FINAL REPORT

Proposition 13
Coastal NonPoint Source Pollution Control
Grant Agreement No. 04-026-559-0
The San Diego Watersheds Common Grounds Project: San Diego Bay Watershed Demonstration

Prepared for:
State Water Resources Control Board

Prepared by:

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Prepared For:

State Water Resources Control Board

Prepared By:

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Acronyms and Abbreviations

BPTCP	Bay Protection and Toxic Cleanup Program
CDFG	California Department of Fish and Game
COC	Chain of Custody
CRG	CRG Marine Laboratories
CSBP	Californial Stream Bioassessment Procedure
CV-AFS	Cold Vapor Atomic Fluorescence Spectrometer
DO	Dissolved Oxygen
ELAP	Environmental Laboratory Accreditation Program
EPT	Ephemeroptera, Plecoptera, and Trichoptera
ERMQ	Effects Range Median Quotient
FFG	Functional Feeding Group
GIS	Geographic Information Systems
IBI	Index of Biotic Integrity
ICP-MS	Inductively Coupled Plasma-Mass Spectrometer
JURMP	Jurisdictional Urban Runoff Monitoring Program
MBAS	Methylene Blue Active Substances [Surfactants]
MH	Macrophyte Herbivores
MPN	Most Probable Number
MS4	Municipal Separate Storm Sewer System
NAD	North American Datum
NELAP	National Environmental Laboratory Accreditation Program
NOAA	National Oceanographic and Atmospheric Administration
NTU	Nephelometric Turbidity Units
OM	Omnivores
PAHs	Polynuclear Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
PEL	Probable Effects Level
PH	Piercer Herbivores
PST	Pacific Standard Time
QA/QC	Quality Assurance Quality Control
QAPP	Quality Assurance Project Plan
RWQCB	Regional Water Quality Control Board [San Diego]
SWRCB	State Water Resources Control Board
TEL	Threshold Exposure Limit
TKN	Total Kjeldahl Nitrogen
TMDLs	Total Maximum Daily Loads
TOC	Total Organic Carbon
TSS	Total Suspended Solids
TV	Tolerance Value
USEPA	U.S. Environmental Protection Agency
XY	Xylophages
WQO	Water Quality Objectives

1.0 INTRODUCTION

The State Water Resources Control Board (SWRCB) of California recently reported that two-thirds of the water bodies in San Diego County remain unassessed because not enough data exists to determine their status. Despite the allocation of significant resources to monitoring efforts, there still remains an inadequate understanding of local water quality which undermines the ability to properly manage these vital resources. A great part of this problem is that while water quality and related monitoring efforts have been undertaken in the region for many years, there is at present no method to effectively manage and utilize data collected by regulatory agencies, academic institutions, businesses and non-profit organizations. Inadequate data management hinders the ability of local and state agencies to arrive at informed management decisions to effectively identify and abate point and non-point source pollution. Gathering and managing sufficient data to gain a comprehensive and objective view of regional water quality issues remains a formidable task. Water quality-monitoring data must be obtained and effectively managed in order to protect sensitive ecosystems, assess pollution sources, track the effectiveness of implemented actions, and prevent further degradation of our precious water resources.

The *San Diego Watersheds Common Grounds Project* was created to incorporate water quality monitoring programs and data gathering, integration and analysis at a watershed level to create a web-based interactive application to serve as a broad communication, education and decision-making tool. The primary objective of the project is to further develop the region's capacity to understand processes affecting our water resources so that point and nonpoint pollution sources can be readily identified and abated. The primary goals of the *San Diego Watersheds Common Grounds Project* are to:

1. Obtain baseline data to measure water quality improvements throughout San Diego Bay by undertaking a targeted monitoring program that will support the development of three Total Maximum Daily Loads (TMDLs) in the Bay.
2. Enhance understanding and management of the San Diego Bay watershed by developing a Geographic Information Systems (GIS) and supporting data management tools to integrate and optimize monitoring data collected by local and state agencies, citizen groups, educational and research institutions and local businesses.
3. Reduce pollution into San Diego Bay by undertaking a comprehensive outreach and education program that will increase awareness of watershed issues and promote adoption of non-polluting behaviors among local residents and students.
4. Build the capacity of community-based water assessment efforts to improve regional understanding of our water resources so that point and non-point pollution sources can be readily identified and abated.

The San Diego Regional Water Quality Control Board (RWQCB) has identified areas within the San Diego Bay with water quality that does not meet beneficial use criteria; these locations have been included on the 2002 Clean Water Act 303(d) list. Along the San Diego Bay shoreline, three of these areas are Downtown Anchorage, the mouth of Switzer Creek and the vicinity of B Street and Broadway Piers. Downtown Anchorage has been identified as having sediment toxicity and benthic community effects. Near the mouth of Switzer Creek, chlordane, lindane and polynuclear aromatic hydrocarbons (PAHs) are the constituents of concern. B Street and

Broadway Piers are listed for bacterial indicators, sediment toxicity and benthic community effects (Table 1-1).

Table 1-1. 2003 CWA Section 303(d) List of Water Quality Limited Segments.

2003 CWA Section 303(d) List of Water Quality Limited Segments (*Approved by USEPA: July 2003)*				
REGION	NAME	POLLUTANT/STRESSOR	POTENTIAL SOURCES	EST. SIZE AFFECTED
9	San Diego Bay Shoreline, Downtown Anchorage	Benthic Community Effects Sediment Toxcity	Nonpoint/Point source	7.4 Acres
9	San Diego Bay Shoreline, near Switzer Creek	Chlordane	Urban Runoff/Storm Sewers Other Boatyards Nonpoint/Point source	5.5 Acres
		Lindane	Urban Runoff/Storm Sewers Other Boatyards Nonpoint/Point source	5.5 Acres
		PAHs	Urban Runoff/Storm Sewers Other Boatyards Nonpoint/Point source	5.5 Acres
9	San Diego Bay Shoreline, Vicinity of B St and Broadway Piers	Bacteria Indicators	Urban Runoff/Storm Sewers Unknown Nonpoint Source Unknown Point Source	9.9 Acres (Estimated size of impairment is 0.4 miles around the shoreline of the bay.)
		Benthic Community Effects	Nonpoint/Point source	9.9 Acres
		Sediment Toxicity	Nonpoint/Point source	9.9 Acres

In support of the primary goals of the *San Diego Watersheds Common Grounds Project*, water and sediment quality data was gathered for the aforementioned three drainages to analyze and further the understanding of the watershed processes and provide linkages to the Bay Protection and Toxic Cleanup Program (BPTCP) areas of concern in the San Diego Bay. The results generated from the water quality monitoring effort will assist in the development of a Phase II TMDL effort by identifying pollution sources and calculating amounts, or loads, on spatial and temporal scales. These load calculations can subsequently be used to determine the overall effect of potential contamination to the water bodies. The analytical results for each sampling event for water, sediment and bioassessment monitoring are presented in the following sections. The appendices contain the field data sheets and the analytical laboratory reports for the sampling events.

1.1 Setting

San Diego Bay is the largest estuary in San Diego County and has been extensively developed as a deep water commercial and naval port. It covers 10,532 acres of water and 4,419 acres of tidelands. Approximately 20% of the original Bay floor remains undisturbed by dredge or fill. Dams and extensive use of groundwater in the Sweetwater and Otay Rivers have reduced the input from these rivers to the Bay by 76%. The majority of freshwater input to the Bay is surface runoff from these urban areas and intermittent flow from rivers, creeks, and over 200 storm drains during rain events. Pueblo San Diego watershed, which contains the water quality limited segments, drains into the northern portion of San Diego Bay. It covers 36,061 acres, encompassing Point Loma to the west, downtown San Diego and parts of La Mesa and Lemon Grove to the east (Figure 1-1).

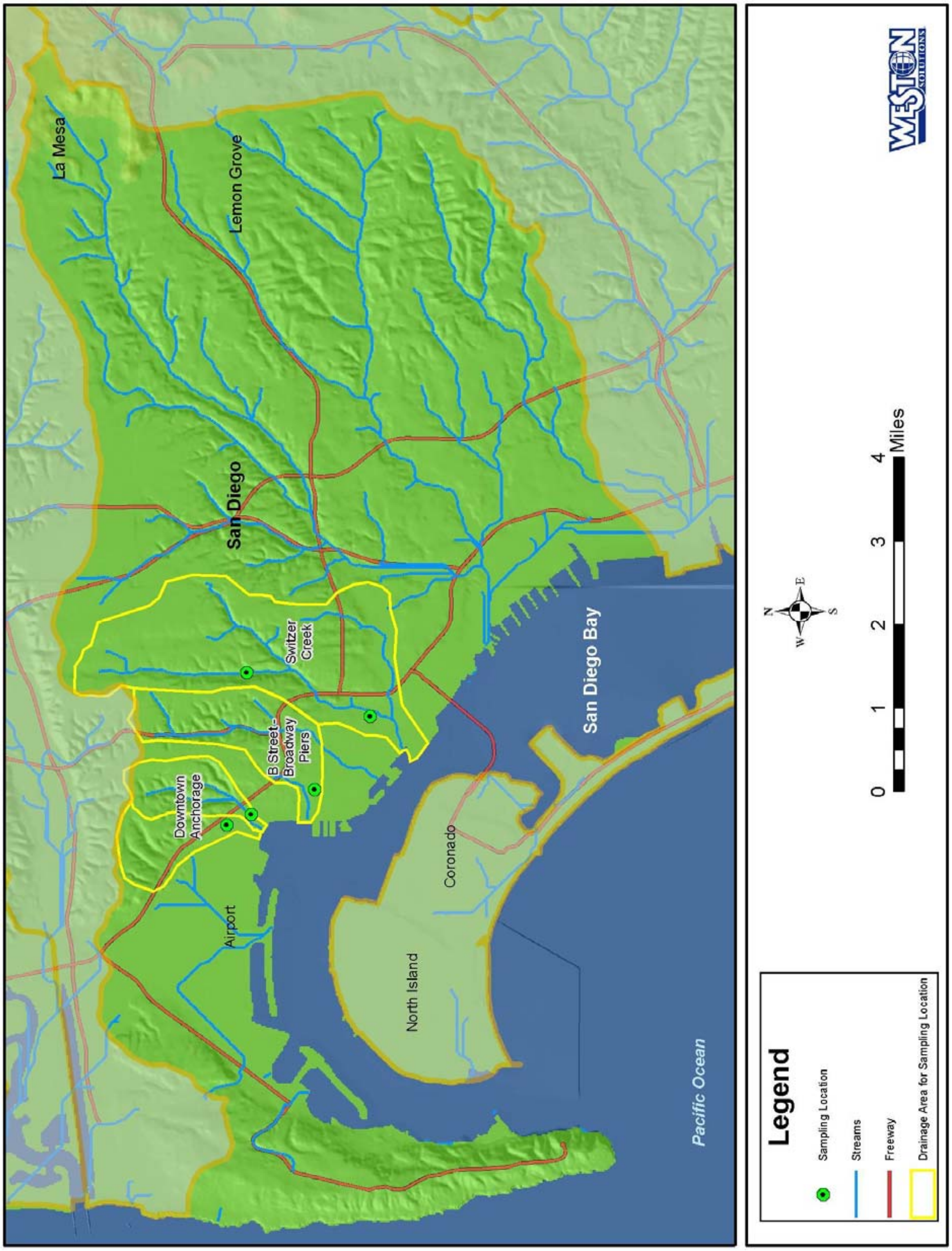

Figure 1-1. Pueblo San Diego Watershed.

The San Diego Bay receives water from numerous drainages. Three of these drainage areas that have been identified as water quality limited are Downtown Anchorage, B Street and Broadway Piers, and Switzer Creek, which cover approximately 1,136, 1,143, and 3,193 acres, respectively. The Pueblo San Diego watershed is densely populated and highly urbanized with over 50% residential land use. Figure 1-2 illustrates the location of the Pueblo San Diego watershed, the Downtown Anchorage, B Street and Broadway Piers and Switzer Creek drainages and its land uses.

Two major municipal separate storm sewer systems (MS4) serve Downtown Anchorage. The subdrainage area encompassing the western portion of Downtown Anchorage is comprised of 43% transportation use including a section of Interstate 5 and 37% residential land use. The subdrainage is estimated to be about 63% impervious.

The subdrainage area encompassing the eastern portion of Downtown Anchorage is dominated by residential (47%) and transportation (30%) land uses. The park space (12%) is mainly in the canyon areas. The subdrainage is estimated to be about 55% impervious based on assumptions of the imperviousness of the represented land use types.

The B Street and Broadway Piers drainage consists of the downtown central business district and the Cortez Hill neighborhood. The land use of the entire area is 37% transportation, 12% residential, 15% parks, 15% public facilities, 12% commercial recreation, and 7% commercial. The upper portion of the drainage is primarily residential. Balboa Park is located in the middle of this drainage and the downstream area receives storm water from downtown San Diego. The drainage is estimated to be about 58% impervious.

