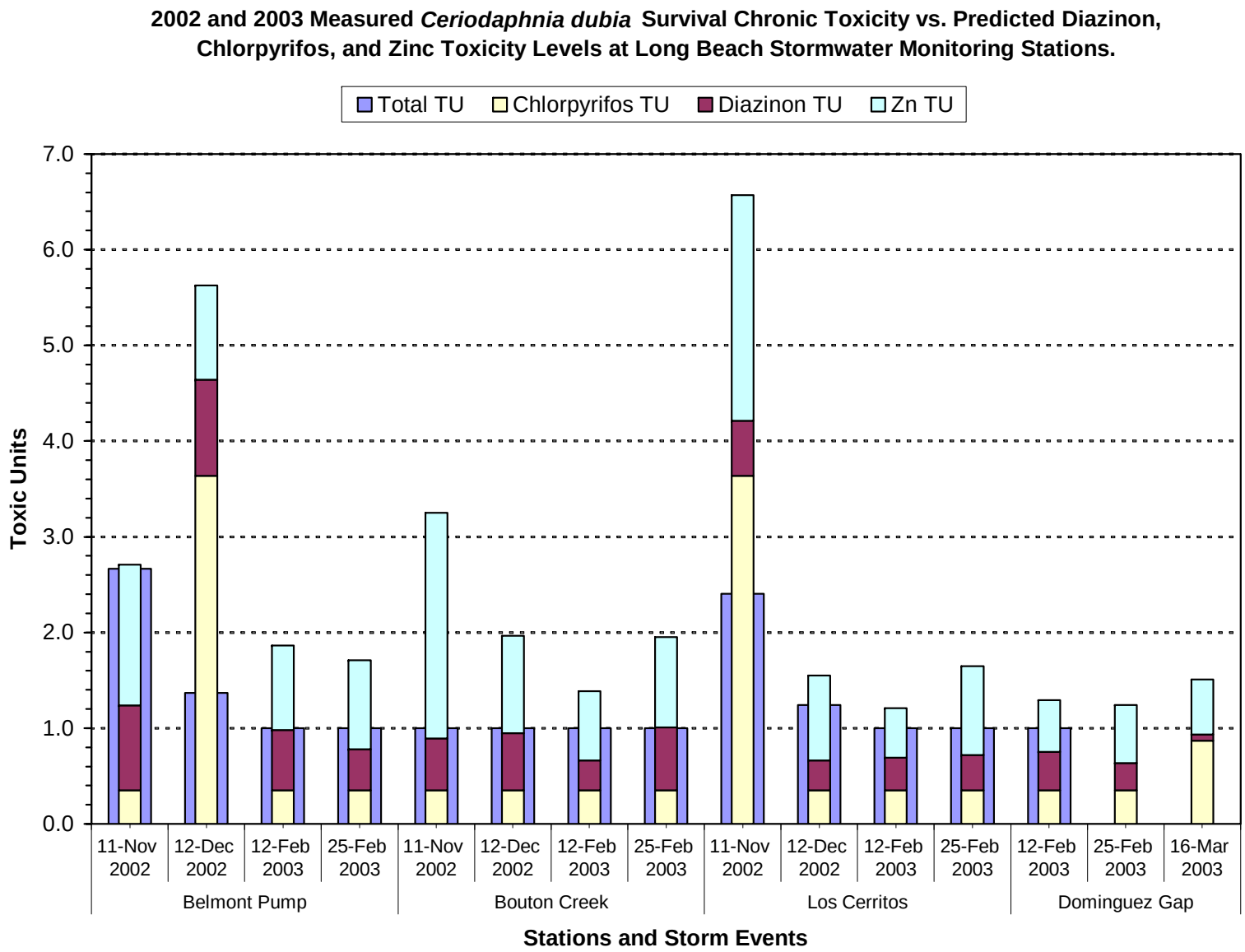



**Figure 9.24b** **Comparison of Measured (Total) Toxic Units for the Water Flea Survival Test and Toxic Units Predicted from the Concentrations of Chlorpyrifos, Diazinon, and Dissolved Zinc in the Test Samples.** Measured toxic units are based on the $EC_{50}$ ($100/EC_{50}$). A value of 1 toxic unit was assigned to low/non-toxic samples have an estimated $EC_{50}$>100%.

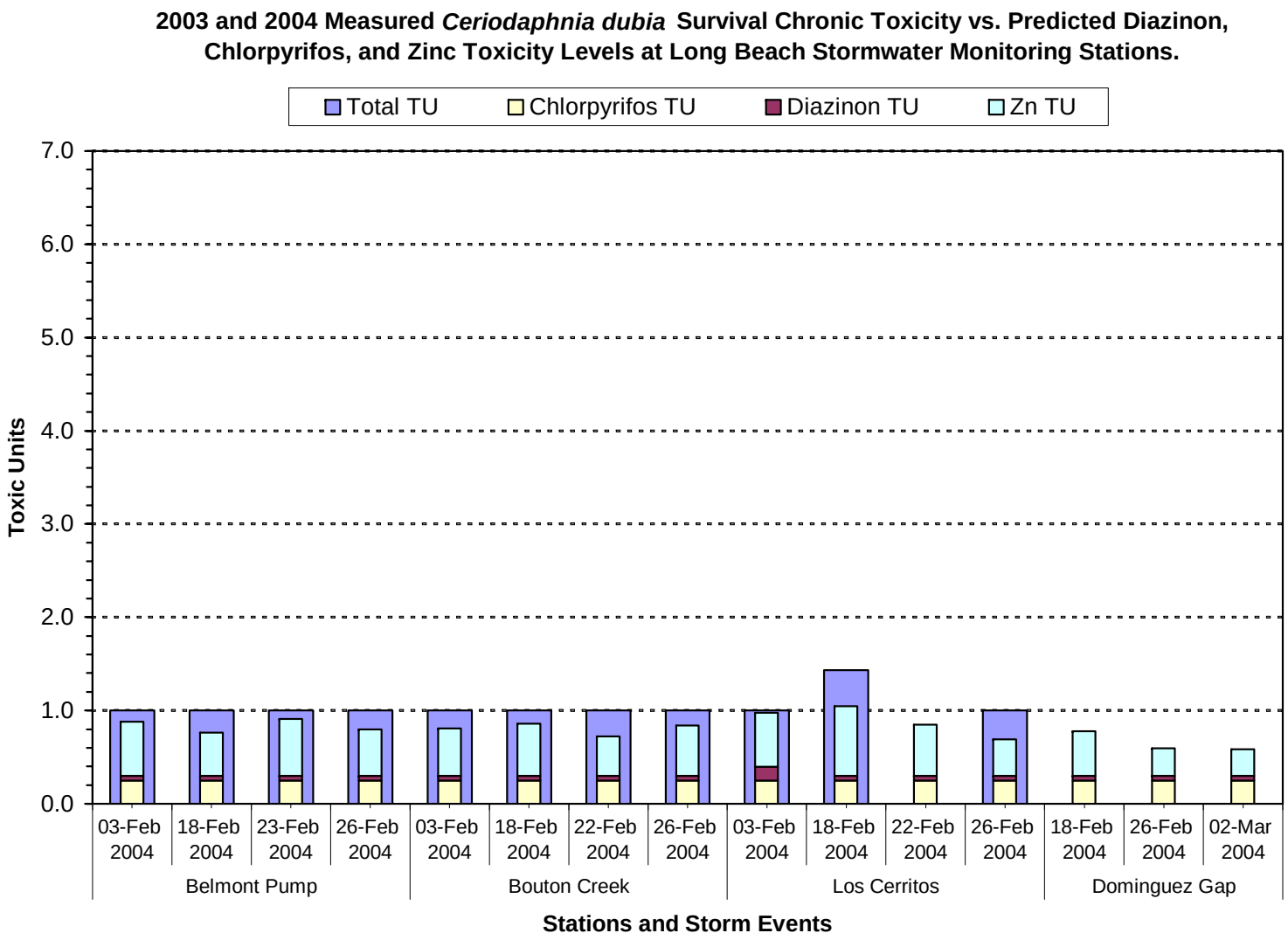



**Figure 9.24c** **Comparison of Measured (Total) Toxic Units for the Water Flea Survival Test and Toxic Units Predicted from the Concentrations of Chlorpyrifos, Diazinon, and Dissolved Zinc in the Test Samples.** Measured toxic units are based on the $EC_{50}$ ($100/EC_{50}$). A value of 1 toxic unit was assigned to low/non-toxic samples have an estimated $EC_{50}$>100%.