The Switzer Creek drainage encompasses the downtown neighborhood of East Village, eastern portions of Balboa Park and the residential community of North Park. Switzer Creek runs underground through the East Village and is a part of the MS4. Switzer Creek daylights near the Pershing Street access ramps to Interstate 5 approximately one mile upstream. The primary land use types surrounding the sampling point are commercial and industrial. This drainage is 35% transportation related, 31% residential and 14% park space representing the eastern part of Balboa Park. The drainage is estimated to be about 55% impervious.

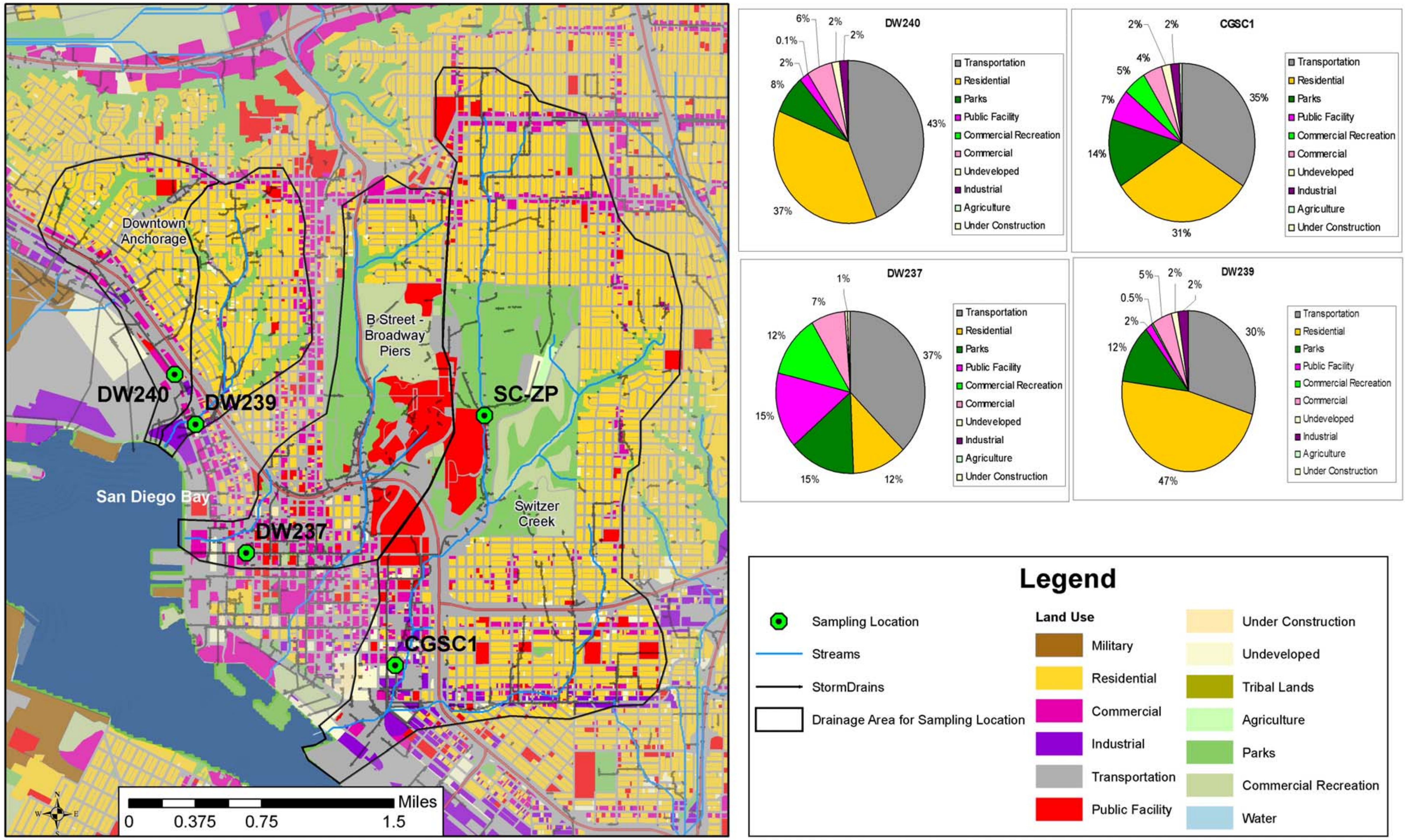

Figure 1-2. Downtown Anchorage, B Street/Broadway Pier and Switzer Creek and Associated Land Uses.

2.0 BACKGROUND INFORMATION

The natural resources of San Diego Bay have changed dramatically since the explorer Cabrillo entered the bay in 1542 (San Diego Unified Port District, 1995). San Diego Bay is an extremely productive area for natural resources, providing an important home or migratory stop-over for hundreds of species of fish, birds, mammals, plants, and invertebrates that are found over thousands of acres of marine, estuarine, marsh, and water habitats. Over the past 100 years, development and urbanization of the Bay have caused many changes and impacts to the natural and economic resources of the San Diego Bay watershed.

Prior to development, approximately seven creeks and river tributaries provided freshwater flows into the Bay. In 1853, the "Derby Dike" created a permanent diversion of the San Diego River into Mission Bay rather than into San Diego Bay, thus eliminating a large source of freshwater for San Diego Bay. Since that time, freshwater flows into the Bay have been further cut by upstream dam construction, extensive use of ground water, and natural periods of drought. Currently, freshwater sources into the Bay are limited to periodic drainage from land and seasonal flows (during times of rainfall) from still existing streams and creeks such as Paradise, Chollas, Paleta, Switzer, and Sweetwater (SAIC, 1998). In addition, discharges and spills from municipal, commercial, and military activities; dredging and filling operations; ongoing, permitted waste discharges; and storm water and other non-point source runoff from the large surrounding drainage region (watershed) have further degraded and impacted the water quality of the Bay.

Up until the 1960s, systems for collecting and treating raw sewage and other wastes before discharge to the Bay were not used or were ineffective. As a result, domestic sewage and industrial wastes containing a variety of metals, solvents, waste oil, and paints were discharged directly into the Bay at volumes up to 50 million gallons per day. Discharges from Navy facilities on North Island alone contributed an estimated 70 tons of metals to the Bay over a 50-year period (San Diego Unified Port District, 1995). The relatively weak natural flushing of Bay waters led to large accumulations of sewage and industrial wastes, and in some areas caused sewage sludge deposits up to six feet deep.

In 1990, SWRCB and the RWQCB initiated the Bay Protection and Toxic Cleanup Program (BPTCP). The BPTCP is focused on the control of pollution in the State's enclosed bays, estuaries and coastal waters by identifying and characterizing toxic hot spots, developing cleanup plans and developing strategies to prevent toxic pollutants from creating new toxic hot spots. This program is significant because it provided the first comprehensive study of the severity of impacts and the occurrence of biological effects in San Diego Bay.

The present condition of San Diego Bay can be characterized from the results of the recent BPTCP conducted by the SWRCB. The study used measurements of chemical contaminants in sediments, evaluations of bottom-dwelling organisms, and laboratory toxicity tests to define the health of bottom habitats throughout the Bay. Thus, the findings were based on multiple indicators of environmental health, and increase confidence in the conclusions.

Sediments in the San Diego Bay in the vicinity of Switzer Creek, B Street/Broadway Piers, and the Downtown Anchorage area were found to be contaminated with anthropogenic chemicals, which include PAHs, polychlorinated biphenyls (PCBs), chlorinated pesticides (chlordane and lindane), and metals (copper, mercury, and zinc) (Table 2-1). In addition these sites have degraded benthic macroinvertebrate communities, and sediments from these sites were toxic to marine invertebrates in laboratory tests (Sediment Quality Assessment Study, 2004). As a consequence, these sites have been listed as impaired on the State of California's 303(d) list. Consequently, the RWQCB initiated efforts to develop TMDL calculations and cleanup plans for these sites.

Table 2-1. Summary of findings of the BPTCP for the Switzer Creek, B Street/Broadway Piers, and Downtown Anchorage study sites.

Study Site	Degradation	Possible Contaminant Sources
Switzer Creek*	Elevated Chemistry Copper Low MW PAHs High MW PAHs Chlordane Total (ERMQ) Toxicity (sediment, porewater) Benthics	Shipyard Facilities Shipping Activities Storm water PAH disposal Refuse disposal Air deposition
B Street/Broadway Piers	Elevated Chemistry Copper Low MW PAHs High MW PAHs Chlordane Total (ERMQ) Toxicity (porewater) Benthics	Shipping Activities Storm water Redistribution of adjacent sediments Air deposition
Downtown Anchorage*	Elevated Chemistry Metals Chlordane Total (ERMQ) Toxicity (sediment, porewater) Benthic community	Storm water Airport Runoff Redistribution of adjacent sediments Antifouling paints Air deposition

*These sites were classified by BPTCP as high priority sites for future study.

ERMQ = Effects Range Median Quotient, an indicator of pollution due to multiple contaminants. References: Fairey *et al*. 1996, 1998; Marine Pollution Studies Laboratory 2003; Marine Pollution Studies Laboratory 2004.

3.0 MATERIALS AND METHODS

3.1 Site Locations

Sampling sites were identified for the collection of water and sediment samples and the monitoring of the benthic macroinvertebrate community and the physical stream habitat quality. Sampling locations, where practicable, were selected to be consistent with historical sampling locations. Other site selection factors included:

- Suitability of the site drainage area to monitor area-wide contributions and to provide adequate coverage of the entire watershed and possible sediment pollutant loading
- Suitability of the site's hydrological characteristics and land use types to enable practical measurement of flow and collection of representative samples
- Safety from traffic and other hazards
- Field crew access for retrieving water and sediment samples

3.1.1 Water and Sediment Quality Monitoring Stations

One sampling station within each drainage area was selected, except Downtown Anchorage. Two sites were located within the Downtown Anchorage drainage area to represent the two large drainage pipes that converge within this drainage area and the different land uses that contribute to the two primary conveyance systems. Stations were located at the furthest downstream accessible point without being tidally influenced in order to best characterize the runoff of the entire drainage area.

The four water and sediment quality monitoring stations were located in the MS4 as illustrated in Figure 3-1. Three of the stations are co-located with stations monitored by the City of San Diego within the scope of the Dry Weather Monitoring Program, and for consistency used the same station identifier. The fourth location is not currently monitored by the City of San Diego and had a unique identifier.

Station DW240 was the first of two sampling stations located within the Downtown Anchorage drainage area. Station DW240 is a manhole located on the intersection of California Street and Palm Street just west of the trolley tracks (N32°43.988', W117°10.475' [North American Datum (NAD) 83]). Kettner Boulevard, a major north-south arterial, is located approximately 0.1 mi to the east. Pacific Highway, a major north-south arterial, is located 0.1 mi to the west.

Station DW239 was the second of two sampling stations located within the Downtown Anchorage drainage area. Station DW239 is a manhole located on California Street south of Laurel Street approximately 0.1 mi east of Pacific Highway (N32°43.732', W117°10.346' [NAD 83]).

Station DW237 was located within the B Street and Broadway Piers drainage areas. Station DW237 is a manhole located on the north side of B Street just east of the intersection with Columbia Street (N32°43.072', W117°10.030' [NAD 83]). Interstate 5 is located approximately 0.5 mi to the north. It is outside any tidal influence from San Diego Bay. The primary land use type surrounding the sampling point is commercial.

Station CGSC1 was located within the Switzer Creek drainage area on Switzer Creek. Station CGSC1 is a manhole located at 14th Street and K Street (N32°42.500', W117°09.119' [NAD 83]). Imperial Avenue, a major east-west arterial is located approximately 0.2 mi to the south and Interstate 5 is located approximately 0.25 mi to the east. The sampling point is outside any tidal influence from San Diego Bay.