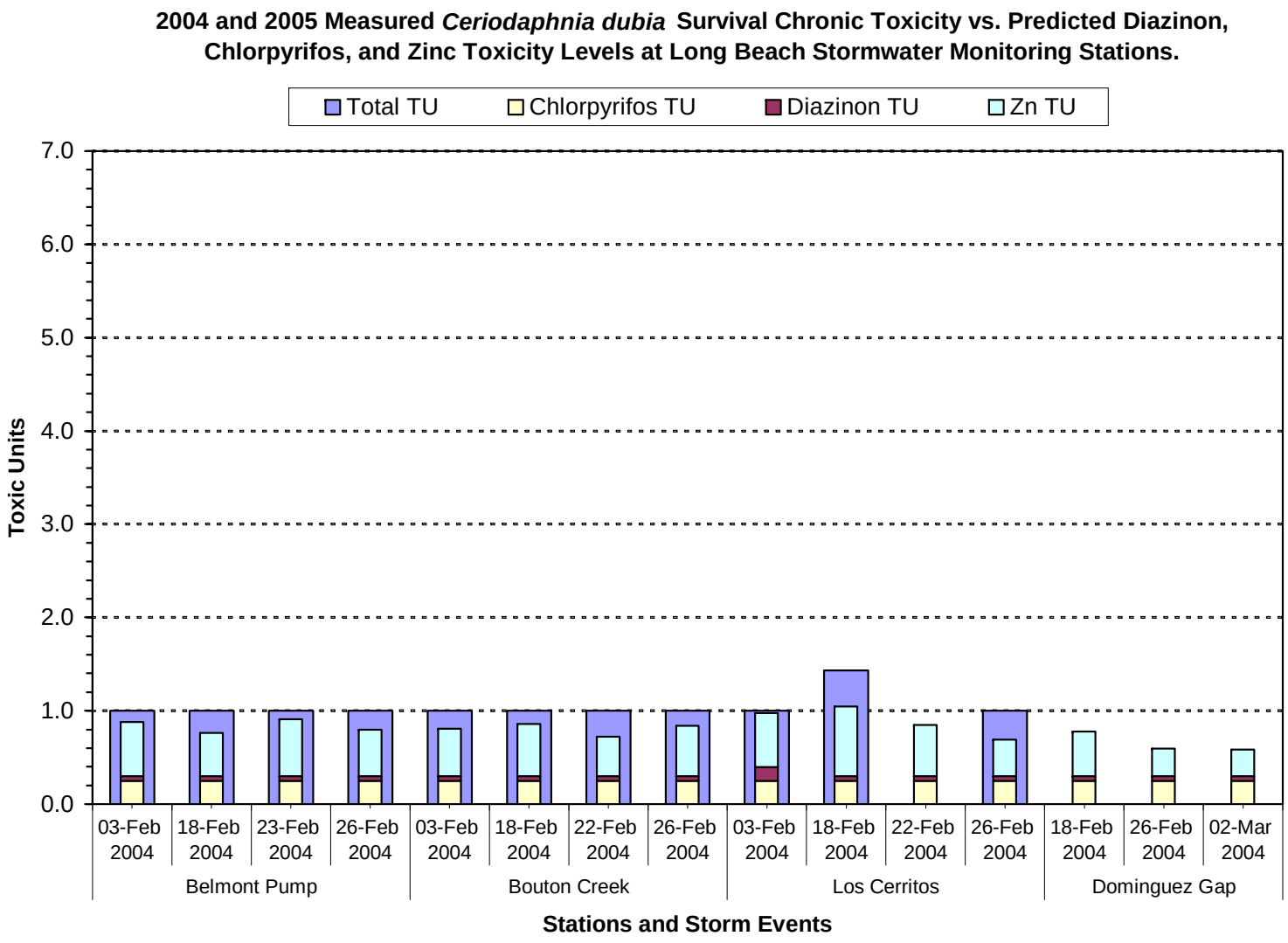



**Figure 9.24d** **Comparison of Measured (Total) Toxic Units for the Water Flea Survival Test and Toxic Units Predicted from the Concentrations of Chlorpyrifos, Diazinon, and Dissolved Zinc in the Test Samples.** Measured toxic units are based on the $EC_{50}$ ($100/EC_{50}$). A value of 1 toxic unit was assigned to low/non-toxic samples have an estimated $EC_{50}$>100%.

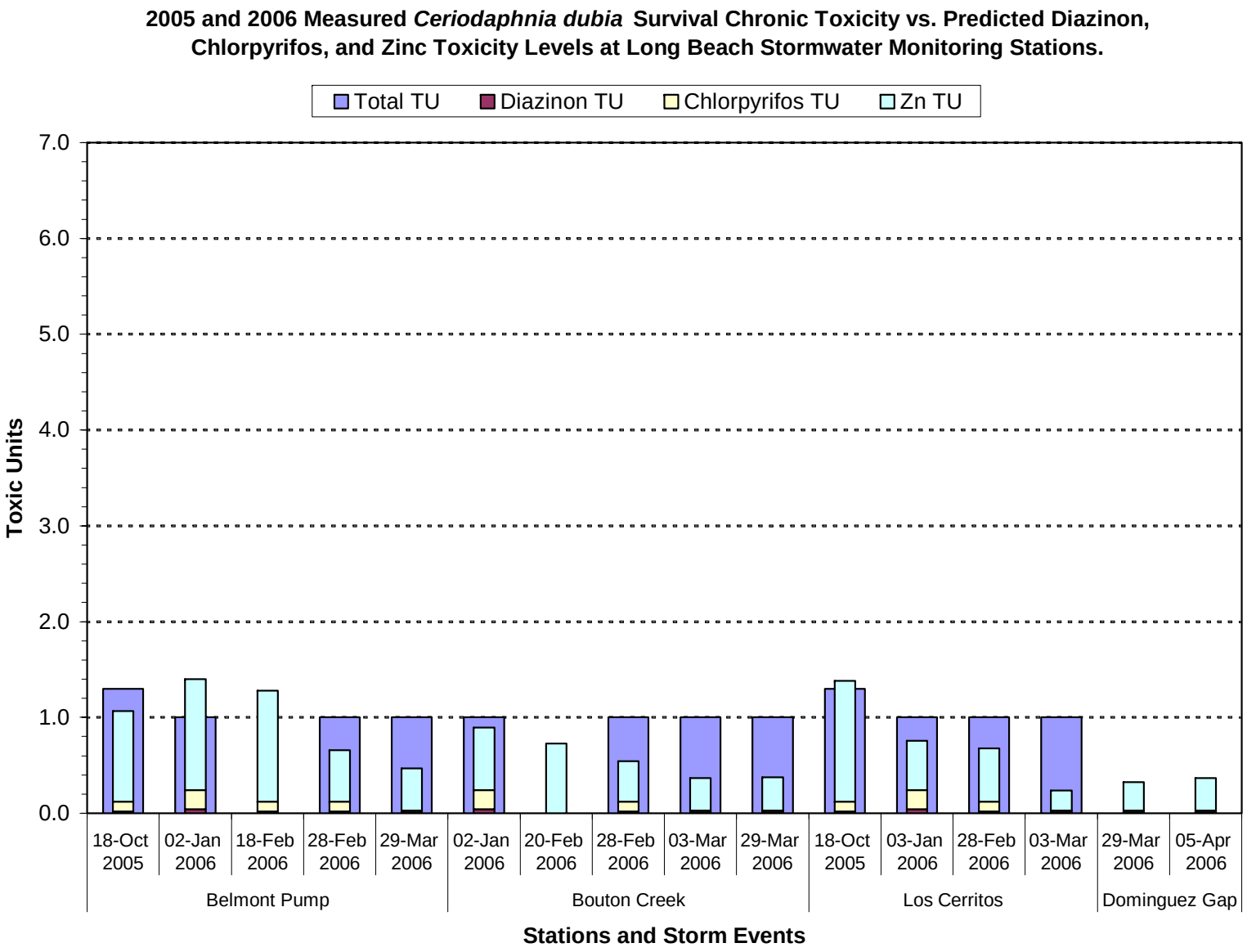



**Figure 9.24e** **Comparison of Measured (Total) Toxic Units for the Water Flea Survival Test and Toxic Units Predicted from the Concentrations of Chlorpyrifos, Diazinon, and Dissolved Zinc in the Test Samples.** Measured toxic units are based on the $EC_{50}$ ($100/EC_{50}$). A value of 1 toxic unit was assigned to low/non-toxic samples have an estimated $EC_{50}$>100%.

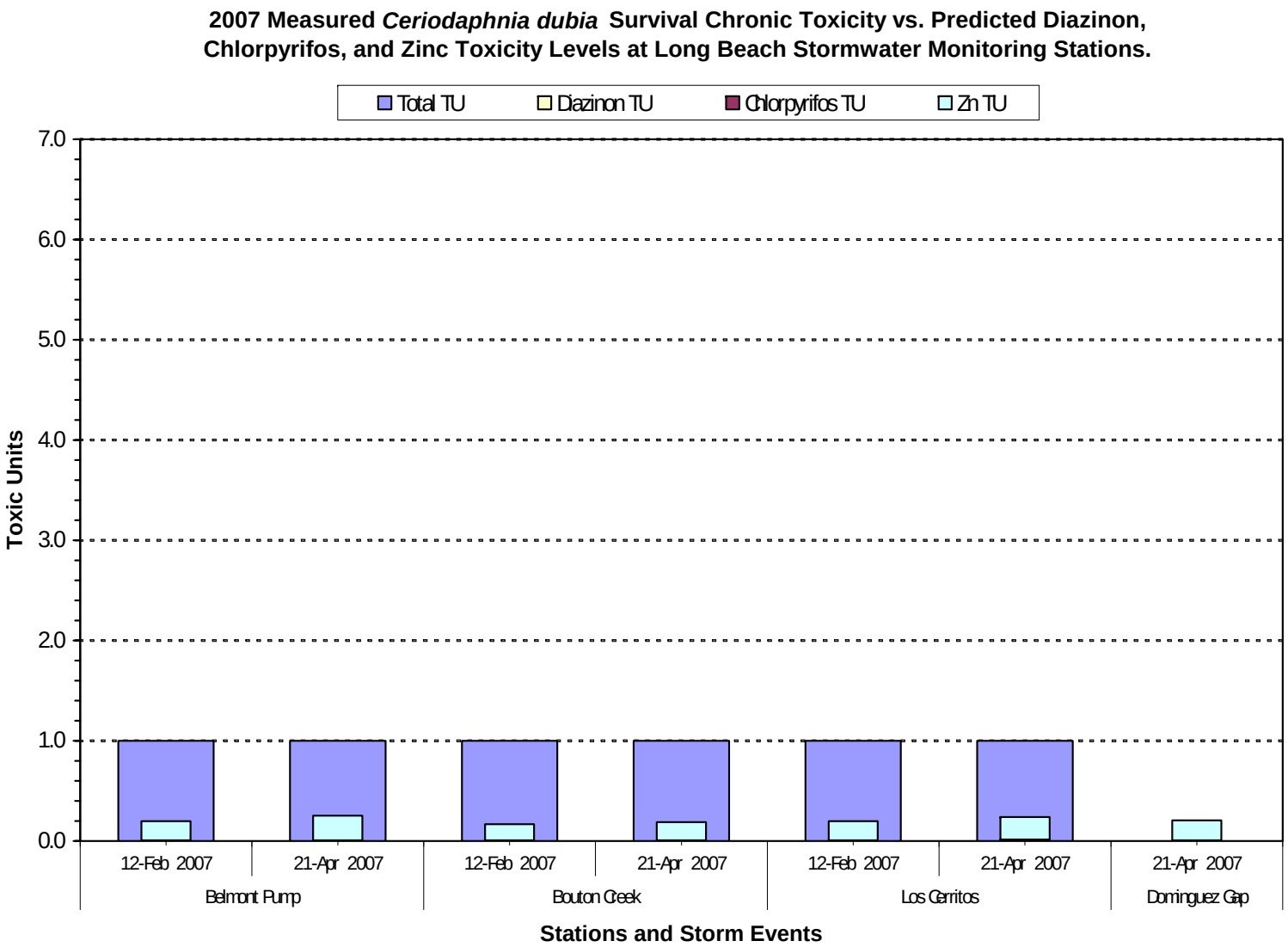



**Figure 9.24f** **Comparison of Measured (Total) Toxic Units for the Water Flea Survival Test and Toxic Units Predicted from the Concentrations of Chlorpyrifos, Diazinon, and Dissolved Zinc in the Test Samples.** Measured toxic units are based on the $EC_{50}$ ($100/EC_{50}$). A value of 1 toxic unit was assigned to low/non-toxic samples have an estimated $EC_{50}$>100%.

## Table 9.1 Summary of Beneficial Uses for Receiving Water Bodies Associated with each Monitoring Location[1].

| DISCHARGE LOCATION | HYDRO. UNIT | COMM | EST | GWR | IND | MAR | MUN | NAV | RARE | REC1 | REC2 | SHELL | WARM | WET | WILD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Bouton Creek** | **405.15** | | | | | | **P** | | | **P** | **I** | | **I** | | **E** |
| **Los Cerritos Channel** | **405.15** | | | | | | **P** | | | **P** | **I** | | **I** | | **E** |
| **Dominguez Gap Pump Sta.** | **405. 15** | | | **E** | **P** | | **P** | | | **E** | **E** | | **E** | | **P** |
| **Belmont Pump Sta./Alamitos Bay** | **405.12** | **E** | **E** | | **E** | **E** | | **E** | **E** | **E** | **E** | **E** | | **E** | **E** |

1. Source: California Regional Water Quality Control Board, Los Angeles Region. 1994. Water Quality Control Plan, Los Angeles Region, Basin Plan for the Coastal Watersheds of Los Angeles and Ventura Counties. P=Potential, E=Existing, and I=Intermittent

**Commercial and Sport Fishing (COMM):** Uses of water for commercial or recreational collection of fish, shellfish, or other organisms including, but not limited to, uses involving organisms intended for human consumption or bait purposes.

**Estuarine Habitat (EST):** Uses of water that support estuarine ecosystems including, but not limited to, preservation or enhancement of estuarine habitats, vegetation, fish, shellfish, or wildlife (e.g., estuarine mammals, waterfowl, shorebirds).

**Ground Water Recharge (GWR):** Uses of water for natural or artificial recharge of ground water for purposes of future extraction, maintenance of water quality, or halting of saltwater intrusion into freshwater aquifers.

**Industrial Service Supply (IND):** Uses of water for industrial activities that do not depend primarily on water quality including, but not limited to, mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, or oil well re-pressurization.

**Marine Habitat (MAR):** Uses of water that support marine ecosystems including, but not limited to, preservation or enhancement of marine habitats, vegetation, such as kelp, fish, shellfish, or wildlife (e.g., marine mammals, shorebirds).

**Municipal and Domestic Supply (MUN):** Uses of water for community, military, or individual water supply systems including, but not limited to, drinking water.

**Navigation (NAV):** Uses of water for shipping, travel, or other transportation by private, military, or commercial vessels.

**Rare, Threatened, or Endangered Species (RARE):** Uses of water that support habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species established under state or federal law as rare, threatened, or endangered.

**Water Contact Recreation (REC-1):** Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, white water activities, fishing, or use of natural hot springs.

**Non-contact Water Recreation (REC-2):** Uses of water for recreational activities involving proximity to water, but not normally involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sun bathing, hiking, beachcombing, camping, boating, tide pool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.

**Shellfish Harvesting (SHELL):** Uses of water that support habitats suitable for the collection of filter-feeding shellfish (e.g., clams, oysters, and mussels) for human consumption, commercial, or sports purposes.

**Warm Freshwater Habitat (WARM):** Uses of water that support warm water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

**Wetland Habitat (WET):** Uses if water that support wetland ecosystems including, but not limited to, preservation or enhancement of wetland habitats, vegetation, fish, shellfish, or wildlife, and other unique wetland functions which enhance water quality, such as providing flood and erosion control, stream bank stabilization, and filtration and purification of naturally occurring contaminants.

**Wildlife Habitat (WILD):** Uses of water that support terrestrial ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., Mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.

**Table 9.2 Available Benchmarks and Guidelines used to Evaluate Quality of Wet and Dry Season Discharges from the Mass Emission Sites.**

| Analyte Name | Long Beach 2005-2006 ML | Ocean Plan | LA Basin Plan | California Fish and Game Freshwater | California Fish and Game Saltwater | California Toxics Rule Freshwater | California Toxics Rule Saltwater | National Non Priority Pollutant Freshwater | National Non Priority Pollutant Saltwater |
|---|---|---|---|---|---|---|---|---|---|
| ***Bacteria (MPN/100 ml)*** | | | | | | | | | |
| Enterococcus | 10 | 104 | 104 | | | | | | |
| Fecal Coliform | 20 | 400 | 400 | | | | | | |
| Total Coliform | 20 | 10000 | 10000 | | | | | | |
| Ratio of Fecal to Total Coliform | - | FC/TC>0.1 & TC>1000 | FC/TC>0.1 & TC>1000 | | | | | | |
| ***Conventionals (mg/L unless noted)*** | | | | | | | | | |
| pH (pH Units) | 0.1 | | <[6.5-8.5]< | | | | | | |
| Conductivity (umhos/cm) | 1 | | | | | | | | |
| Alkalinity as CaCO3 | 1 | | | | | | | | |
| Hardness as CaCO3 | 2 | | | | | | | | |
| Biochemical Oxygen Demand | 2 | | | | | | | | |
| Chemical Oxygen Demand | 4 | | | | | | | | |
| Total Organic Carbon | 1 | | | | | | | | |
| Chloride | 1 | | | | | | | | |
| Fluoride | 0.1 | | | | | | | | |
| MBAS | 0.025 | | 0.5 | | | | | | |
| Oil and Grease | 5 | | | | | | | | |
| Total Ammonia (as N) | 0.1 | | | | | | | | |
| Total Kjeldahl Nitrogen | 0.1 | | | | | | | | |
| Nitrate (as N) | 0.1 | | 10 | | | | | | |
| Nitrite (as N) | 0.1 | | 1 | | | | | | |
| Orthophosphate (as P) | 0.01 | | | | | | | | |
| Total Phosphorus | 0.01 | | | | | | | | |
| Total Recoverable Phenolics | 0.1 | | | | | | | | |
| Total Dissolved Solids | 10 | | | | | | | | |
| Total Suspended Solids | 5 | | | | | | | | |
| Total Volatile Solids | 2 | | | | | | | | |
| Turbidity (NTU) | 0.1 | | | | | | | | |

**Table 9.2 Available Benchmarks and Guidelines used to Evaluate Quality of Wet and Dry Season Discharges from the Mass Emission Sites (continued)**

| Analyte Name | Long Beach 2005-2006 ML | Ocean Plan | LA Basin Plan | California Fish and Game Freshwater | California Fish and Game Saltwater | California Toxics Rule Freshwater | California Toxics Rule Saltwater | National Non Priority Pollutant Freshwater | National Non Priority Pollutant Saltwater |
|---|---|---|---|---|---|---|---|---|---|
| ***Dissolved Metals (ug/L)*** | | | | | | | | | |
| Aluminum | 25 | | | | | | | | |
| Arsenic | 0.5 | | | | | 150 | 36 | | |
| Cadmium | 0.2 | | | | | 1.3 | 9.3 | | |
| Chromium | 0.01 | | | | | | | | |
| Copper | 0.5 | | | | | 5 | 3.1 | | |
| Iron | 25 | | | | | | | | |
| Lead | 0.2 | | | | | 1.2 | 8.1 | | |
| Nickel | 0.5 | | | | | 29 | 8.2 | | |
| Selenium | 1 | | | | | | 71 | | |
| Silver | 0.2 | | | | | 1.1 | 1.9 | | |
| Zinc | 1 | | | | | 66 | 81 | | |
| ***Total Metals (ug/L)*** | | | | | | | | | |
| Aluminum | 25 | | 1000 | | | | | 87 | |
| Arsenic | 0.5 | 32 | 50 | | | | | | |
| Cadmium | 0.2 | 4 | 5 | | | | | | |
| Chromium | 0.01 | | 50 | | | | | | |
| Copper | 0.5 | 12 | | | | | | | |
| Iron | 25 | | | | | | | 1000 | |
| Lead | 0.2 | 8 | | | | | | | |
| Nickel | 0.5 | 20 | 100 | | | | | | |
| Selenium | 0.1 | 60 | 50 | | | 5 | | | |
| Silver | 0.2 | 2.8 | | | | | | | |
| Zinc | 1 | 80 | | | | | | | |
| ***Aroclors (ug/L)*** | | | | | | | | | |
| Aroclor 1016 | 0.02 | | 0.5 | | | | | | |
| Aroclor 1221 | 0.02 | | 0.5 | | | | | | |
| Aroclor 1232 | 0.02 | | 0.5 | | | | | | |
| Aroclor 1242 | 0.02 | | 0.5 | | | | | | |
| Aroclor 1248 | 0.02 | | 0.5 | | | | | | |
| Aroclor 1254 | 0.02 | | 0.5 | | | | | | |
| Aroclor 1260 | 0.02 | | 0.5 | | | | | | |