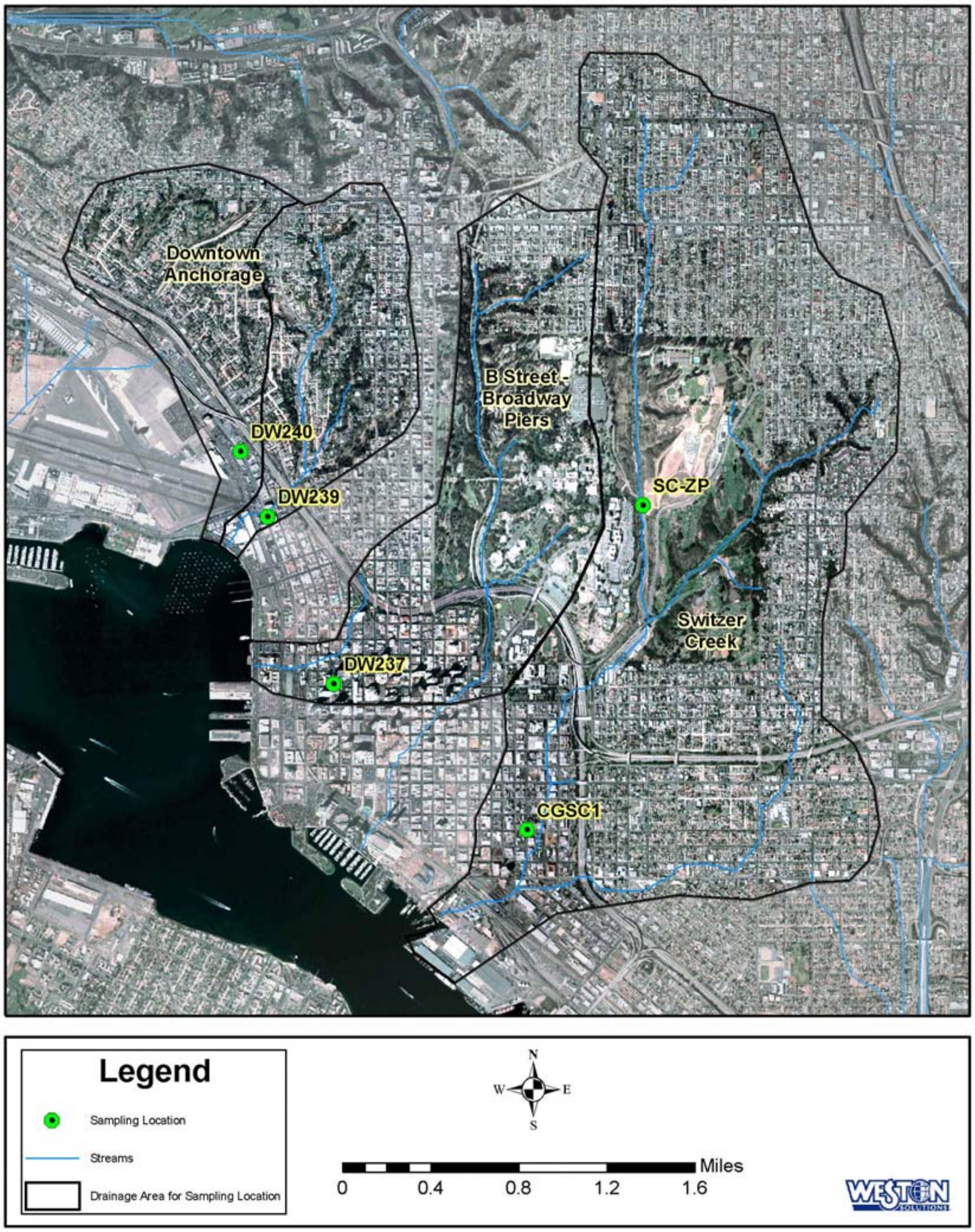

Figure 3-1. Vicinity Map and Water Quality and Biological Assessment Sampling Locations.

3.1.2 Biological Assessment Monitoring Station

One bioassessment monitoring site was located within the Switzer Creek drainage area (Figure 3-1). Station SC-ZP was located on the west side of Florida Street just south of the intersection with Zoo Place (N32°43.789’, W117°08.590’ [NAD 83]). Highway 163 is located approximately 0.75 mi to the west. Station SC-ZP consisted of three replicate samples located within 100 meters of each other in this stretch of the creek. The reach consisted of a natural stream bed bordered by mostly non-native plants. Photographs were taken of each riffle in the monitoring reach and a representative photo is shown in Figure 3-2.

Figure 3-2. Bioassessment monitoring reach of Switzer Creek.

3.2 Sample Frequency

3.2.1 Water and Sediment Quality Monitoring

Samples were collected during the wet-weather (October 1-April 30) and dry-weather (May 1-September 30) seasons. Storm water samples were collected from each station during one storm event on March 22, 2005. The storm event measured greater than 0.10 inches of rainfall, had an antecedent dry period of 72 hours and was representative of typical storms for the area in terms of intensity, depth and duration.

Three dry-weather water samples were collected at each station. Samples from DW239 were collected on May 16, June 14, and June 28, 2005 and samples from DW240, DW237 and CGSC1 were collected on June 14, June 28 and July 12, 2005. Sediment samples were collected at each station on June 14, 2005. Dry weather samples were collected on non-rainy days which were preceded by at least 72 hours of dry weather.

3.2.2 Biological Assessment

Samples were collected from the Switzer Creek station, SC-ZP, on May 17, 2005 and October 28, 2005. Bioassessment samples were collected on non-rainy days which were preceded by at least 72 hours of dry weather.

3.3 Sample Collection

3.3.1 Water Quality Samples

Water quality sampling was conducted by Weston Solutions, Inc. (Weston) personnel in compliance with the Municipal Storm Water Permit Dry Weather Monitoring protocols as identified in Attachment E of Order 2001-01 (Feb. 2001). Samples were collected in laboratory-certified, sterile sample bottles. Grab samples were collected from the center of the channel using sampling poles, where possible. The majority of dry weather samples were collected by hand due to low flows. The sample bottle was submerged open-end down and then turned face-up and allowed to fill. General characteristics including land use, weather, odor, color, clarity, floatables, deposits, vegetation, biology, and flow were recorded, where applicable. The samples were analyzed for the following constituents to aid in the development of TMDLs: total suspended solids (TSS), total organic carbon (TOC), orthophosphorus as P (reactive phosphorus), nitrate nitrogen, nitrite, TKN (total kjeldahl nitrogen), ammonia nitrogen, total hardness, surfactants (MBAS), oil and grease, diazinon and chlorpyrifos, chlorinated hydrocarbons (chlordane, lindane, and PCBs), synthetic pyrethroids, PAHs, total and dissolved trace metals, total coliform, fecal coliform and enterococcus.

Field testing was conducted for pH, specific conductance, temperature, turbidity, orthophosphorus as P (reactive phosphorus), nitrate nitrogen, and ammonia nitrogen. Triplicate readings were taken in the field for each constituent. All field measurements for pH, conductivity and temperature were made using an Oakton CON10 pH/temp/cond meter and all field measurements for turbidity were made using a Hach 2100P Turbidity meter. Turbidity measurements were not recorded during the June 28, 2005 sampling event due to equipment difficulties. Field measurements for reactive phosphorus, nitrate nitrogen, and ammonia nitrogen were made using CHEMetrics portable field test kits K-8510, K-6902D, and K-1510, respectively. Table 3-1 lists the water quality constituents that were monitored and the appropriate analytical methods, sample collection, preservation and holding times.

For total and dissolved metals analyses, two different U.S. Environmental Protection Agency (USEPA) methods (200.8 and 1640) were used. The primary difference between these two methods was their method detection limits: USEPA Method 1640 has a lower method detection limit than USEPA Method 200.8, providing better resolution in the analysis. Due to the increased cost of using USEPA Method 1640 and limited project budget, metals were first analyzed using USEPA Method 200.8. If metal concentrations were not detected using this method, they were reanalyzed using USEPA Method 1640.

Table 3-1. Sample Collection, Preservation and Analysis for Water Quality Monitoring Constituents.

Analytical Parameter	Analytical Method	Sample Volume	Container Type	Preservation (chemical, temperature, light protected)	Maximum Holding Time: Preparation/ analysis
pH	N/A	N/A	Analyzed in Field	Immediate	Immediate
Conductivity	N/A	N/A	Analyzed in Field	Immediate	Immediate
Temperature	N/A	N/A	Analyzed in Field	Immediate	Immediate
Turbidity	N/A	N/A	Analyzed in Field	Immediate	Immediate
Total Suspended Solids	SM 2540-D	1 L	Plastic	Store Cool at <4ºC	7 Days
Total Organic Carbon	EPA 415.1	250 mL	Amber Glass	Store Cool at <4ºC	28 Days
Orthophosphorus-P	SM 4500 P,C	150 mL	Analyzed in Field and Lab, Plastic	Store Cool at <4ºC	48 Hours
Nitrate - N	SM 4500 NO_3	100 mL	Analyzed in Field and Lab, Plastic	Store Cool at <4ºC	48 Hours
Nitrite	SM 4500-NO2 B	250 mL	Plastic	Store Cool at <4ºC	48 Hours
TKN	EPA 351.3	500 mL	Amber Glass	Store Cool at <4ºC	28 Days
Ammonia - N	SM 4500 NH_3	250 mL	Analyzed in Field and Lab, Plastic	Acidify to <2 with H_2S0_4	28 Days
Total Hardness	SM 2340 B	250 mL	Plastic	HNO_3	6 Months
Surfactants (MBAS)	SM 5540 C	500 mL	Plastic	Store Cool at <4ºC	48 Hours
Oil and Grease	EPA 1664	1 L	Amber Glass	Store Cool at <4ºC, Add HCL to pH<2	28 Days
Diazinon	EPA 625	2 L	Amber Glass	Store Cool at <4ºC	Extraction-7 Days, Analysis-40 Days
Chlorpyrifos	EPA 625	2 L	Amber Glass	Store Cool at <4ºC	Extraction-7 Days, Analysis-40 Days
Chlorinated Hydrocarbons	EPA 625	2 L	Amber Glass	Store Cool at <4ºC	Extraction-7 Days, Analysis-40 Days
Synthetic Pyrethroids	EPA 625	2 L	Amber Glass	Store Cool at <4ºC	Extraction-7 Days, Analysis-40 Days
PAH's	EPA 625	2 L	Amber Glass	Store Cool at <4ºC	Extraction-7 Days, Analysis-40 Days
Total and Dissolved Trace Metals	EPA 200.8 & EPA 1640	1 L	Plastic	Store Cool at <4ºC	48 Hours
Total Coliform	SM 9221 B	100 mL	Plastic	Store Cool at <4ºC	6 Hours
Fecal Coliform	SM 9221 E	100 mL	Plastic	Store Cool at <4ºC	6 Hours
Enterococcus	SM 9230 B	100 mL	Plastic	Store Cool at <4ºC	6 Hours

A field data log was completed at each site for each sample collection (Appendix A). The field data log includes empirical observations of the site and water quality characteristics. Observations include parameters such as approximate depth of the water and flow velocity, where applicable, which will be used to calculate an approximate discharge volume, meteorological conditions at the time of sampling, and water quality characteristics such as odor, color, clarity and floatables/deposits in the runoff.

3.3.2 Sediment Quality Samples

Samples were collected in laboratory-certified, sterile sample bottles. Sediment was collected from the bottom of the drain pipes using a stainless steal spoon and placed into a glass sample jar. A single sediment grab was collected from one location at each station.

Sediment samples were analyzed for the following constituents: trace metals, organophosphorus pesticides, synthetic pyrethroids, TOC, and grain size. Table 3-2 lists the constituents that were monitored and the appropriate analytical methods, sample collection, preservation and holding times.

Table 3-2. Sediment Quality Analytical Parameters.

Analytical Parameter	Analytical Method	Sample Volume	Container Type	Preservation (chemical, temperature, light protected)	Maximum Holding Time: Preparation/ analysis
Trace Metals	EPA 6020	50 g	Glass Jar	Store Cool at <4ºC	6 Months
Organo - phosphorus Pesticides	EPA 8270C	50 g	Glass Jar	Store Cool at <4ºC	40 Days
Synthetic Pyrethroids	EPA 8270C	50 g	Glass Jar	Store Cool at <4ºC	40 Days
Total Organic Carbon	EPA 415.1	50 g	Plastic	Store Frozen	N/A
Grain Size	Plumb 1981	100 g	Plastic	Store Cool at <4ºC	3 Months

3.3.3 Biological Assessment Samples

Field collection and laboratory sample processing followed the protocols specified in the California Stream Bioassessment Procedure (CSBP) (Harrington 1999). The sampling points for stream bioassessment were located within a stream feature known as a riffle. An ideal riffle is an area of rapid flow with some surface disturbance and a relatively complex and stable substrate. These areas provide increased colonization potential for benthic macroinvertebrates. Under optimal conditions, the CSBP recommends a sampling transect in a single riffle be established perpendicular to stream flow. The monitoring site in Switzer Creek was relatively wide and deep, and the riffles were generally limited to the margins of the river and the samples were taken to best represent available micro-habitat types.

Once a sampling riffle was selected, benthic invertebrates were collected using a 1-ft wide, 0.5-mm mesh, D-frame kick-net. A 2-ft^2 area upstream of the net was sampled by disrupting the substrate and scrubbing the cobble and boulders so that the organisms were dislodged and swept into the net by the current. The duration of the sampling generally ranged from 1 to 2 minutes, depending on substrate complexity. Three 2-ft^2 areas were sampled in the riffle and combined into one composite sample representing 6-ft^2. The three sample points in the riffle were selected to represent the diversity of habitat types present. This procedure was repeated for the next 2 riffles until 3 separate replicate samples were collected.

Water quality measurements were collected at the time of sample collection at each of the monitoring reaches. Measurements included water temperature, specific conductance, pH, turbidity, *in situ* relative chlorophyll, and dissolved oxygen (DO). Table 3-3 lists the constituents that were monitored and the appropriate analytical methods, sample collection, preservation and holding times.

For each monitoring reach sampled, the overall physical habitat of the stream and its adjacent banks were assessed using the 10 physical habitat parameters recommended in the USEPA Rapid Bioassessment Protocol. Habitat quality parameters were assessed to provide a record of the overall condition of the reach. Parameters such as channel alteration, frequency of riffles, width of riparian zones, and vegetative cover help to provide a more comprehensive understanding of the condition of the stream. Additionally, specific characteristics of the sampled riffles were recorded, including riffle length, depth, gradient, velocity, substrate complexity, and substrate composition. A field data log was completed at the bioassessment site for each survey (Appendix B).