**Table 9.2 Available Benchmarks and Guidelines used to Evaluate Quality of Wet and Dry Season Discharges from the Mass Emission Sites (continued)**

| Analyte Name | Long Beach 2005-2006 ML | Ocean Plan | LA Basin Plan | California Fish and Game Freshwater | California Fish and Game Saltwater | California Toxics Rule Freshwater | California Toxics Rule Saltwater | National Non Priority Pollutant Freshwater | National Non Priority Pollutant Saltwater |
|---|---|---|---|---|---|---|---|---|---|
| ***Chlorinated Pesticides (ug/L)*** | | | | | | | | | |
| 2,4'-DDD | 0.005 | | | | | | | | |
| 2,4'-DDE | 0.005 | | | | | | | | |
| 2,4'-DDT | 0.005 | | | | | | | | |
| 4,4'-DDD | 0.005 | | | | | | | | |
| 4,4'-DDE | 0.005 | | | | | | | | |
| 4,4'-DDT | 0.005 | | | | | 0.001 | 0.001 | | |
| Total DDT | 0.005 | | | | | | | | |
| Aldrin | 0.005 | 0.000022 | | | | 3 | 1.3 | | |
| Dieldrin | 0.005 | 0.00004 | | | | 0.056 | 0.0019 | | |
| Endrin | 0.005 | 0.004 | 2 | | | 0.036 | 0.023 | | |
| Endrin aldehyde | 0.005 | | | | | | | | |
| Endrin ketone | 0.005 | | | | | | | | |
| alpha-BHC | 0.005 | | | | | | | | |
| beta-BHC | 0.005 | | | | | | | | |
| delta-BHC | 0.005 | | | | | | | | |
| gamma-BHC (Lindane) | 0.005 | | 0.2 | | | 0.95 | 0.16 | | |
| Endosulfan I | 0.005 | | | | | 0.056 | 0.0087 | | |
| Endosulfan II | 0.005 | | | | | 0.056 | 0.0087 | | |
| Endosulfan sulfate | 0.005 | | | | | | | | |
| alpha-Chlordane | 0.005 | | | | | | | | |
| gamma-Chlordane | 0.005 | | | | | | | | |
| Heptachlor | 0.005 | 0.00005 | 0.01 | | | 0.0038 | 0.0036 | | |
| Heptachlor epoxide | 0.005 | 0.00002 | 0.01 | | | 0.0038 | 0.0036 | | |
| Oxychlordane | 0.005 | | | | | | | | |
| cis-Nonachlor | 0.005 | | | | | | | | |
| trans-Nonachlor | 0.005 | | | | | | | | |
| Total Chlordane | 0.005 | | 0.1 | | | | | | |
| Methoxychlor | 0.005 | | 40 | | | | | 0.03 | 0.03 |
| Mirex | 0.005 | | | | | | | 0.001 | 0.001 |
| Toxaphene | 0.05 | 0.00021 | 2 | | | 0.0002 | 0.0002 | | |

**Table 9.2 Available Benchmarks and Guidelines used to Evaluate Quality of Wet and Dry Season Discharges from the Mass Emission Sites (continued)**

| Analyte Name | Long Beach 2005-2006 ML | Ocean Plan | LA Basin Plan | California Fish and Game Freshwater | California Fish and Game Saltwater | California Toxics Rule Freshwater | California Toxics Rule Saltwater | National Non Priority Pollutant Freshwater | National Non Priority Pollutant Saltwater |
|---|---|---|---|---|---|---|---|---|---|
| ***Organophosphates (ug/L)*** | | | | | | | | | |
| Bolstar (Sulprofos) | 0.004 | | | | | | | | |
| Chlorpyrifos | 0.002 | | | 0.02 | 0.02 | | | 0.041 | 0.0056 |
| Demeton | 0.002 | | | | | | | 0.1 | 0.1 |
| Diazinon | 0.004 | | | 0.08 | | | | 0.17 | 0.82 |
| Dichlorvos | 0.006 | | | | | | | | |
| Dimethoate | 0.006 | | | | | | | | |
| Disulfoton | 0.002 | | | | | | | | |
| Ethoprop | 0.002 | | | | | | | | |
| Fensulfothion | 0.002 | | | | | | | | |
| Fenthion | 0.004 | | | | | | | | |
| Malathion | 0.006 | | | | | | | 0.1 | 0.1 |
| Merphos | 0.002 | | | | | | | | |
| Methyl Parathion | 0.002 | | | | | | | | |
| Mevinphos | 0.016 | | | | | | | | |
| Phorate | 0.012 | | | | | | | | |
| Ronnel | 0.004 | | | | | | | | |
| Tetrachlorvinphos (Stirophos) | 0.004 | | | | | | | | |
| Tokuthion (Prothiofos) | 0.006 | | | | | | | | |
| Trichloronate | 0.002 | | | | | | | | |
| ***Triazines (ug/L)*** | | | | | | | | | |
| Ametryn | 0.01 | | | | | | | | |
| Atraton | 0.01 | | | | | | | | |
| Atrazine | 0.01 | | 3 | | | | | | |
| Cyanazine | 0.01 | | | | | | | | |
| Prometon | 0.01 | | | | | | | | |
| Prometryn | 0.01 | | | | | | | | |
| Propazine | 0.01 | | | | | | | | |
| Secbumeton | 0.01 | | | | | | | | |
| Simazine | 0.01 | | 4 | | | | | | |
| Simetryn | 0.01 | | | | | | | | |
| Terbutryn | 0.01 | | | | | | | | |
| Terbutylazine | 0.01 | | | | | | | | |

## Notes to Table 9.2:

General

- Minimum Level (ML) is the concentration at which the entire analytical system must give a recognizable signal and acceptable calibration point. The ML is the concentration in a sample that is equivalent to the concentration of the lowest calibration standard analyzed by a specific method. analytical procedure, assuming that all the method specified sample weights, volumes, and processing steps have been followed.
- Criteria continuous concentration (CCC) equals the highest concentration of pollutant to which aquatic life can be exposed for an extended period of time without deleterious effects.
- Criteria maximum concentration (CMC) equals the highest concentration of pollutant to which aquatic life can be exposed for a short period of time with deleterious effects.

California Toxics Rule

- CTR freshwater dissolved metals are hardness dependant. The values listed here are computed for a hardness of 50 mg/L.
- CTR freshwater dissolved cadmium and lead conversion coefficients for total to dissolved are also hardness dependent.
- CTR freshwater and saltwater dissolved metal criteria are "CCC" except for Silver which are "CMC".
- CTR freshwater and saltwater organics are "CCC" except for aldrin and gamma-BHC which are "CMC".

Ocean Plan and LA Basin Plan

- Bacteria are instantaneous or single sample criteria.
- LA Basin Plan contains Title 22 Drinking Water standards

California Fish and Game

- All values are "CMC" criteria. CMCs are considered acute criteria.

National Recommended Water Quality Criteria

- All values CCCs

**Table 9.3 Belmont Pump: Comparison of Stormwater Chemistry with Benchmarks and Guidelines.**

| Analyte Name | Samples | Hits | Ocean Plan | LA Basin Plan | California Toxics Rule Freshwater | California Toxics Rule Saltwater | California Fish and Game Freshwater | California Fish and Game Saltwater | National Non Priority Pollutant Freshwater | National Non Priority Pollutant Saltwater |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Conventionals*** | | | | | | | | | | |
| pH | 2 | 2 | | 0 | | | | | | |
| MBAS | 2 | 2 | | 0 | | | | | | |
| Nitrate (as N) | 2 | 2 | | 0 | | | | | | |
| Nitrite (as N) | 2 | 0 | | 0 | | | | | | |
| ***Dissolved Metals*** | | | | | | | | | | |
| Arsenic | 2 | 2 | | | 0 | 0 | | | | |
| Cadmium | 2 | 0 | | | 0 | 0 | | | | |
| Copper | 2 | 2 | | | 2 | 2 | | | | |
| Lead | 2 | 2 | | | 0 | 0 | | | | |
| Nickel | 2 | 2 | | | 0 | 0 | | | | |
| Selenium | 2 | 0 | | | | 0 | | | | |
| Silver | 2 | 0 | | | 0 | 0 | | | | |
| Zinc | 2 | 2 | | | 0 | 1 | | | | |
| ***Total Metals*** | | | | | | | | | | |
| Aluminum | 2 | 2 | | 1 | | | | | 2 | 0 |
| Arsenic | 2 | 2 | 0 | 0 | | | | | | |
| Cadmium | 2 | 2 | 0 | 0 | | | | | | |
| Copper | 2 | 2 | 2 | | | | | | | |
| Iron | 2 | 2 | | | | | | | 1 | 0 |
| Lead | 2 | 2 | 2 | | | | | | | |
| Nickel | 2 | 2 | 0 | 0 | | | | | | |
| Selenium | 2 | 0 | 0 | 0 | 0 | | | | | |
| Silver | 2 | 0 | 0 | | | | | | | |
| Zinc | 2 | 2 | 2 | | | | | | | |