Table 3-3. Biological Assessment Analytical Parameters.

Analytical Parameter	Analytical Method	Sample Volume	Container Type	Preservation (chemical, temperature, light protected)	Maximum Holding Time: Preparation/ analysis
pH	N/A	N/A	Analyzed in Field	Immediate	Immediate
Specific Conductance	N/A	N/A	Analyzed in Field	Immediate	Immediate
Temperature	N/A	N/A	Analyzed in Field	Immediate	Immediate
Dissolved Oxygen	N/A	N/A	Analyzed in Field	Immediate	Immediate
Relative Chlorophyll	N/A	N/A	Analyzed in Field	Immediate	Immediate
Turbidity	N/A	N/A	Analyzed in Field	Immediate	Immediate
Stream Flow Velocity	N/A	N/A	Analyzed in Field	Immediate	Immediate
Benthic Invertebrates	N/A	$2ft^2$	Glass Jar	95% Ethanol	5 Years

3.4 Sample Handling

3.4.1 Water and Sediment Quality Samples

Water and sediment samples were labeled with the project name, sample identification number, site location, date and time collected, analyses to be performed, and sample preservatives (if any). Samples were stored and transported on ice (4 °C) to the proper analytical laboratory. Chemistry samples were analyzed by CRG Marine Laboratories (CRG). CRG is certified by the Environmental Laboratory Accreditation Program (ELAP) (Certificate No. 2261) for the analyses of inorganics, toxic chemical elements and organics in wastewater. Bacterial samples were analyzed by Weston's in-house microbiology laboratory. Weston's Microbiology Laboratory is certified by ELAP (Certificate No. 2613) and is nationally accredited under the National Environmental Laboratory Accreditation Program (NELAP) (Accreditation No. 01113CA). TOC and grain size samples were analyzed by Weston's in-house benthic laboratory (NELAP Accreditation No. 01103CA).

3.4.2 Bioassessment Samples

Samples were placed in 1-qt jars properly labeled with the project name, sample identification number, site location, date and time, preserved in 95% ethanol, and returned to Weston's benthic laboratory for processing. At the laboratory, samples were poured over a No. 35 standard testing sieve (0.5-mm stainless steel mesh) and the ethanol retained for re-use. The sample was gently rinsed with fresh water, and large debris such as wood, leaves, or rocks were removed. The sample was transferred to a glass tray marked with grids 50 cm^2 in size. One grid was randomly selected and the sample material contained within the grid was removed and processed. In cases where the animals appeared extremely abundant, a fraction of the grid may have been removed. The material from the grid was examined under a stereomicroscope and all the invertebrates were removed, sorted into major taxonomic groups, and placed in vials containing 70% ethanol. This process was repeated until 300 organisms were removed from the sample. Organisms from a grid in excess of the 300 were placed in a separate vial labeled "remaining animals", so that a total abundance for the sample could be estimated. Processed material from the sample was placed in a separate jar and labeled "grunge", and the unprocessed material was returned to the original sample container and archived. "Grunge" material was retained for quality assurance purposes. All organisms were identified to a standard taxonomic level, genus level for most insects, and order or class for non-insects, using standard taxonomic keys (Larson, Alarie, and Roughly 2000; Merritt and Cummins 1995; Pennak 1989; Thorp and Covich 1991; Usinger 1963; Wiggins 1996). These taxonomic levels are fixed under the CSBP.

3.4.2.1 Data Analysis

A taxonomic list of benthic macroinvertebrates identified from the samples was created using Microsoft Excel, and included the designated tolerance value (TV) and functional feeding group (FFG) of each taxon. Benthic macroinvertebrate community-based metric values were calculated from the database. A list of the metrics and a brief description of what they signify is presented in Table 3-4. Functional feeding group designations were refined in 2003, with the addition of macrophyte herbivores (MH), piercer herbivores (PH), omnivores (OM), and xylophages (XY, wood eater). These groups were previously included in the grazer FFG. The California Department of Fish and Game (CDFG) recommends that for the FFG proportional bioassessment metric calculations, these four categories plus parasites are combined into a group designated "Other".

In addition to the individual metric values, a multi-metric Index of Biotic Integrity (IBI) was calculated for each monitoring reach. A Southern California IBI was developed late in 2003 by the CDFG (Ode et al. 2005). The IBI is a multi-metric quantitative scoring system for assessing the quality of benthic macroinvertebrate assemblages.

Table 3-4. Bioassessment metrics used to characterize benthic invertebrate communities.

BMI Metric	Description	Response to Impairment
Richness Measures		
Taxa Richness	Total number of individual taxa	Decrease
Coleopteran Taxa*	Number of taxa in the insect order Coleoptera (beetles)	Decrease
EPT Taxa*	Number of taxa in the Ephemeroptera (mayfly), Plecoptera (stonefly) and Trichoptera (caddisfly) insect orders	Decrease
Dipteran Taxa	Number of taxa in the insect order Diptera (true flies)	Increase
Non-Insect Taxa	Number of non-insect taxa	Increase
Predator Taxa*	Number of taxa in the predator feeding group	Decrease
Composition Measures		
EPT Index	Percent composition of mayfly, stonefly, and caddisfly larvae	Decrease
Sensitive EPT Index	Percent composition of mayfly, stonefly, and caddisfly larvae with tolerance values between 0 and 3	Decrease
Shannon Diversity Index	General measure of sample diversity that incorporates richness and evenness (Shannon and Weaver 1963)	Decrease
Margalef Diversity	Measure of sample diversity weighted for richness	Decrease
Tolerance/Intolerance Measures		
Tolerance Value	Value between 0 and 10 of individuals designated as pollution tolerant (higher values) or intolerant (lower values)	Increase
Dominant Taxon	Percent composition of the single most abundant taxon	Increase
Percent Chironomidae	Percent composition of the tolerant dipteran family Chironomidae	Increase
Percent Intolerant Organisms*	Percent of organisms in sample that are highly intolerant to impairment as indicated by a tolerance value of 0, 1 or 2	Decrease
Percent Tolerant Organisms	Percent of organisms in sample that are highly tolerant to impairment as indicated by a tolerance value of 8, 9 or 10	Increase
Percent Tolerant Taxa*	Percent of taxa in sample that are highly tolerant to impairment as indicated by a tolerance value of 8, 9 or 10	Increase
Percent Non-insect Organisms	Percent of organisms in sample that are not in the Class Insecta	Increase
Percent Non-insect Taxa*	Percent of taxa in sample that are not in the Class Insecta	Increase
Functional Feeding Groups (FFG)		
Percent Collector-Gatherers*	Percent of macrobenthos that collect or gather fine particulate matter	Increase
Percent Collector-Filterers*	Percent of macrobenthos that filter fine particulate matter	Increase
Percent Scrapers	Percent of macrobenthos that graze upon periphyton	Increase
Percent Predators	Percent of macrobenthos that feed on other organisms	Variable
Percent Shredders	Percent of macrobenthos that shreds coarse particulate matter	Decrease
Percent Other	Percent of macrobenthos that are parasites, macrophyte herbivores, piercer herbivores, omnivores, and xylophages	Variable
Abundance		
Estimated Abundance	Estimated number of organisms in entire sample	Variable

*indicates metrics used to calculate the Index of Biotic Integrity
Source: modified from SDRWQCB 1999

3.5 Action Levels

Water chemistry results were compared to dry weather action levels from the Water Quality Control Plan (Basin Plan, RWQCB 1994) for the San Diego Region, Title 40 of the Code of Federal Regulations (Part 131; Water Quality Standards) (USEPA 2000a), the City of San Diego Jurisdictional Urban Runoff Monitoring Program (JURMP) and water quality objectives (WQOs) for diazinon and chlorpyrifos to determine the presence or absence of the analyzed constituents, the magnitude of any impacts from urban runoff to San Diego Bay and and to establish a baseline to compare future analyses against. Dry weather action levels taken from the JURMP do not apply to samples collected during wet weather events, however, for the purposes of consistency, wet weather results were compared to these criteria simply as a reference. Table 3-5 summarizes the WQOs. For many constituents (some metals and most organophosphorus pesticides, PAHs, PCBs, chlorinated pesticides and synthetic pyrethroids), WQOs have not been promulgated. Therefore, the data presented herein is provided solely as a baseline to compare future monitoring results.

It should be noted that WQOs for several metals are related to and vary with the hardness of the water. Water hardness is dependent on the total concentration of calcium (Ca) and magnesium (Mg), the two most prevalent divalent metal ions. All freshwater sources contain calcium and magnesium in varying quantities. In some geographical locations iron, aluminum, and manganese may also be present at elevated levels, which may affect water hardness. Calcium usually enters the water from either limestone or other calcareous deposits. The predominant source of magnesium is dolomite, a mineral found in sedimentary rocks. It should be noted that the source of dry weather runoff is typically the municipal water supply which has likely been in contact with calcareous deposits and therefore would have a higher hardness. Stormwater, in an urbanized area such as the Pueblo San Diego Watershed, has not been in contact with these deposits to increase its hardness.

WQOs for certain metals, including cadmium, chromium, copper, lead, nickel, silver, and zinc, are expressed as a function of hardness because hardness can affect the toxicities of these metals. The hardness calculation accounts for any differences in water quality characteristics that may affect the toxicity of metals. Site-specific water quality criteria are determined for each metal depending on the concentrations of hardness. The criterion not only varies among sites, but also among sampling times. For example, water quality criterion determined for a specific metal at one location during one sampling event, will differ from the criterion determined for the same metal at the same location during a different sampling event. As water hardness increases, the toxicity of metals decreases, therefore, the water quality objective increases. Appendix C presents the hardness dependent WQOs for cadmium, chromium, copper, lead, nickel, silver and zinc based on the measured hardness values for each sample and station.

The ratio of the water quality result to the WQO provides a quick way to compare the magnitude of constituents' concentrations to each other, especially for metals since WQOs vary due to hardness. For example, if the dissolved copper concentration is 26.4 µg/L and its hardness dependent WQO is 19.8 µg/L, its ratio is 1.33. This indicates that it exceeded its WQO by only 33%. Ratios less than one indicate the constituent did not exceed its WQO. Further, the ratios can be ranked, providing an indication of which constituent is most problematic at a station.

Table 3-5. Water, Sediment, and Bioassessment Action Levels.

Constituent	Criteria	Source
Water Samples		
pH	6.5 – 9.0	Basin Plan (RWQCB 1994)
Specific Conductance	Best Professional Judgment	City of San Diego JURMP (b)
Temperature	Best Professional Judgment	City of San Diego JURMP (b)
Turbidity	Best Professional Judgment	City of San Diego JURMP (b)
Total Suspended Solids	100 mg/L	Multi-sector general permit (USEPA 2000b)
Total Organic Carbon	-	-
Reactive Phosphorus	2.0 mg/L	Multi-sector general permit (USEPA 2000b)
Nitrate Nitrogen	10 mg/L	Basin Plan (RWQCB 1994)
Nitrite-N	1 mg/L	Basin Plan (RWQCB 1994)
TKN	-	-
Ammonia Nitrogen	1.0 mg/L	City of San Diego JURMP (b)
Total and Dissolved Trace Metals	(a)	40 CFR 131 (USEPA 2000a)
Total Hardness	-	-
Surfactants (MBAS)	1.0 mg/L	Basin Plan (RWQCB 1994)
Oil and Grease	15 mg/L	Multi-sector general permit (USEPA 2000b)
Diazinon	0.5 µg/L	City of San Diego JURMP (b)
Chlorpyrifos	0.5 µg/L	City of San Diego JURMP (b)
Organochlorine Pesticides and PCBs	-	-
Synthetic Pyrethroids	-	-
PAHs	-	-
Organophosphorus Pesticides	-	-
Total Coliform	50,000 MPN/100mL	City of San Diego JURMP (b)
Fecal Coliform	20,000 MPN/100mL	City of San Diego JURMP (b)
Enterococcus	10,000 MPN/100mL	City of San Diego JURMP (b)
Sediment Samples		
Trace Metals	(c)	NOAA
Organophosphorus Pesticides	-	-
Synthetic Pyrethoirds	-	-
Total Organic Carbon	-	-
Grain Size	-	-
Bioassessment Samples		
pH	6.5 – 9.0	Basin Plan (RWQCB 1994)
Specific Conductance	Best Professional Judgment	City of San Diego JURMP (b)
Temperature	Best Professional Judgment	City of San Diego JURMP (b)
Dissolved Oxygen	5.0 mg/L	Basin Plan (RWQCB 1994)
Relative Chlorophyll	-	-
Turbidity	Best Professional Judgment	City of San Diego JURMP (b)
Stream Flow Velocity	-	-
Benthic Invertebrates	-	-

(a) WQO for total and dissolved metal fractions are based on Total Hardness (as CaCO3) and are calculated as described by Title 40 of the Code of Federal Regulations (Part 131) (USEPA 2000).

(b) As modified by San Diego Stormwater Copermittees Dry Weather Monitoring Workgroup, April 20, 2004.

(c) Probable Effects Level (PEL). From NOAA's Screening Quick Reference Tables for Inorganics in Solids (NOAA 1999).

Sediment chemistry results were compared to threshold exposure limits (TEL) and probable effects levels (PEL) for freshwater sediment (National Oceanographic and Atmospheric Administration [NOAA] 1999) as listed in Table 3-5. TEL values represent concentrations below which adverse biological effects are rarely observed. PEL values represent concentrations above which adverse effects are more likely to occur.

The bioassessment provides information about the biota and the physical state of the watershed through field monitoring of several characteristics, including pH, specific conductance, and DO. This information will be used as a baseline for future trend analysis.

3.6 Chain of Custody Procedures

Chain of custody (COC) procedures were used for all samples throughout the collection, transport and analytical process. Samples were considered to be in custody if they were (1) in the custodian's possession or view, (2) retained in a secured place (under lock) with restricted access, or (3) placed in a container and secured with an official seal such that the sample could not be reached without breaking the seal. The principal documents used to identify samples and to document possession were COC records, field logbooks and field tracking forms.

The COC procedures were initiated during sample collection. A COC record was provided with each sample or group of samples. Each person who had custody of the samples signed the form and ensured the samples were not left unattended unless properly secured. Documentation of sample handling and custody included the following:

- Sample identifier
- Sample collection date and time
- Any special notations on sample characteristics or analysis
- Initials of the person collecting the sample
- Date the sample was sent to the analytical laboratory
- Shipping company and waybill information.

Completed COC forms were placed in a plastic envelope and kept inside the container containing the samples. Once delivered to the analytical laboratory, the COC form was signed by the person receiving the samples. The condition of the samples (i.e., confirming all samples were accounted for and properly labeled, the temperature of the samples, and integrity of the sample jars) was noted and recorded by the receiver. COC records were included in the final reports prepared by the analytical laboratories and are considered an integral part of the report.

3.7 QA/QC

Field measurements for pH, conductivity and temperature were made using an Oakton CON10 pH/temp/cond meter according to manufacturer's specifications. All field measurements for turbidity were made using a Hach 2100P Turbidity meter. Calibration of the instruments was conducted prior to each sampling event. Triplicate readings were made in the field.

Quality assurance and quality control (QA/QC) for sampling processes included proper collection of the samples in order to minimize the possibility of contamination. All samples were collected in laboratory supplied, laboratory-certified, contaminant free sample bottles.

Field blanks were collected at a rate of one sample per water quality sampling event. Field blanks were check samples that monitored potential contamination originating from the collection, transport, or storage of environmental samples. A field blank was analyte-free water that was poured into the sample collection device and sub-sampled for chemistry analyses to verify that field cleansing procedures were adequate and sampling handling and transportation did not introduce any analytes of interest. Field blanks were analyzed for metals, organophosphorus pesticides, oil and grease and surfactants.

One field blank was also collected during the sediment sampling event. It consisted of pouring analyte free water through the sample collection equipment and collecting this water for chemistry analyses. The field blank was collected to verify that field cleansing procedures were adequate and sampling handling and transportation did not introduce any analytes of interest. The field blank was analyzed for metals and TOC.

4.0 RESULTS

One of the primary goals of the *San Diego Watersheds Common Grounds Project* is to achieve measurable water quality improvements throughout San Diego Bay by undertaking a targeted monitoring program that will support the development of three TMDLs in the Bay. The three drainages which TMDLs are being developed are Downtown Anchorage, B Street/Broadway Piers and Switzer Creek. To best support this goal, the analytical results are presented by drainage area. Within each drainage area, results for the wet weather monitoring, dry weather monitoring and sediment quality monitoring are presented (and in the case of Switzer Creek, bioassessment data are also presented). Tables have been generated that allow easy comparison of wet weather and dry weather results.

The results provided herein are presented from the most northerly drainage area, Downtown Anchorage, comprised of two stations DW240 and DW239, to the most southerly drainage area, Switzer Creek.

Wet weather sampling was conducted on March 22, 2005. Approximately 0.5 inches of rain accumulated over a 3 hour period (0.17 in/hr). The storm began at approximately 18:00 Pacific Standard Time (PST) and ended at approximately 21:00 PST. Two field technicians were deployed to the site and collected all required samples at each station between 20:00 and 23:00 PST.

Dry weather sampling was conducted on May 16, June 14 and 28, and July 12, 2005. On May 16, only one station, DW239, had sufficient flow to be monitored and sampled; the remaining three sites were documented as either dry or small amounts of ponded water unable to be sampled. All four stations were sampled on June 14 and June 28. The third dry weather sample for stations DW240, DW237, and CGSC1 was collected on July 12. All dry weather sampling events had an antecedent dry period of at least 72 hours.

Sediment samples were collected once, on June 14, 2005 in conjunction with the second dry weather sampling event. Field crews entered the storm drains using confined space entry protocols with assistance from the City of San Diego’s Streets Division. Sufficient sediment was collected at each site for grain size, trace metals, organophosphorus pesticides and synthetic pyrethroids analyses. Unfortunately, only eight metals have PELs developed and none of the pesticides or pyrethroids have established criteria (guidelines). The following subsections present a summary of the sediment analytical results and Appendix D provides complete analytical reports and chain of custody records.

4.1 Downtown Anchorage

4.1.1 Wet Weather Monitoring – Station DW240

Sampling was conducted in heavy rain. The water quality sample collected at DW240 was yellowish in color and cloudy, with no apparent odor. There was no sheen apparent, however, trash, debris and other organic materials were observed floating on the water. Triplicate readings were taken of pH, temperature, conductivity and turbidity. The mean results of each parameter were 6.97 units, 17.2 °C, 189 µS/cm and 113 Nephelometric Turbidity Units (NTU), respectively (Table 4-1).

Table 4-1. Wet Weather and Dry Weather Water Quality Analytical Results, Downtown Anchorage Station DW240.

Analyte	Units	WQO	Downtown Anchorage (DW240)				
			Wet Weather	Dry Weather			
			22-Mar-05	14-Jun-05	28-Jun-05	12-Jul-05	Dry Weather Average
Physical							
pH	units	6.5 - 9.0	6.97	7.94	7.98	7.84	7.92
Specific Conductance	µS/cm	BPJ	189	1125	1140	987	1084
Temperature	°C	BPJ	17.2	19.3	22	22.6	21.3
Turbidity	NTU	BPJ	113	11.2	NA	40	25.60
General Chemistry							
Ammonia-N	mg/L	1.0	0.46	0.03E	0.47	0.06	0.19
MBAS	mg/L	1.0	**1.1**	**30.2**	0.154	**1.388**	10.581
Nitrate-N	mg/L	10	2.06	0.18	0.62	<0.02	0.27
Nitrite-N	mg/L	1.0	0.11	<0.02	0.59	<0.02	0.20
Oil & Grease	mg/L	15	6.87	6	<1	3	3.17
Orthophosphate as P	mg/L	2.0	1.77	**4.3**	0.875	1	2.06
Total Hardness as CaCO3	mg/L		48	151	238	240	210
Total Suspended Solids	mg/L	100.0	**260**	60.5	32	**146**	79.5
Total Kjeldahl Nitrogen	mg/L		2.7	<0.50	2.9	<0.50	1.13
Carbon, Total Organic	mg/L		38	63	23	37	41.00
Bacterial							
Total Coliform	MPN/100 mL	50,000	**80,000**	**>1,600,000**	**300,000**	**>16,000,000**	300,000
Fecal Coliform	MPN/100 mL	20,000	2,300	**>1,600,000**	**240,000**	**80,000**	160,000
Enterococcus	MPN/100 mL	10,000	3,873	75	3,448	2,400	1,974
Total Metals							
Aluminum (Al)	µg/L		2000	866	607	583	685
Antimony (Sb)	µg/L		5.51	4.5	5.92	8.52	6.31
Arsenic (As)	µg/L		2.71	5.58	2.8	6.78	5.05
Barium (Ba)	µg/L		91.5	119	166	141	142.0
Beryllium (Be)	µg/L		<0.1	<0.1	<0.1	<0.1	0.05
Cadmium (Cd)	µg/L	a	1.08[1]	0.392[2]	0.23[1]	0.61[1]	0.41
Chromium (Cr)	µg/L	a	9	4.43	4.25	6.1	4.93
Cobalt (Co)	µg/L		2.51	1.69	1.35	<0.1	1.03
Copper (Cu)	µg/L	a	**90.1**	**140**	**42.5**	**183**	121.8
Iron (Fe)	µg/L		2810	2,860	1,480	2,750	2,363
Lead (Pb)	µg/L	a	**36.3**	36.8	10.4	29.8	25.67
Manganese (Mn)	µg/L		133	209	109	195	171
Mercury (Hg)	µg/L		<0.05	0.020	0.018	0.038	0.026
Molybdenum (Mo)	µg/L		4.54	8.97	11.3	6.29	8.85
Nickel (Ni)	µg/L	a	13.3	16.4	8.29	11.1	11.93
Selenium (Se)	µg/L		0.72	1.19	<0.1	0.5E	0.6
Silver (Ag)	µg/L	a	<0.1	<0.1	<0.1	<0.1	0.05
Strontium (Sr)	µg/L		163	685	670	1350	902
Thallium (Tl)	µg/L		<0.1	<0.1	<0.1	<0.1	0.05
Tin (Sn)	µg/L		0.3E	2.19	0.54	1.47	1.40
Titanium (Ti)	µg/L		101	17.1	36.7	13.4	22.40
Vanadium (V)	µg/L		16.5	6.78	6.22	5.92	6.31
Zinc (Zn)	µg/L	a	**538**	**356**	130	**389**	291.7
Dissolved Metals							
Dissolved Aluminum	µg/L		76.1	28.9	<1	10.7	13

Analyte	Units	WQO	Downtown Anchorage (DW240)				
			Wet Weather	Dry Weather			
			22-Mar-05	14-Jun-05	28-Jun-05	12-Jul-05	Dry Weather Average
Dissolved Antimony	µg/L		4.77	3.45	3.75	5.58	4.26
Dissolved Arsenic	µg/L		2.38	4.69	3.57	5.97	4.74
Dissolved Barium	µg/L		35	69.3	134	90.6	98.0
Dissolved Beryllium	µg/L		<0.1	<0.1	<0.1	<0.1	0.05
Dissolved Cadmium	µg/L	a	0.32	<0.1	<0.1	0.17E	0.09
Dissolved Chromium	µg/L	a	2.93	1.89	1.07	2.29	1.75
Dissolved Cobalt	µg/L		0.6	0.99	0.62	<0.1	0.55
Dissolved Copper	µg/L	a	**50.1**	**26.4**	15.4	**35.7**	25.8
Dissolved Iron	µg/L		145	728	458	304	497
Dissolved Lead	µg/L	a	2.3	6.25	0.88	3.42	3.52
Dissolved Manganese	µg/L		33.5	161	1.82	142	102
Dissolved Mercury	µg/L		<0.05	0.008	0.008	0.007	0.008
Dissolved Molybdenum	µg/L		6.15	16.3	10.9	15.7	14.30
Dissolved Nickel	µg/L	a	8.64	12.9	7.47	6.65	9.01
Dissolved Selenium	µg/L		0.73	1.31	<0.1	0.53	0.63
Dissolved Silver	µg/L	a	<0.1	<0.1	<0.1	<0.1	0.05
Dissolved Strontium	µg/L		141	543	666	669	626
Dissolved Thallium	µg/L		<0.1	<0.1	<0.1	<0.1	0.05
Dissolved Tin	µg/L		0.17E	0.98	0.1E	0.33E	0.47
Dissolved Titanium	µg/L		3.79	3.33	1.37	1.66	2.12
Dissolved Vanadium	µg/L		7.47	3.88	4.17	3	3.68
Dissolved Zinc	µg/L	a	**209**	57.3	75.9	51.2	61.5
Polynuclear Aromatic Hydrocarbons (PAHs)							
1-Methylnaphthalene	ng/L		15.4	<1	8.9	10	6.5
1-Methylphenanthrene	ng/L		81.8	<1	28.4	<1	9.8
2,3,5-Trimethylnaphthalene	ng/L		<1	<1	7.4	<1	2.8
2,6-Dimethylnaphthalene	ng/L		16.9	<1	15.8	18.8	11.7
2-Methylnaphthalene	ng/L		26.5	<1	11	24.1	11.9
Acenaphthene	ng/L		18.8	<1	<1	<1	0.5
Acenaphthylene	ng/L		21.7	<1	8.1	11.5	6.7
Anthracene	ng/L		54.5	18.3	16.2	19.5	18
Benz[a]anthracene	ng/L		130	23.8	28.5	76.4	42.9
Benzo[a]pyrene	ng/L		139	<1	28.8	108	45.8
Benzo[b]fluoranthene	ng/L		228	28.8	57.6	140	75.5
Benzo[e]pyrene	ng/L		252	27.9	60.1	145	78
Benzo[g,h,i]perylene	ng/L		400	<1	103	238	114
Benzo[k]fluoranthene	ng/L		128	<1	<1	81.5	27.5
Biphenyl	ng/L		59.3	<1	7.5	25.7	11.2
Chrysene	ng/L		314	61.1	100	231	131
Dibenz[a,h]anthracene	ng/L		<1	<1	<1	<1	0.5
Dibenzothiophene	ng/L		178	<1	<1	<1	0.5
Fluoranthene	ng/L		604	162	112	184	152.7
Fluorene	ng/L		<1	<1	<1	<1	0.5
Indeno[1,2,3-c,d]pyrene	ng/L		159	<1	<1	57.8	19.6
Naphthalene	ng/L		55.8	<1	11	13.4	8.3
Perylene	ng/L		153	<1	46.4	<1	15.8
Phenanthrene	ng/L		379	80.8	40.8	61.9	61.2
Pyrene	ng/L		670	146	221	359	242.0
Total Detectable PAHs	ng/L		4084.7	548.7	912.5	1,806	1,089