**Table 9.3 Belmont Pump Storms : Comparison of Stormwater Chemistry with Benchmarks and Guidelines (continued).**

| Analyte Name | Samples | Hits | Ocean Plan | LA Basin Plan | California Toxics Rule Freshwater | California Toxics Rule Saltwater | California Fish and Game Freshwater | California Fish and Game Saltwater | National Non Priority Pollutant Freshwater | National Non Priority Pollutant Saltwater |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Bacteria*** | | | | | | | | | | |
| Enterococcus | 2 | 2 | 2 | 2 | | | | | | |
| Fecal Coliform | 2 | 2 | 2 | 2 | | | | | | |
| Total Coliform | 2 | 2 | 2 | 2 | | | | | | |
| Fecal to Total Coliform Ratio | 2 | 2 | 2 | 2 | | | | | | |
| ***Chlorinated Pesticides*** | | | | | | | | | | |
| 4,4'-DDT | 2 | 0 | | | 0 | 0 | | | | |
| Aldrin | 2 | 0 | 0 | | 0 | 0 | | | | |
| Dieldrin | 2 | 0 | 0 | | 0 | 0 | | | | |
| Endrin | 2 | 0 | 0 | 0 | 0 | 0 | | | | |
| gamma-BHC (Lindane) | 2 | 0 | | 0 | 0 | 0 | | | | |
| Endosulfan I | 2 | 0 | | | 0 | 0 | | | | |
| Endosulfan II | 2 | 0 | | | 0 | 0 | | | | |
| Heptachlor | 2 | 0 | 0 | 0 | 0 | 0 | | | | |
| Heptachlor epoxide | 2 | 0 | 0 | 0 | 0 | 0 | | | | |
| Total Chlordane | 2 | 0 | | 0 | | | | | | |
| Methoxychlor | 2 | 0 | | 0 | | | | | | |
| Mirex | 2 | 0 | | | | | | | 0 | 0 |
| Toxaphene | 2 | 0 | 0 | 0 | 0 | 0 | | | | |
| ***Organophosphates*** | | | | | | | | | | |
| Chlorpyrifos | 2 | 0 | | | | | 0 | | 0 | 0 |
| Demeton | 2 | 0 | | | | | | | 0 | 0 |
| Diazinon | 2 | 0 | | | | | | | 0 | 0 |
| Malathion | 2 | 2 | | | | | | | 2 | 2 |
| ***Triazine*** | | | | | | | | | | |
| Atrazine | 2 | 0 | | 0 | | | | | | |
| Simazine | 2 | 1 | | 0 | | | | | | |

**Table 9.4 Bouton Creek: Comparison of Stormwater Chemistry with Benchmarks and Guidelines.**

| Analyte Name | Samples | Hits | Ocean Plan | LA Basin Plan | California Toxics Rule Freshwater | California Toxics Rule Saltwater | California Fish and Game Freshwater | California Fish and Game Saltwater | National Non Priority Pollutant Freshwater | National Non Priority Pollutant Saltwater |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Conventionals*** | | | | | | | | | | |
| pH | 3 | 3 | | 0 | | | | | | |
| MBAS | 2 | 2 | | 0 | | | | | | |
| Nitrate (as N) | 2 | 2 | | 0 | | | | | | |
| Nitrite (as N) | 2 | 0 | | 0 | | | | | | |
| ***Dissolved Metals*** | | | | | | | | | | |
| Arsenic | 2 | 2 | | | 0 | 0 | | | | |
| Cadmium | 2 | 0 | | | 0 | 0 | | | | |
| Copper | 2 | 2 | | | 2 | 2 | | | | |
| Lead | 2 | 2 | | | 1 | 0 | | | | |
| Nickel | 2 | 2 | | | 0 | 0 | | | | |
| Selenium | 2 | 0 | | | | 0 | | | | |
| Silver | 2 | 0 | | | 0 | 0 | | | | |
| Zinc | 2 | 2 | | | 0 | 0 | | | | |
| ***Total Metals*** | | | | | | | | | | |
| Aluminum | 2 | 2 | | 1 | | | | | 2 | 0 |
| Arsenic | 2 | 2 | 0 | 0 | | | | | | |
| Cadmium | 2 | 2 | 0 | 0 | | | | | | |
| Copper | 2 | 2 | 2 | | | | | | | |
| Iron | 2 | 2 | | | | | | | 2 | 0 |
| Lead | 2 | 2 | 1 | | | | | | | |
| Nickel | 2 | 2 | 0 | 0 | | | | | | |
| Selenium | 2 | 0 | 0 | 0 | 0 | | | | | |
| Silver | 2 | 0 | 0 | | | | | | | |
| Zinc | 2 | 2 | 2 | | | | | | | |

**Table 9.4 Bouton Creek: Comparison of Stormwater Chemistry with Benchmarks and Guidelines. (continued)**

| Analyte Name | Samples | Hits | Ocean Plan | LA Basin Plan | California Toxics Rule Freshwater | California Toxics Rule Saltwater | California Fish and Game Freshwater | California Fish and Game Saltwater | National Non Priority Pollutant Freshwater | National Non Priority Pollutant Saltwater |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Bacteria*** | | | | | | | | | | |
| Enterococcus | 2 | 2 | 1 | 1 | | | | | | |
| Fecal Coliform | 2 | 2 | 2 | 2 | | | | | | |
| Total Coliform | 2 | 2 | 2 | 2 | | | | | | |
| Fecal to Total Coliform Ratio | 2 | 2 | 2 | 2 | | | | | | |
| ***Chlorinated Pesticides*** | | | | | | | | | | |
| 4,4'-DDT | 2 | 0 | | | 0 | 0 | | | | |
| Aldrin | 2 | 0 | 0 | | 0 | 0 | | | | |
| Dieldrin | 2 | 0 | 0 | | 0 | 0 | | | | |
| Endrin | 2 | 0 | 0 | 0 | 0 | 0 | | | | |
| gamma-BHC (Lindane) | 2 | 0 | | 0 | 0 | 0 | | | | |
| Endosulfan I | 2 | 0 | | | 0 | 0 | | | | |
| Endosulfan II | 2 | 0 | | | 0 | 0 | | | | |
| Heptachlor | 2 | 0 | 0 | 0 | 0 | 0 | | | | |
| Heptachlor epoxide | 2 | 0 | 0 | 0 | 0 | 0 | | | | |
| Total Chlordane | 2 | 0 | | 0 | | | | | | |
| Methoxychlor | 2 | 0 | | 0 | | | | | | |
| Mirex | 2 | 0 | | | | | | | 0 | 0 |
| Toxaphene | 2 | 0 | 0 | 0 | 0 | 0 | | | | |
| ***Organophosphates*** | | | | | | | | | | |
| Chlorpyrifos | 2 | 0 | | | | | 0 | | 0 | 0 |
| Demeton | 2 | 0 | | | | | | | 0 | 0 |
| Diazinon | 2 | 0 | | | | | | | 0 | 0 |
| Malathion | 2 | 1 | | | | | | | 1 | 1 |
| ***Triazine*** | | | | | | | | | | |
| Atrazine | 2 | 0 | | 0 | | | | | | |
| Simazine | 2 | 1 | | 0 | | | | | | |

**Table 9.5 Los Cerritos Channel: Comparison of Stormwater Chemistry with Benchmarks and Guidelines.**

| Analyte Name | Samples | Hits | Ocean Plan | LA Basin Plan | California Toxics Rule Freshwater | California Toxics Rule Saltwater | California Fish and Game Freshwater | California Fish and Game Saltwater | National Non Priority Pollutant Freshwater | National Non Priority Pollutant Saltwater |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Conventionals*** | | | | | | | | | | |
| pH | 2 | 2 | | 1 | | | | | | |
| MBAS | 2 | 2 | | 0 | | | | | | |
| Nitrate (as N) | 2 | 2 | | 0 | | | | | | |
| Nitrite (as N) | 2 | 0 | | 0 | | | | | | |
| ***Dissolved Metals*** | | | | | | | | | | |
| Arsenic | 2 | 2 | | | 0 | 0 | | | | |
| Cadmium | 2 | 0 | | | 0 | 0 | | | | |
| Copper | 2 | 2 | | | 2 | 2 | | | | |
| Lead | 2 | 2 | | | 1 | 0 | | | | |
| Nickel | 2 | 2 | | | 0 | 0 | | | | |
| Selenium | 2 | 0 | | | | 0 | | | | |
| Silver | 2 | 0 | | | 0 | 0 | | | | |
| Zinc | 2 | 2 | | | 2 | 1 | | | | |
| ***Total Metals*** | | | | | | | | | | |
| Aluminum | 2 | 2 | | 2 | | | | | 2 | 0 |
| Arsenic | 2 | 2 | 0 | 0 | | | | | | |
| Cadmium | 2 | 2 | 0 | 0 | | | | | | |
| Copper | 2 | 2 | 2 | | | | | | | |
| Iron | 2 | 2 | | | | | | | 2 | 0 |
| Lead | 2 | 2 | 2 | | | | | | | |
| Nickel | 2 | 2 | 1 | 0 | | | | | | |
| Selenium | 2 | 0 | 0 | 0 | 0 | | | | | |
| Silver | 2 | 0 | 0 | | | | | | | |
| Zinc | 2 | 2 | 2 | | | | | | | |

**Table 9.5 Los Cerritos Channel Storm: Comparison of Stormwater Chemistry with Benchmarks and Guidelines. (continued)**

| Analyte Name | Samples | Hits | Ocean Plan | LA Basin Plan | California Toxics Rule Freshwater | California Toxics Rule Saltwater | California Fish and Game Freshwater | California Fish and Game Saltwater | National Non Priority Pollutant Freshwater | National Non Priority Pollutant Saltwater |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Bacteria*** | | | | | | | | | | |
| Enterococcus | 2 | 2 | 2 | 2 | | | | | | |
| Fecal Coliform | 2 | 2 | 1 | 1 | | | | | | |
| Total Coliform | 2 | 2 | 1 | 1 | | | | | | |
| Fecal to Total Coliform Ratio | 2 | 2 | 1 | 1 | | | | | | |
| ***Chlorinated Pesticides*** | | | | | | | | | | |
| 4,4'-DDT | 2 | 0 | | | 0 | 0 | | | | |
| Aldrin | 2 | 0 | 0 | | 0 | 0 | | | | |
| Dieldrin | 2 | 0 | 0 | | 0 | 0 | | | | |
| Endrin | 2 | 0 | 0 | 0 | 0 | 0 | | | | |
| gamma-BHC (Lindane) | 2 | 0 | | 0 | 0 | 0 | | | | |
| Endosulfan I | 2 | 0 | | | 0 | 0 | | | | |
| Endosulfan II | 2 | 0 | | | 0 | 0 | | | | |
| Heptachlor | 2 | 0 | 0 | 0 | 0 | 0 | | | | |
| Heptachlor epoxide | 2 | 0 | 0 | 0 | 0 | 0 | | | | |
| Total Chlordane | 2 | 2 | | 0 | | | | | | |
| Methoxychlor | 2 | 0 | | 0 | | | | | | |
| Mirex | 2 | 0 | | | | | | | 0 | 0 |
| Toxaphene | 2 | 0 | 0 | 0 | 0 | 0 | | | | |
| ***Organophosphates*** | | | | | | | | | | |
| Chlorpyrifos | 2 | 0 | | | | | 0 | 0 | 0 | 0 |
| Demeton | 2 | 0 | | | | | | | 0 | 0 |
| Diazinon | 2 | 1 | | | | | | 0 | 0 | 0 |
| Malathion | 2 | 1 | | | | | | | 1 | 1 |
| ***Triazine*** | | | | | | | | | | |
| Atrazine | 2 | 0 | | 0 | | | | | | |
| Simazine | 2 | 0 | | 0 | | | | | | |

**Table 9.6 Dominguez Gap: Comparison of Stormwater Chemistry with Benchmarks and Guidelines.**

| Analyte Name | Samples | Hits | Ocean Plan | LA Basin Plan | California Toxics Rule Freshwater | California Toxics Rule Saltwater | California Fish and Game Freshwater | California Fish and Game Saltwater | National Non Priority Pollutant Freshwater | National Non Priority Pollutant Saltwater |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Conventionals*** | | | | | | | | | | |
| pH | 1 | 1 | | 0 | | | | | | |
| MBAS | 1 | 1 | | 0 | | | | | | |
| Nitrate (as N) | 1 | 1 | | 0 | | | | | | |
| Nitrite (as N) | 1 | 0 | | 0 | | | | | | |
| ***Dissolved Metals*** | | | | | | | | | | |
| Arsenic | 1 | 1 | | | 0 | 0 | | | | |
| Cadmium | 1 | 0 | | | 0 | 0 | | | | |
| Copper | 1 | 1 | | | 1 | 1 | | | | |
| Lead | 1 | 1 | | | 1 | 0 | | | | |
| Nickel | 1 | 1 | | | 0 | 0 | | | | |
| Selenium | 1 | 0 | | | | 0 | | | | |
| Silver | 1 | 0 | | | 0 | 0 | | | | |
| Zinc | 1 | 1 | | | 1 | 1 | | | | |
| ***Total Metals*** | | | | | | | | | | |
| Aluminum | 1 | 1 | | 1 | | | | | 1 | 0 |
| Arsenic | 1 | 1 | 0 | 0 | | | | | | |
| Cadmium | 1 | 1 | 0 | 0 | | | | | | |
| Copper | 1 | 1 | 1 | | | | | | | |
| Iron | 1 | 1 | | | | | | | 1 | 0 |
| Lead | 1 | 1 | 1 | | | | | | | |
| Nickel | 1 | 1 | 0 | 0 | | | | | | |
| Selenium | 1 | 0 | 0 | 0 | 0 | | | | | |
| Silver | 1 | 0 | 0 | | | | | | | |
| Zinc | 1 | 1 | 1 | | | | | | | |

**Table 9.6 Dominguez Gap: Comparison of Stormwater Chemistry with Benchmarks and Guidelines. (continued)**

| Analyte Name | Samples | Hits | Ocean Plan | LA Basin Plan | California Toxics Rule Freshwater | California Toxics Rule Saltwater | California Fish and Game Freshwater | California Fish and Game Saltwater | National Non Priority Pollutant Freshwater | National Non Priority Pollutant Saltwater |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Bacteria*** | | | | | | | | | | |
| Enterococcus | 1 | 1 | 1 | 1 | | | | | | |
| Fecal Coliform | 1 | 1 | 1 | 1 | | | | | | |
| Total Coliform | 1 | 1 | 1 | 1 | | | | | | |
| Fecal to Total Coliform Ratio | 1 | 1 | 1 | 1 | | | | | | |
| ***Chlorinated Pesticides*** | | | | | | | | | | |
| 4,4'-DDT | 1 | 0 | | | 0 | 0 | | | | |
| Aldrin | 1 | 0 | 0 | | 0 | 0 | | | | |
| Dieldrin | 1 | 0 | 0 | | 0 | 0 | | | | |
| Endrin | 1 | 0 | 0 | 0 | 0 | 0 | | | | |
| gamma-BHC (Lindane) | 1 | 0 | | 0 | 0 | 0 | | | | |
| Endosulfan I | 1 | 0 | | | 0 | 0 | | | | |
| Endosulfan II | 1 | 0 | | | 0 | 0 | | | | |
| Heptachlor | 1 | 0 | 0 | 0 | 0 | 0 | | | | |
| Heptachlor epoxide | 1 | 0 | 0 | 0 | 0 | 0 | | | | |
| Total Chlordane | 1 | 0 | | 0 | | | | | | |
| Methoxychlor | 1 | 0 | | 0 | | | | | | |
| Mirex | 1 | 0 | | | | | | | 0 | 0 |
| Toxaphene | 1 | 0 | 0 | 0 | 0 | 0 | | | | |
| ***Organophosphates*** | | | | | | | | | | |
| Chlorpyrifos | 1 | 0 | | | | | 0 | 0 | 0 | 0 |
| Demeton | 1 | 0 | | | | | | | 0 | 0 |
| Diazinon | 1 | 0 | | | | | | 0 | 0 | 0 |
| Malathion | 1 | 1 | | | | | | | 1 | 1 |
| ***Triazine*** | | | | | | | | | | |
| Atrazine | 1 | 0 | | 0 | | | | | | |
| Simazine | 1 | 1 | | 0 | | | | | | |

**Table 9.7 Belmont Pump: Comparison of Dry Weather Chemistry with Benchmarks and Guidelines.**

| Analyte Name | Samples | Hits | Ocean Plan | LA Basin Plan | California Toxics Rule Freshwater | California Toxics Rule Saltwater | California Fish and Game Freshwater | California Fish and Game Saltwater | National Non Priority Pollutant Freshwater | National Non Priority Pollutant Saltwater |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Conventionals*** | | | | | | | | | | |
| pH | 2 | 2 | | 0 | | | | | | |
| MBAS | 2 | 1 | | 0 | | | | | | |
| Nitrate (as N) | 2 | 2 | | 0 | | | | | | |
| Nitrite (as N) | 2 | 1 | | 0 | | | | | | |
| ***Dissolved Metals*** | | | | | | | | | | |
| Arsenic | 2 | 2 | | | 0 | 0 | | | | |
| Cadmium | 2 | 0 | | | 0 | 0 | | | | |
| Copper | 2 | 1 | | | 0 | 1 | | | | |
| Lead | 2 | 1 | | | 0 | 0 | | | | |
| Nickel | 2 | 1 | | | 0 | 0 | | | | |
| Selenium | 2 | 0 | | | | 0 | | | | |
| Silver | 2 | 0 | | | 0 | 0 | | | | |
| Zinc | 2 | 2 | | | 0 | 0 | | | | |
| ***Total Metals*** | | | | | | | | | | |
| Aluminum | 2 | 1 | | 0 | | | | | 1 | 0 |
| Arsenic | 2 | 2 | 0 | 0 | | | | | | |
| Cadmium | 2 | 0 | 0 | 0 | | | | | | |
| Copper | 2 | 2 | 0 | | | | | | | |
| Iron | 2 | 2 | | | | | | | 0 | 0 |
| Lead | 2 | 1 | 0 | | | | | | | |
| Nickel | 2 | 1 | 0 | 0 | | | | | | |
| Selenium | 2 | 0 | 0 | 0 | 0 | | | | | |
| Silver | 2 | 0 | 0 | | | | | | | |
| Zinc | 2 | 2 | 0 | | | | | | | |