Analyte	Units	WQO	Downtown Anchorage (DW240)				
			Wet Weather	Dry Weather			
			22-Mar-05	14-Jun-05	28-Jun-05	12-Jul-05	Dry Weather Average
PCBs							
Aroclor 1016	ng/L		<10	<10	<10	<10	5
Aroclor 1221	ng/L		<10	<10	<10	<10	5
Aroclor 1232	ng/L		<10	<10	<10	<10	5
Aroclor 1242	ng/L		<10	<10	<10	<10	5
Aroclor 1248	ng/L		<10	<10	<10	<10	5
Aroclor 1254	ng/L		<10	<10	<10	<10	5
Aroclor 1260	ng/L		<10	<10	<10	<10	5
Total Detectable PCBs	ng/L		0	0	0	0	0
Chlorinated Pesticides							
2,4'-DDD	ng/L		<1	<1	<1	<1	0.5
2,4'-DDE	ng/L		<1	<1	<1	<1	0.5
2,4'-DDT	ng/L		<1	<1	<1	<1	0.5
4,4'-DDD	ng/L		<1	<1	<1	<1	0.5
4,4'-DDE	ng/L		<1	<1	<1	<1	0.5
4,4'-DDT	ng/L		<1	<1	<1	<1	0.5
Total Detectable DDTs	ng/L		0	0	0	0	0
Aldrin	ng/L		<1	<1	<1	<1	0.5
BHC-alpha	ng/L		<1	<1	<1	<1	0.5
BHC-beta	ng/L		<1	<1	<1	<1	0.5
BHC-delta	ng/L		<1	<1	<1	<1	0.5
BHC-gamma	ng/L		<1	<1	<1	<1	0.5
Chlordane-alpha	ng/L		<1	<1	<1	<1	0.5
Chlordane-gamma	ng/L		<1	<1	<1	<1	0.5
Dieldrin	ng/L		<1	<1	<1	<1	0.5
Endosulfan Sulfate	ng/L		<1	<1	<1	<1	0.5
Endosulfan-I	ng/L		<1	<1	<1	<1	0.5
Endosulfan-II	ng/L		<1	<1	<1	<1	0.5
Endrin	ng/L		<1	<1	<1	<1	0.5
Endrin Aldehyde	ng/L		<1	<1	<1	<1	0.5
Endrin Ketone	ng/L		<1	<1	<1	<1	0.5
Heptachlor	ng/L		<1	<1	<1	<1	0.5
Heptachlor Epoxide	ng/L		<1	<1	<1	<1	0.5
Methoxychlor	ng/L		<1	<1	<1	<1	0.5
Mirex	ng/L		<1	<1	<1	<1	0.5
Oxychlordane	ng/L		<1	<1	<1	<1	0.5
Toxaphene	ng/L		<10	<10	<10	<10	5
cis-Nonachlor	ng/L				<1	<1	0.5
trans-Nonachlor	ng/L		<1	<1	<1	<1	0.5
Organophosphorus Pesticides							
Bolstar (Sulprofos)	ng/L		<10	<10	<10	<10	5
Chlorpyrifos	ng/L	500	<5	<5	<5	<5	2.5
Demeton	ng/L		<10	<10	<10	<10	5
Diazinon	ng/L	500	<5	<5	<5	<5	2.5
Dichlorvos	ng/L		<10	<10	<10	<10	5
Dimethoate	ng/L		<5	<5	<5	<5	2.5
Disulfoton	ng/L		<10	<10	<10	<10	5
Ethoprop (Ethoprofos)	ng/L		<10	<10	<10	<10	5
Fenchlorphos (Ronnel)	ng/L			<10	<10	<10	5
Fensulfothion	ng/L		<10	<10	<10	<10	5

Analyte	Units	WQO	Downtown Anchorage (DW240)				
			Wet Weather	Dry Weather			
			22-Mar-05	14-Jun-05	28-Jun-05	12-Jul-05	Dry Weather Average
Fenthion	ng/L		<10	<10	<10	<10	5
Malathion	ng/L		<5	<5	<5	<5	2.5
Merphos	ng/L		<10	<10	<10	<10	5
Methyl Parathion	ng/L		<10	<10	<10	<10	5
Mevinphos (Phosdrin)	ng/L		<10	<10	<10	<10	5
Phorate	ng/L		<10	<10	<10	<10	5
Tetrachlorvinphos (Stirofos)	ng/L		<10	<10	<10	<10	5
Tokuthion	ng/L		<10	<10	<10	<10	5
Trichloronate	ng/L		<10	<10	<10	<10	5
Synthetic Pyrethroids							
Allethrin	ng/L		<5	<5	<5	<5	2.5
Bifenthrin	ng/L		<5	<5	<5	<5	2.5
Cyfluthrin	ng/L		<5	<5	<5	<5	2.5
Cypermethrin	ng/L		<5	<5	<5	<5	2.5
Danitol	ng/L		<5	<5	<5	<5	2.5
Deltamethrin	ng/L		<5	<5	<5	<5	2.5
L-Cyhalothrin	ng/L		<5	<5	<5	<5	2.5
Permethrin	ng/L		<5	<5	<5	<5	2.5
Prallethrin	ng/L		<5	<5	<5	<5	2.5

BOLD - Exceeds water quality objective
[1] EPA 200.8
[2] EPA 1640
(a) WQO for total and dissolved metal fractions are based on Total Hardness (as CaCO3) and are calculated as described by Title 40 of the Code of Federal Regulations (Part 131) (USEPA 2000).
NA - Not Assessed

Only two general chemistry constituents, MBAS and TSS, exceeded WQOs at Station DW240 during the wet weather sampling event. MBAS concentrations exceeded the 1.0 mg/L WQO with a value of 1.1 mg/L and TSS concentrations exceeded the 100 mg/L WQO with a value of 260 mg/L. All other general chemistry parameters were detected but were below their respective WQOs.

Total coliform was the only bacterial parameter that exceeded WQOs during the wet weather event. The total coliform density was 80,000 Most Probable Number (MPN)/100 mL, which exceeded the 50,000 MPN/100mL WQO. Fecal coliform and enterococcus densities were below WQOs with concentrations of 2,300 MPN/100 mL and 3,873 MPN/100 mL, respectively.

Three total metals exceeded WQO during the wet weather sampling event. Copper, lead and zinc concentrations exceeded objectives with measurements of 90.1 µg/L, 36.3 µg/L and 538 µg/L, respectively. Only copper and zinc concentrations exceeded objectives in the dissolved state. The dissolved copper concentration was 50.1 µg/L and the dissolved zinc concentration was 209 µg/L. All other metal concentrations were detected at low concentrations or were below their respective WQOs with the exception of dissolved and total beryllium, mercury, silver and thallium, which were not detected. Total hardness as $CaCO_3$ was measured at 48 mg/L.

All but three PAH compounds were detected at low levels. Dibenz[a,h]anthracene, fluorene and 2,3,5-Trimethylnaphthalene were not detected. Total detectable PAHs were measured at 4,084.7 ng/L, the highest measured concentration out of all the wet weather samples. All PCBs, chlorinated pesticides, organophosphorus pesticides and synthetic pyrethroids were not detected.

4.1.2 Dry Weather Monitoring – Station DW240

On May 16, 2005, station DW240 was not sampled due to insufficient water volumes. The field crews documented pooled water less than 0.25 in deep and no flow. Three dry weather samples were collected on subsequent visits to the site. A summary of the water quality visual observations is presented in Table 4-2. The means of the triplicate readings for pH, temperature, conductivity and turbidity values are presented.

Table 4-2. Dry Weather Visual Observations at Downtown Anchorage, Station DW240.

Observation/Parameter	June 14, 2005	June 28, 2005	July 12, 2005
Odor	Musty, Gasoline	None	None
Color	Yellow	Light Yellow	Brown
Floating Materials	Trash or Debris; Organic Material	Organic Material	-[2]
Oil and Grease	Sheen	Sheen	None
Turbidity (visual)	Some Cloudiness	None	Cloudy
pH	7.94	7.98	7.84
Temperature (°C)	19.3	22	22.6
Conductivity (µS/cm)	1125	1140	987
Turbidity (NTU)	11.2[1]	-[2]	40

[1] – Single measurement; triplicate readings not conducted
[2] – Parameter not assessed

Three general chemistry constituents, MBAS, orthophosphate as P and TSS, exceeded water quality objectives during at least one dry weather event at Station DW240 (Table 4-1). MBAS concentrations exceeded objectives on June 14, 2005 and July 12, 2005, with values of 30.2 mg/L and 1.388 mg/L, respectively. Orthophosphate as P and TSS each exceeded WQO during one dry weather event. Orthophosphate as P exceeded the 2.0 mg/L objective on June 14, 2005 with a value of 4.3 mg/L, and TSS exceeded the 100 mg/L WQO with a value of 146 mg/L on July 12, 2005.

Total and fecal coliform densities exceeded water quality objectives during all dry weather events. Total coliform densities ranged from 300,000 MPN/100mL to greater than 16,000,000 MPN/100mL and fecal coliform densities ranged from 80,000 MPN/100mL to greater than 1,600,000 MPN/100mL. Enterococcus densities were below water quality standards during all dry weather events.

Concentrations of two total metals, copper and zinc, exceeded water quality objectives during at least two dry weather events. Total copper concentrations exceeded objectives during all three dry weather events, with values of 140 µg/L on June 14, 2005, 42.5 µg/L on June 28, 2005 and

183 µg/L on July 12, 2005. Total zinc concentrations exceeded objectives during the first and third dry weather events with values of 356 µg/L and 389 µg/L, respectively. Only dissolved copper exceeded objectives during two dry weather events. Dissolved copper exceeded the WQO during the first and third dry weather sampling events with values of 26.4 µg/L and 35.7 µg/L, respectively. Total hardness as $CaCO_3$ ranged from 151 to 240 mg/L during the dry weather sampling events at Station DW240.

Concentrations of all PAHs, PCBs, chlorinated pesticides, organophosphorus pesticides and synthetic pyrethroids were either non-detect or below their respective water quality objectives during all dry weather sampling events.

4.1.3 Sediment Quality Monitoring – Station DW240

Sediment collected from within the storm drain was predominantly a silty sand (21.55% silt and 76.16% sand) (Table 4-3). Finer grained clays made up the rest of the sample (2.29%). There was no gravel or larger sized material in the sample. The TOC content was 0.12%.

Mercury was the only metal that exceeded the PEL with a value of 2.29 µg/dry g. Cadmium, cobalt, silver, and thallium were not detected. All remaining metals were detected at low concentrations. None of the organophosphorus pesticides or synthetic pyrethroids was detected in the sediment sample collected at DW240.

Table 4-3. Sediment Quality Analytical Results, Downtown Anchorage Station DW240.