**Table 9.7 Belmont Pump: Comparison of Dry Weather Chemistry with Benchmarks and Guidelines. (continued)**

| Analyte Name | Samples | Hits | Ocean Plan | LA Basin Plan | California Toxics Rule Freshwater | California Toxics Rule Saltwater | California Fish and Game Freshwater | California Fish and Game Saltwater | National Non Priority Pollutant Freshwater | National Non Priority Pollutant Saltwater |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Bacteria*** | | | | | | | | | | |
| Enterococcus | 2 | 2 | 2 | 2 | | | | | | |
| Fecal Coliform | 2 | 2 | 2 | 2 | | | | | | |
| Total Coliform | 2 | 2 | 2 | 2 | | | | | | |
| Fecal to Total Coliform Ratio | 2 | 2 | 2 | 2 | | | | | | |
| ***Chlorinated Pesticides*** | | | | | | | | | | |
| 4,4'-DDT | 2 | 0 | | | 0 | 0 | | | | |
| Aldrin | 2 | 0 | 0 | | 0 | 0 | | | | |
| Dieldrin | 2 | 0 | 0 | | 0 | 0 | | | | |
| Endrin | 2 | 0 | 0 | 0 | 0 | 0 | | | | |
| gamma-BHC (Lindane) | 2 | 0 | | 0 | 0 | 0 | | | | |
| Endosulfan I | 2 | 0 | | | 0 | 0 | | | | |
| Endosulfan II | 2 | 0 | | | 0 | 0 | | | | |
| Heptachlor | 2 | 0 | 0 | 0 | 0 | 0 | | | | |
| Heptachlor epoxide | 2 | 0 | 0 | 0 | 0 | 0 | | | | |
| Total Chlordane | 2 | 0 | | 0 | | | | | | |
| Methoxychlor | 2 | 0 | | 0 | | | | | | |
| Mirex | 2 | 0 | | | | | | | 0 | 0 |
| Toxaphene | 2 | 0 | 0 | 0 | 0 | 0 | | | | |
| ***Organophosphates*** | | | | | | | | | | |
| Chlorpyrifos | 2 | 0 | | | | | 0 | 0 | 0 | 0 |
| Demeton | 2 | 0 | | | | | | | 0 | 0 |
| Diazinon | 2 | 1 | | | | | | 0 | 0 | 0 |
| Malathion | 2 | 0 | | | | | | | 0 | 0 |
| ***Triazine*** | | | | | | | | | | |
| Atrazine | 2 | 0 | | 0 | | | | | | |
| Simazine | 2 | 0 | | 0 | | | | | | |

**Table 9.8 Bouton Creek: Comparison of Dry Weather Chemistry with Benchmarks and Guidelines.**

| Analyte Name | Samples | Hits | Ocean Plan | LA Basin Plan | California Toxics Rule Freshwater | California Toxics Rule Saltwater | California Fish and Game Freshwater | California Fish and Game Saltwater | National Non Priority Pollutant Freshwater | National Non Priority Pollutant Saltwater |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Conventionals*** | | | | | | | | | | |
| pH | 2 | 2 | | 0 | | | | | | |
| MBAS | 2 | 1 | | 0 | | | | | | |
| Nitrate (as N) | 2 | 0 | | 0 | | | | | | |
| Nitrite (as N) | 2 | 0 | | 0 | | | | | | |
| ***Dissolved Metals*** | | | | | | | | | | |
| Arsenic | 2 | 1 | | | 0 | 0 | | | | |
| Cadmium | 2 | 0 | | | 0 | 0 | | | | |
| Copper | 2 | 2 | | | 0 | 2 | | | | |
| Lead | 2 | 1 | | | 0 | 0 | | | | |
| Nickel | 2 | 1 | | | 0 | 0 | | | | |
| Selenium | 2 | 0 | | | | 0 | | | | |
| Silver | 2 | 0 | | | 0 | 0 | | | | |
| Zinc | 2 | 2 | | | 0 | 0 | | | | |
| ***Total Metals*** | | | | | | | | | | |
| Aluminum | 2 | 1 | | 0 | | | | | 0 | 0 |
| Arsenic | 2 | 1 | 0 | 0 | | | | | | |
| Cadmium | 2 | 0 | 0 | 0 | | | | | | |
| Copper | 2 | 2 | 0 | | | | | | | |
| Iron | 2 | 1 | | | | | | | 0 | 0 |
| Lead | 2 | 1 | 0 | | | | | | | |
| Nickel | 2 | 1 | 0 | 0 | | | | | | |
| Selenium | 2 | 0 | 0 | 0 | 0 | | | | | |
| Silver | 2 | 0 | 0 | | | | | | | |
| Zinc | 2 | 2 | 0 | | | | | | | |

**Table 9.8 Bouton Creek: Comparison of Dry Weather Chemistry with Benchmarks and Guidelines. (continued)**

| Analyte Name | Samples | Hits | Ocean Plan | LA Basin Plan | California Toxics Rule Freshwater | California Toxics Rule Saltwater | California Fish and Game Freshwater | California Fish and Game Saltwater | National Non Priority Pollutant Freshwater | National Non Priority Pollutant Saltwater |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Bacteria*** | | | | | | | | | | |
| Enterococcus | 2 | 2 | 2 | 2 | | | | | | |
| Fecal Coliform | 2 | 2 | 1 | 1 | | | | | | |
| Total Coliform | 2 | 2 | 1 | 1 | | | | | | |
| Fecal to Total Coliform Ratio | 2 | 2 | 1 | 1 | | | | | | |
| ***Chlorinated Pesticides*** | | | | | | | | | | |
| 4,4'-DDT | 2 | 0 | | | 0 | 0 | | | | |
| Aldrin | 2 | 0 | 0 | | 0 | 0 | | | | |
| Dieldrin | 2 | 0 | 0 | | 0 | 0 | | | | |
| Endrin | 2 | 0 | 0 | 0 | 0 | 0 | | | | |
| gamma-BHC (Lindane) | 2 | 0 | | 0 | 0 | 0 | | | | |
| Endosulfan I | 2 | 0 | | | 0 | 0 | | | | |
| Endosulfan II | 2 | 0 | | | 0 | 0 | | | | |
| Heptachlor | 2 | 0 | 0 | 0 | 0 | 0 | | | | |
| Heptachlor epoxide | 2 | 0 | 0 | 0 | 0 | 0 | | | | |
| Total Chlordane | 2 | 0 | | 0 | | | | | | |
| Methoxychlor | 2 | 0 | | 0 | | | | | | |
| Mirex | 2 | 0 | | | | | | | 0 | 0 |
| Toxaphene | 2 | 0 | 0 | 0 | 0 | 0 | | | | |
| **Organophosphates** | | | | | | | | | | |
| Chlorpyrifos | 2 | 0 | | | | | 0 | | 0 | 0 |
| Demeton | 2 | 0 | | | | | | | 0 | 0 |
| Diazinon | 2 | 0 | | | | | | | 0 | 0 |
| Malathion | 2 | 0 | | | | | | | 0 | 0 |
| **Triazine** | | | | | | | | | | |
| Atrazine | 2 | 0 | | 0 | | | | | | |
| Simazine | 2 | 0 | | 0 | | | | | | |

**Table 9.9 Los Cerritos Channel: Comparison of Dry Weather Chemistry with Benchmarks and Guidelines.**

| Analyte Name | Samples | Hits | Ocean Plan | LA Basin Plan | California Toxics Rule Freshwater | California Toxics Rule Saltwater | California Fish and Game Freshwater | California Fish and Game Saltwater | National Non Priority Pollutant Freshwater | National Non Priority Pollutant Saltwater |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Conventionals*** | | | | | | | | | | |
| pH | 2 | 2 | | 2 | | | | | | |
| MBAS | 2 | 2 | | 0 | | | | | | |
| Nitrate (as N) | 2 | 1 | | 0 | | | | | | |
| Nitrite (as N) | 2 | 0 | | 0 | | | | | | |
| ***Dissolved Metals*** | | | | | | | | | | |
| Arsenic | 2 | 2 | | | 0 | 0 | | | | |
| Cadmium | 2 | 1 | | | 0 | 0 | | | | |
| Copper | 2 | 2 | | | 0 | 2 | | | | |
| Lead | 2 | 2 | | | 0 | 0 | | | | |
| Nickel | 2 | 2 | | | 0 | 0 | | | | |
| Selenium | 2 | 0 | | | | 0 | | | | |
| Silver | 2 | 0 | | | 0 | 0 | | | | |
| Zinc | 2 | 2 | | | 0 | 0 | | | | |
| ***Total Metals*** | | | | | | | | | | |
| Aluminum | 2 | 2 | | 0 | | | | | 2 | 0 |
| Arsenic | 2 | 2 | 0 | 0 | | | | | | |
| Cadmium | 2 | 1 | 0 | 0 | | | | | | |
| Copper | 2 | 2 | 2 | | | | | | | |
| Iron | 2 | 2 | | | | | | | 0 | 0 |
| Lead | 2 | 2 | 0 | | | | | | | |
| Nickel | 2 | 2 | 0 | 0 | | | | | | |
| Selenium | 2 | 0 | 0 | 0 | 0 | | | | | |
| Silver | 2 | 0 | 0 | | | | | | | |
| Zinc | 2 | 2 | 0 | | | | | | | |

**Table 9.9 Los Cerritos Channel: Comparison of Dry Weather Chemistry with Benchmarks and Guidelines (continued)**

| Analyte Name | Samples | Hits | Ocean Plan | LA Basin Plan | California Toxics Rule Freshwater | California Toxics Rule Saltwater | California Fish and Game Freshwater | California Fish and Game Saltwater | National Non Priority Pollutant Freshwater | National Non Priority Pollutant Saltwater |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Bacteria*** | | | | | | | | | | |
| Enterococcus | 2 | 2 | 2 | 2 | | | | | | |
| Fecal Coliform | 2 | 2 | 2 | 2 | | | | | | |
| Total Coliform | 2 | 2 | 2 | 2 | | | | | | |
| Fecal to Total Coliform Ratio | 2 | 2 | 2 | 2 | | | | | | |
| ***Chlorinated Pesticides*** | | | | | | | | | | |
| 4,4'-DDT | 2 | 0 | | | 0 | 0 | | | | |
| Aldrin | 2 | 0 | 0 | | 0 | 0 | | | | |
| Dieldrin | 2 | 0 | 0 | | 0 | 0 | | | | |
| Endrin | 2 | 0 | 0 | 0 | 0 | 0 | | | | |
| gamma-BHC (Lindane) | 2 | 0 | | 0 | 0 | 0 | | | | |
| Endosulfan I | 2 | 0 | | | 0 | 0 | | | | |
| Endosulfan II | 2 | 0 | | | 0 | 0 | | | | |
| Heptachlor | 2 | 0 | 0 | 0 | 0 | 0 | | | | |
| Heptachlor epoxide | 2 | 0 | 0 | 0 | 0 | 0 | | | | |
| Total Chlordane | 2 | 0 | | 0 | | | | | | |
| Methoxychlor | 2 | 0 | | 0 | | | | | | |
| Mirex | 2 | 0 | | | | | | | 0 | 0 |
| Toxaphene | 2 | 0 | 0 | 0 | 0 | 0 | | | | |
| ***Organophosphates*** | | | | | | | | | | |
| Chlorpyrifos | 2 | 0 | | | | | 0 | 0 | 0 | 0 |
| Demeton | 2 | 0 | | | | | | | 0 | 0 |
| Diazinon | 2 | 0 | | | | | | 0 | 0 | 0 |
| Malathion | 2 | 0 | | | | | | | 0 | 0 |
| ***Triazine*** | | | | | | | | | | |
| Atrazine | 2 | 0 | | 0 | | | | | | |
| Simazine | 2 | 0 | | 0 | | | | | | |

**Table 9.10 Summary of Toxicity Characteristics of Stormwater from Various Southern California Watersheds.** Test Types: SF = sea urchin fertilization, MS = mysid survival/growth, DS = daphnid survival/reproduction**.**

| Location | Date | Test Type | Number of Samples | %Toxic | $TU_c$ |
|---|---|---|---|---|---|
| **Long Beach** | 2006-2007 | SF | 6 | 100 | 4->32 |
| | 2006-2007 | DS | 6 | 0 | 1 |
| **Long Beach** | 2005-2006 | SF | 12 | 83 | 2->32 |
| | 2005-2006 | DS | 2 | 17 | 1-2 |
| **Long Beach** | 2004-2005 | SF | 12 | 58 | 2-16 |
| | 2004-2005 | DS | 12 | 25 | 1-8 |
| **Long Beach** | 2003-2004 | SF | 11 | 45 | <2-32 |
| | 2003-2004 | DS | 11 | 9 | 1-2 |
| **Long Beach** | 2002-2003 | SF | 13 | 46 | ≤2-32 |
| | 2002-2003 | DS | 13 | 31 | 1-4 |
| **Long Beach** | 2000-2002 | SF | 22 | 86 | ≤2-32 |
| | 2000-2002 | MS | 20 | 55 | 1-16 |
| | 2000-2002 | DS | 22 | 77 | 1->16 |
| **Los Angeles River** | 1997-1999 | SF | 4 | 100 | 4-8 |
| **San Gabriel River** | 1997-1999 | SF | 4 | 50 | ≤2-4 |
| **Ballona Creek** | 1996-1997 | SF | 13 | 85 | ≤4-32 |
| **Chollas Creek** | 2000-2001 | DS | 40 | 35[1] | Not reported |
| | 1999-2000 | SF | 5 | 100 | 8-32 |
| | 1999 | MS | 3 | 0 | 1 |
| | 1999 | DS | 3 | 67 | 1-2 |
| | 1994-1998 | DS | 11 | 100 | 2-8 |

1. Percent toxic based only on daphnid survival $LC_{50}$.

**Table 9.11 Spearman Rank Correlation Coefficients ($r_s$) for Toxicity and Chemical Data from Seven Wet Weather Seasons from 2001 to 2007.** The nonparametric tests show the relationship between paired chemical concentrations and toxic units (TU) for either acute or chronic bioassay toxicity tests. Toxic units are based on either the median response ($EC_{50}$ or $LC_{50}$, acute $TU_a$) or the NOEC (chronic $TU_c$) concentration. Values of $r_s$ in bold text are significant at $p \leq 0.05$ and indicate that each significant ranked pair series approach the same positive or negative order and are statistically different from an order that is random. For all constituents n=78.

| | Sea Urchin Fertilization | Water Flea Survival | Water Flea Reproduction |
|---|---|---|---|
| **Constituent** | **$TU_a$** | **$TU_a$** | **$TU_c$** |
| ***Conventionals*** | | | |
| Hardness | 0.207 | **0.387** | **0.389** |
| TSS | 0.009 | **0.394** | **0.487** |
| TDS | 0.184 | **0.333** | **0.372** |
| TOC | 0.213 | **0.418** | **0.505** |
| ***Dissolved Metals*** | | | |
| Cadmium | 0.052 | **0.486** | **0.415** |
| Chromium | 0.137 | 0.024 | -0.035 |
| Copper | **0.356** | **0.348** | **0.361** |
| Lead | 0.187 | **0.520** | **0.561** |
| Nickel | **0.326** | **0.458** | **0.508** |
| Zinc | **0.243** | **0.413** | **0.473** |
| ***Organophosphate Pesticides*** | | | |
| Diazinon | 0.008 | **0.519** | **0.443** |

**In bold**, significant values at the level of significance alpha=0.050 (two-tailed test).

## 10.0 CONCLUSIONS

The City of Long Beach's water quality monitoring program for stormwater and dry weather discharges through the City's municipal separate storm sewer system (MS4) began in the 1999/2000 wet weather season under terms of Order No. 99-060 National Pollutant Discharge Elimination Systems Municipal Permit No. CAS004003 (CI 8052). Since that time, 88 wet weather monitoring events have been conducted at the four Long Beach mass emission stations for the full set of analytes, along with 62 dry weather inspections/monitoring events. In addition 44 wet weather events have been monitored to develop Event Mean Concentrations (EMCs) for total suspended solids only. For the past five years, annual studies have been conducted in Alamitos Bay to characterize the vertical and horizontal extent of the stormwater plume and document potential toxicity effects in the receiving waters in the Bay.

The Long Beach stormwater monitoring program has emphasized an approach of paired chemical analysis and toxicity testing of discharges of municipal stormwater. The purpose of this approach was to first identify the constituents in the City of Long Beaches stormwater discharges that exhibited potential water quality impacts. This requires that the chemical analyses and toxicity tests be conducted on the same composite water samples. Also, since numerical stormwater quality standards do not exist, it was desired to directly measure the impacts of these discharges in the Alamitos Bay receiving waters.

The 2006/2007 monitoring period ended with the lowest rainfall quantities on record in Los Angeles County. As a result only two complete storm events were monitored this season. Despite the limited number of events, the results continue to support the many common trends identified over the previous seven years of the program. These have been described in all recent reports. The following are among the more significant trends.

- The decline in concentrations of chlorpyrifos and diazinon in stormwater at all sites remains one of the most significant temporal trends. These compounds are now rarely detected and, when detected, are now present at low concentrations that do not exhibit toxicity in the more sensitive bioassay tests.

- Concentrations of total copper, lead and zinc are consistently elevated in stormwater discharges when compared to concentrations measured in dry weather discharges.

- Concentrations of dissolved cadmium, copper, and nickel are relatively comparable during both wet and dry weather periods compared to concentrations of the total recoverable forms. Although the concentrations of many dissolved metals remain relatively consistent between storm events and dry weather flows, higher levels of hardness during dry weather conditions tend to prevent frequent exceedances of freshwater CTR water quality criteria.

- Dissolved lead and zinc concentrations are consistently higher during storm events than during dry weather surveys

- Stormwater discharges from the Dominguez Gap Pump Station are less frequent and typically of a higher quality than the other mass emission sites. During the 2006/2007 monitoring season, this site and the adjacent infiltration basin were undergoing construction that will change the way in which this site is managed. The site has been completely reconfigured to serve as a constructed wetland with a constant source of water being diverted from the Los Angeles River. Maintenance of the wetland is currently not expected to alter the performance of this site during storm events.

- Stormwater plumes that develop in Alamitos Bay have consistently shown little evidence of toxicity. This season, a stormwater plume was monitored in Alamitos Bay following a moderate storm event yielding approximately 0.5 inches of rain. The plume was mapped from the Los Cerritos Channel into Alamitos Bay. As usual, TSS and total metals were highest in surface waters dominated by stormwater and declined as the plume became less defined and mixed with ambient marine waters of Alamitos Bay. This year, toxicity tests showed no evidence of toxicity at any of the plume monitoring sites.

Two primary adjustments are recommended for the 2007/2008 monitoring period. It is recommended that monitoring of the stormwater plume in Alamitos Bay receiving waters be discontinued and that the triazine pesticides be eliminated from the analytical suite.

Over the past five years, the Long Beach stormwater monitoring program has clearly demonstrated a lack of substantial toxicity in the stormwater plume over a wide range of storm events. This program was implemented based upon toxicity observed in stormwater plumes emanating from Ballona Creek and extending well out into Santa Monica Bay (Bay and Schiff, 1999) as well as toxicity observed in stormwater plumes in San Diego Bay from the Chollas Creek watershed. Having demonstrated that the general lack of toxicity in the stormwater plumes within Alamitos Bay, we believe that monitoring funds could be better expended on other activities.

The only triazine pesticides detected in stormwater or dry weather discharges have been prometon, simazine and cyanazine. All three typically occur at levels of less than 10 times the detection limit. The infrequent presence of these compounds in stormwater runoff and the low concentrations when they are detected suggests that this group of organic compounds should be considered for elimination from the analytical suite.

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