Analyte	Units	TEL	PEL	Downtown Anchorage (DW240)
				14-Jun-05
Grain Size				
Gravel	%			0.00
Sand	%			76.16
Silt	%			21.55
Clay	%			2.29
TOC	%			0.12
Trace Metals				
Aluminum (Al)	µg/dry g			3740
Antimony (Sb)	µg/dry g			0.35
Arsenic (As)	µg/dry g	5.9	17	2.7
Barium (Ba)	µg/dry g			17.9
Beryllium (Be)	µg/dry g			0.09
Cadmium (Cd)	µg/dry g	0.596	3.53	<0.025
Chromium (Cr)	µg/dry g	37.3	90	5.79
Cobalt (Co)	µg/dry g			<0.025
Copper (Cu)	µg/dry g	35.7	197	8.41
Iron (Fe)	µg/dry g			5450
Lead (Pb)	µg/dry g	35	91.3	6.3
Manganese (Mn)	µg/dry g			47.7
Mercury (Hg)	µg/dry g	0.174	0.486	**2.29**
Molybdenum (Mo)	µg/dry g			0.51
Nickel (Ni)	µg/dry g	18	35.9	2.27
Selenium (Se)	µg/dry g			0.21

Analyte	Units	TEL	PEL	Downtown Anchorage (DW240)
				14-Jun-05
Silver (Ag)	µg/dry g			<0.025
Strontium (Sr)	µg/dry g			22.6
Thallium (Tl)	µg/dry g			<0.025
Tin (Sn)	µg/dry g			0.96
Titanium (Ti)	µg/dry g			214
Vanadium (V)	µg/dry g			12.2
Zinc (Zn)	µg/dry g	123.1	315	50.8
Organophosphorus Pesticides				
Bolstar (Sulprofos)	ng/dry g			<10
Chlorpyrifos	ng/dry g			<5
Demeton	ng/dry g			<10
Diazinon	ng/dry g			<5
Dichlorvos	ng/dry g			<10
Dimethoate	ng/dry g			<5
Disulfoton	ng/dry g			<10
Ethoprop (Ethoprofos)	ng/dry g			<10
Fenchlorphos (Ronnel)	ng/dry g			<10
Fensulfothion	ng/dry g			<10
Fenthion	ng/dry g			<10
Malathion	ng/dry g			<5
Merphos	ng/dry g			<10
Methyl Parathion	ng/dry g			<10
Mevinphos (Phosdrin)	ng/dry g			<10
Phorate	ng/dry g			<10
Tetrachlorvinphos (Stirofos)	ng/dry g			<10
Tokuthion	ng/dry g			<10
Trichloronate	ng/dry g			<10
Synthetic Pyrethroids				
Allethrin	ng/dry g			<5
Bifenthrin	ng/dry g			<5
Cyfluthrin	ng/dry g			<5
Cypermethrin	ng/dry g			<5
Danitol	ng/dry g			<5
Deltamethrin	ng/dry g			<5
L-Cyhalothrin	ng/dry g			<5
Permethrin	ng/dry g			<5
Prallethrin	ng/dry g			<5

BOLD - Exceeds PEL

4.1.4 Wet Weather Monitoring – Station DW239

Sampling was conducted in light rain. The water quality sample collected at DW239 was yellowish in color and cloudy, with a musty odor. There was no sheen apparent and no other floatables were observed. Triplicate readings were taken of pH, temperature, conductivity and turbidity. The mean results of each parameter were 6.86 units, 16.5 °C, 88.2 µS/cm and 248 NTU, respectively (Table 4-4).

Only one general chemistry parameter exceeded water quality objectives during the wet weather sampling event at Station DW239. TSS exceeded objectives with a value of 970 mg/L. Concentrations of all other general chemistry parameters were below their respective WQO.

Total coliform was the only bacterial parameter that exceeded water quality objectives during the wet weather event. The total coliform density was 170,000 MPN/100mL, which exceeded the 50,000 MPN/100mL water quality standard. Fecal coliform and enterococcus densities were below water quality objectives.

Four total metals exceeded WQO during the wet weather sampling event. Cadmium, copper, lead and zinc concentrations exceeded hardness dependent objectives with measurements of 0.76 µg/L, 38.3 µg/L, 60.6 µg/L and 227 µg/L, respectively. Only copper concentrations exceeded objectives in the dissolved state, with a value of 9.06 µg/L. All other metal concentrations were detected at low concentrations or were below their respective water quality objectives with the exception of total and dissolved mercury, silver and tin, as well as dissolved beryllium, cadmium and thallium, which were not detected. Total hardness as $CaCO_3$ was measured at 14 mg/L.

All but two PAH compounds were detected at low levels; acenaphthylene and 2,3,5-trimethylnaphthalene were not detected. Total detectable PAHs were measured at 2,810.7 ng/L. Chlordane-alpha, chlordane-gamma and trans-nonachlor, a primary ingredient in chlordane, were detected in the wet weather sample at station DW239 (31.3, 29.1 and 27 ng/L, respectively).

Only one organophosphorus pesticide, malathion, had detectable concentrations (168 ng/L) in the storm water sample. All PCBs and synthetic pyrethroids were not detected.

Table 4-4. Wet Weather and Dry Weather Water Quality Analytical Results, Downtown Anchorage Station DW239.

Analyte	Units	WQO	Downtown Anchorage (DW239)				
			Wet Weather	Dry Weather			
			22-Mar-05	16-May-05	14-Jun-05	28-Jun-05	Dry Weather Average
Physical							
pH	units	6.5 - 9.0	6.86	8.4	8.45	8.15	8.33
Specific Conductance	µS/cm	BPJ	88.2	3220	3117	3413	3250
Temperature	°C	BPJ	16.5	20.3	19.1	21.2	20.2
Turbidity	NTU	BPJ	248	1.7	8.8	NA	5.25
General Chemistry							
Ammonia-N	mg/L	1.0	0.15	0.01E	0.01E	<0.01	0.01
MBAS	mg/L	1.0	0.444	0.016	0.037	0.056	0.036
Nitrate-N	mg/L	10	1.01	6.15	7.59	5.79	6.51
Nitrite-N	mg/L	1.0	0.04E	<0.02	<0.02	<0.02	0.01
Oil & Grease	mg/L	15	3.8E	1E	<1	<1	0.67
Orthophosphate as P	mg/L	2.0	1.22	0.3	0.32	0.55	0.39
Total Hardness as CaCO3	mg/L		14	386	423	477	429
Total Suspended Solids	mg/L	100.0	**970**	6.5	1.7	4	4.1
Total Kjeldahl Nitrogen	mg/L		1.5	0.7	<0.50	0.7	0.55
Carbon, Total Organic	mg/L		9.2	10	9.7	12	10.57
Bacterial							
Total Coliform	MPN/100 mL	50,000	**170,000**	5,000	8,000	28,000	13,667
Fecal Coliform	MPN/100 mL	20,000	17,000	1,300	1,700	1,700	1,567
Enterococcus	MPN/100 mL	10,000	6,968	86	145	608	280

Analyte	Units	WQO	Downtown Anchorage (DW239)				
			Wet Weather	Dry Weather			
			22-Mar-05	16-May-05	14-Jun-05	28-Jun-05	Dry Weather Average
Total Metals							
Aluminum (Al)	µg/L		6370	11.1	74.7	241	109
Antimony (Sb)	µg/L		0.73	0.59	0.91	0.49E	0.66
Arsenic (As)	µg/L		1.57	4.81	6.06	5.31	5.39
Barium (Ba)	µg/L		122	74.6	64.4	76.8	71.9
Beryllium (Be)	µg/L		0.32E	<0.1	<0.1	<0.1	0.05
Cadmium (Cd)	µg/L	a	**0.76**[1]	0.24[1]	0.044[2]	0.089[2]	0.12
Chromium (Cr)	µg/L	a	16.6	2.28	4.71	5.88	4.29
Cobalt (Co)	µg/L		5.78	0.2E	<0.1	0.38E	0.21
Copper (Cu)	µg/L	a	**38.3**	3.15	4.2	10.8	6.1
Iron (Fe)	µg/L		8890	82	256	773	370
Lead (Pb)	µg/L	a	**60.6**	0.41	1.26	2.95	1.54
Manganese (Mn)	µg/L		217	9.45	13.6	16.8	13
Mercury (Hg)	µg/L		<0.05	0.520	0.012	0.009	0.180
Molybdenum (Mo)	µg/L		0.43E	24.9	27.7	38.9	30.50
Nickel (Ni)	µg/L	a	9.55	1.43	2.14	3.02	2.20
Selenium (Se)	µg/L		0.45E	22.8	23	22.2	22.7
Silver (Ag)	µg/L	a	<0.1	<0.1	<0.1	<0.1	0.05
Strontium (Sr)	µg/L		70.8	723	732	604	686
Thallium (Tl)	µg/L		0.17E	<0.1	<0.1	<0.1	0.05
Tin (Sn)	µg/L		<0.1	<0.1	<0.1	0.1E	0.07
Titanium (Ti)	µg/L		154	1	3.37	15.8	6.72
Vanadium (V)	µg/L		33.8	18.7	27.4	30.8	25.63
Zinc (Zn)	µg/L	a	**227**	6.1	6.36	14.8	9.1
Dissolved Metals							
Dissolved Aluminum	µg/L		53.3	<1	12	<1	4
Dissolved Antimony	µg/L		0.49E	0.57	0.5E	0.48E	0.52
Dissolved Arsenic	µg/L		1.42	4.65	5.94	5.36	5.32
Dissolved Barium	µg/L		8.11	74.9	66.3	75.4	72.2
Dissolved Beryllium	µg/L		<0.1	<0.1	<0.1	<0.1	0.05
Dissolved Cadmium	µg/L	a	<0.1	0.13E	<0.1	<0.1	0.08
Dissolved Chromium	µg/L	a	1.02	1.97	4.42	3.46	3.28
Dissolved Cobalt	µg/L		0.1E	0.21E	<0.1	0.2E	0.15
Dissolved Copper	µg/L	a	**9.06**	3.14	3.17	6.73	4.3
Dissolved Iron	µg/L		86.5	76.4	262	497	278
Dissolved Lead	µg/L	a	1.13	<0.05	<0.05	<0.05	0.03
Dissolved Manganese	µg/L		3.09	7.57	5.86	0.33E	5
Dissolved Mercury	µg/L		<0.05	0.260	0.008	0.008	0.092
Dissolved Molybdenum	µg/L		0.74	23	25.4	36.2	28.20
Dissolved Nickel	µg/L	a	1.25	1.62	2.14	3.08	2.28
Dissolved Selenium	µg/L		0.23E	21.7	23.7	<0.1	15.15
Dissolved Silver	µg/L	a	<0.1	<0.1	<0.1	<0.1	0.05
Dissolved Strontium	µg/L		28.5	740	733	638	704
Dissolved Thallium	µg/L		<0.1	<0.1	<0.1	<0.1	0.05
Dissolved Tin	µg/L		<0.1	<0.1	<0.1	<0.1	0.05
Dissolved Titanium	µg/L		2.27	0.59	1.41	2.25	1.42
Dissolved Vanadium	µg/L		3.38	18.4	27.3	29.9	25.20
Dissolved Zinc	µg/L	a	14.4	5.66	4.06	12.7	7.5
Polynuclear Aromatic Hydrocarbons (PAHs)							
1-Methylnaphthalene	ng/L		6.4	2E	2.5E	<1	1.7
1-Methylphenanthrene	ng/L		50.1	<1	<1	<1	0.5
2,3,5-Trimethylnaphthalene	ng/L		<1	<1	<1	<1	0.5
2,6-Dimethylnaphthalene	ng/L		7.8	<1	<1	<1	0.5
2-Methylnaphthalene	ng/L		20.1	1.3E	3.3E	3.6E	2.7
Acenaphthene	ng/L		8.4	1.9E	<1	<1	1.0
Acenaphthylene	ng/L		<1	<1	<1	<1	0.5

Analyte	Units	WQO	Downtown Anchorage (DW239)				
			Wet Weather	Dry Weather			
			22-Mar-05	16-May-05	14-Jun-05	28-Jun-05	Dry Weather Average
Anthracene	ng/L		26.9	<1	<1	<1	0.5
Benz[a]anthracene	ng/L		92.4	<1	<1	<1	0.5
Benzo[a]pyrene	ng/L		115	<1	<1	<1	0.5
Benzo[b]fluoranthene	ng/L		171	<1	<1	<1	0.5
Benzo[e]pyrene	ng/L		166	<1	<1	<1	1
Benzo[g,h,i]perylene	ng/L		235	<1	<1	<1	1
Benzo[k]fluoranthene	ng/L		108	<1	<1	<1	0.5
Biphenyl	ng/L		18.7	<1	<1	<1	0.5
Chrysene	ng/L		236	<1	<1	<1	1
Dibenz[a,h]anthracene	ng/L		16.4	<1	<1	<1	0.5
Dibenzothiophene	ng/L		90.1	<1	<1	<1	0.5
Fluoranthene	ng/L		495	<1	<1	5.9	2.3
Fluorene	ng/L		12.7	1.3E	<1	<1	0.8
Indeno[1,2,3-c,d]pyrene	ng/L		134	<1	<1	<1	0.5
Naphthalene	ng/L		30.7	5.8	12.9	8.3	9.0
Perylene	ng/L		46	<1	<1	<1	0.5
Phenanthrene	ng/L		294	4.8E	<1	5.4	3.6
Pyrene	ng/L		430	2.7E	<1	9.8	4.3
Total Detectable PAHs	ng/L		2810.7	19.8	18.7	33	24
PCBs							
Aroclor 1016	ng/L		<10	<10	<10	<10	5
Aroclor 1221	ng/L		<10	<10	<10	<10	5
Aroclor 1232	ng/L		<10	<10	<10	<10	5
Aroclor 1242	ng/L		<10	<10	<10	<10	5
Aroclor 1248	ng/L		<10	<10	<10	<10	5
Aroclor 1254	ng/L		<10	<10	<10	<10	5
Aroclor 1260	ng/L		<10	<10	<10	<10	5
Total Detectable PCBs	ng/L		0	0	0	0	0
Chlorinated Pesticides							
2,4'-DDD	ng/L		<1	<1	<1	<1	0.5
2,4'-DDE	ng/L		<1	<1	<1	<1	0.5
2,4'-DDT	ng/L		<1	<1	<1	<1	0.5
4,4'-DDD	ng/L		<1	<1	<1	<1	0.5
4,4'-DDE	ng/L		<1	<1	<1	<1	0.5
4,4'-DDT	ng/L		<1	<1	<1	<1	0.5
Total Detectable DDTs	ng/L		0	0	0	0	0
Aldrin	ng/L		<1	<1	<1	<1	0.5
BHC-alpha	ng/L		<1	<1	<1	<1	0.5
BHC-beta	ng/L		<1	<1	<1	<1	0.5
BHC-delta	ng/L		<1	<1	<1	<1	0.5
BHC-gamma	ng/L		<1	<1	<1	<1	0.5
Chlordane-alpha	ng/L		31.3	<1	<1	<1	0.5
Chlordane-gamma	ng/L		29.1	<1	<1	<1	0.5
Dieldrin	ng/L		<1	<1	<1	<1	0.5
Endosulfan Sulfate	ng/L		<1	<1	<1	<1	0.5
Endosulfan-I	ng/L		<1	<1	<1	<1	0.5
Endosulfan-II	ng/L		<1	<1	<1	<1	0.5
Endrin	ng/L		<1	<1	<1	<1	0.5
Endrin Aldehyde	ng/L		<1	<1	<1	<1	0.5
Endrin Ketone	ng/L		<1	<1	<1	<1	0.5
Heptachlor	ng/L		<1	<1	<1	<1	0.5
Heptachlor Epoxide	ng/L		<1	<1	<1	<1	0.5
Methoxychlor	ng/L		<1	<1	<1	<1	0.5
Mirex	ng/L		<1	<1	<1	<1	0.5
Oxychlordane	ng/L		<1	<1	<1	<1	0.5
Toxaphene	ng/L		<10	<10	<10	<10	5

Analyte	Units	WQO	Downtown Anchorage (DW239)				
			Wet Weather	Dry Weather			
			22-Mar-05	16-May-05	14-Jun-05	28-Jun-05	Dry Weather Average
cis-Nonachlor	ng/L					<1	0.5
trans-Nonachlor	ng/L		27	<1	<1	<1	0.5
Organophosphorus Pesticides							
Bolstar (Sulprofos)	ng/L		<10	<10	<10	<10	5
Chlorpyrifos	ng/L	500	<5	<5	<5	<5	2.5
Demeton	ng/L		<10	<10	<10	<10	5
Diazinon	ng/L	500	<5	<5	<5	<5	2.5
Dichlorvos	ng/L		<10	<10	<10	<10	5
Dimethoate	ng/L		<5	<5	<5	<5	2.5
Disulfoton	ng/L		<10	<10	<10	<10	5
Ethoprop (Ethoprofos)	ng/L		<10	<10	<10	<10	5
Fenchlorphos (Ronnel)	ng/L			<10	<10	<10	5
Fensulfothion	ng/L		<10	<10	<10	<10	5
Fenthion	ng/L		<10	<10	<10	<10	5
Malathion	ng/L		168	<5	<5	<5	2.5
Merphos	ng/L		<10	<10	<10	<10	5
Methyl Parathion	ng/L		<10	<10	<10	<10	5
Mevinphos (Phosdrin)	ng/L		<10	<10	<10	<10	5
Phorate	ng/L		<10	<10	<10	<10	5
Tetrachlorvinphos (Stirofos)	ng/L		<10	<10	<10	<10	5
Tokuthion	ng/L		<10	<10	<10	<10	5
Trichloronate	ng/L		<10	<10	<10	<10	5
Synthetic Pyrethroids							
Allethrin	ng/L		<5	<5	<5	<5	2.5
Bifenthrin	ng/L		<5	<5	<5	<5	2.5
Cyfluthrin	ng/L		<5	<5	<5	<5	2.5
Cypermethrin	ng/L		<5	<5	<5	<5	2.5
Danitol	ng/L		<5	<5	<5	<5	2.5
Deltamethrin	ng/L		<5	<5	<5	<5	2.5
L-Cyhalothrin	ng/L		<5	<5	<5	<5	2.5
Permethrin	ng/L		<5	<5	<5	<5	2.5
Prallethrin	ng/L		<5	<5	<5	<5	2.5

BOLD - Exceeds water quality objective
[1] EPA 200.8
[2] EPA 1640
(a) WQO for total and dissolved metal fractions are based on Total Hardness (as CaCO3) and are calculated as described by Title 40 of the Code of Federal Regulations (Part 131) (USEPA 2000).
NA - Not Assessed

4.1.5 Dry Weather Monitoring – Station DW239

On May 16, 2005, station DW239 was the only station with sufficient water volume and flow to permit sampling. The field crews documented a stream of water approximately 6 in wide and 2 in deep flowing at a rate of approximately 1.10 ft/s. A summary of the water quality visual observations is presented in Table 4-5. The means of the triplicate readings for pH, temperature, conductivity and turbidity values are presented.

Water quality did not exceed any established water quality objectives at Station DW239 during any dry weather sampling event (Table 4-4). Ammonia and nitrite were at or below their associated detection limits in all three samples and TKN was either slightly above its 0.5 mg/L detection limit with a value of 0.7 mg/L or not detected. Nitrate was the only nitrogen-based nutrient with measured concentrations significantly above its detection limit, however, nitrate levels were still below its WQO ranging from 5.79 to 7.59 mg/L. Oil and grease was estimated at 1 mg/L in the sample collected on May 16 but was not detected in subsequent samples. Orthophosphate ranged between 0.3 and 0.55 mg/L.

Table 4-5. Dry Weather Visual Observations at Downtown Anchorage, Station DW239.

Observation/Parameter	May 16, 2005	June 14, 2005	June 28, 2005
Odor	None	Oily	None
Color	Colorless	Colorless	Colorless
Floating Materials	Organic Material	Trash or Debris	Trash or Debris
Oil and Grease	None	None	None
Turbidity (visual)	None	None	None
pH	8.40	8.45	8.15
Temperature (°C)	20.3	19.1	21.2
Conductivity (µS/cm)	3220	3117	3413
Turbidity (NTU)	1.7	8.8	-[1]

[1] – Parameter not assessed

Indicator bacteria were below all WQO during each of the three dry weather sampling events. Total coliform ranged from 5,000 to 28,000 MPN/100 mL and fecal coliform ranged from 1,300 to 1,700 MPN/100 mL. Densities of enterococcus ranged from 86 to 608 MPN/100 mL.

Neither total nor dissolved metals exceeded their hardness dependent WQO at station DW239 during the dry weather events. Total and dissolved beryllium, silver and thallium and dissolved tin and lead were not detected in any sample. Total lead was measured at low concentrations, ranging from 0.41 to 2.95 µg/L. Total copper was measured between 3.15 and 10.8 µg/L; total zinc was measured between 6.1 and 14.8 µg/L and total cadmium ranged from 0.044 to 0.24 µg/L. Dissolved copper ranged from 3.14 to 6.73 µg/L and dissolved zinc had a minimum concentration of 4.06 µg/L and a maximum concentration of 12.7 µg/L. Dissolved cadmium was only detected in the first dry weather sample, with an estimated dissolved concentration of 0.13 µg/L. Total hardness as CaCO3 ranged from 386 to 477 mg/L at Station DW239.

Very few PAH compounds were detected above the reporting limit at station DW239. In the first two samples, naphthalene was the only compound detected above the reporting limit; six compounds were estimated at concentrations above the detection limit but below the reporting limit in the May 16 sample while only two compounds were estimated at concentrations above the detection limit but below the reporting limit on June 14. In the third sample collected on June 28, four PAH compounds, fluoranthene, naphthalene, phenanthrene and pyrene, were detected above the reporting limit.

Concentrations of all PCBs, chlorinated pesticides, organophosphorus pesticides and synthetic pyrethroids were either non-detect or below their respective water quality objectives during all dry weather sampling events.

4.1.6 Sediment Quality Monitoring – Station DW239

Sediments collected from within the storm drain at station DW239 were predominantly sand (97.41%) (Table 4-6). Silt comprised the remaining 2.59% of material. TOC content was 0.08%.

Mercury was the only metal that exceeded the PEL with a value of 5.49 µg/dry g. Silver was the only metal not detected in the sample. All remaining metals were detected at low concentrations. None of the organophosphorus pesticides or synthetic pyrethroids was detected in the sediment sample collected at DW239.

Table 4-6. Sediment Quality Analytical Results, Downtown Anchorage Station DW239.

Analyte	Units	TEL	PEL	Downtown Anchorage (DW239)
				14-Jun-05
Grain Size				
Gravel	%			0.00
Sand	%			97.41
Silt	%			2.59
Clay	%			0.00
TOC	%			0.08
Trace Metals				
Aluminum (Al)	µg/dry g			9740
Antimony (Sb)	µg/dry g			0.04E
Arsenic (As)	µg/dry g	5.9	17	2.32
Barium (Ba)	µg/dry g			38.3
Beryllium (Be)	µg/dry g			0.18
Cadmium (Cd)	µg/dry g	0.596	3.53	0.04E
Chromium (Cr)	µg/dry g	37.3	90	13.7
Cobalt (Co)	µg/dry g			1.97
Copper (Cu)	µg/dry g	35.7	197	7.15
Iron (Fe)	µg/dry g			12000
Lead (Pb)	µg/dry g	35	91.3	12.4
Manganese (Mn)	µg/dry g			172
Mercury (Hg)	µg/dry g	0.174	0.486	**5.49**
Molybdenum (Mo)	µg/dry g			0.45
Nickel (Ni)	µg/dry g	18	35.9	4.34
Selenium (Se)	µg/dry g			0.25
Silver (Ag)	µg/dry g			<0.025
Strontium (Sr)	µg/dry g			17.8
Thallium (Tl)	µg/dry g			0.06
Tin (Sn)	µg/dry g			3.04
Titanium (Ti)	µg/dry g			809
Vanadium (V)	µg/dry g			35.7
Zinc (Zn)	µg/dry g	123.1	315	37
Organophosphorus Pesticides				
Bolstar (Sulprofos)	ng/dry g			<10
Chlorpyrifos	ng/dry g			<5
Demeton	ng/dry g			<10
Diazinon	ng/dry g			<5
Dichlorvos	ng/dry g			<10

Analyte	Units	TEL	PEL	Downtown Anchorage (DW239)
				14-Jun-05
Dimethoate	ng/dry g			<5
Disulfoton	ng/dry g			<10
Ethoprop (Ethoprofos)	ng/dry g			<10
Fenchlorphos (Ronnel)	ng/dry g			<10
Fensulfothion	ng/dry g			<10
Fenthion	ng/dry g			<10
Malathion	ng/dry g			<5
Merphos	ng/dry g			<10
Methyl Parathion	ng/dry g			<10
Mevinphos (Phosdrin)	ng/dry g			<10
Phorate	ng/dry g			<10
Tetrachlorvinphos (Stirofos)	ng/dry g			<10
Tokuthion	ng/dry g			<10
Trichloronate	ng/dry g			<10
Synthetic Pyrethroids				
Allethrin	ng/dry g			<5
Bifenthrin	ng/dry g			<5
Cyfluthrin	ng/dry g			<5
Cypermethrin	ng/dry g			<5
Danitol	ng/dry g			<5
Deltamethrin	ng/dry g			<5
L-Cyhalothrin	ng/dry g			<5
Permethrin	ng/dry g			<5
Prallethrin	ng/dry g			<5

BOLD - Exceeds PEL

4.2 B Street/Broadway Piers (Station DW237)

4.2.1 Wet Weather Monitoring

The rain had ceased by the time sampling at station DW237 was conducted. The water quality sample collected at DW237 was yellowish in color and cloudy, with a musty odor. There was no sheen apparent but organic material was observed in the water. Triplicate readings were taken of pH, temperature, conductivity and turbidity. The mean results of each parameter were 6.84 units, 16.5 °C, 79.4 µS/cm and 192 NTU, respectively (Table 4-7).

Only one general chemistry parameter exceeded water quality objectives during the wet weather sampling event at Station DW237. TSS exceeded objectives with a value of 337 mg/L. Concentrations of all other general chemistry parameters were below their respective WQO.

Total and fecal coliform densities exceeded water quality objectives with values of 110,000 MPN/100mL and 70,000 MPN/100mL, respectively. Enterococcus densities were below the water quality objective.

Four total metals exceeded WQO during the wet weather sampling event. Cadmium, copper, lead and zinc concentrations exceeded objectives with measurements of 0.43 µg/L, 24.7 µg/L, 38.1 µg/L and 220 µg/L, respectively. Only copper and zinc concentrations exceeded objectives in the dissolved state, with values of 5.53 µg/L and 22 µg/L. Total and dissolved mercury, silver, thallium and tin and dissolved antimony, beryllium, cadmium, and cobalt were not detected in the storm water sample. All other metals were detected at low concentrations or were below water quality objectives. Total hardness as $CaCO_3$ was measured at 12 mg/L.

All but two PAH compounds were detected at low levels in the storm water sample; the compounds, 2,3,5-Trimethylnaphthalene and dibenzothiophene were not detected. Total detectable PAHs were measured at 2,321.2 ng/L. Chlordane-alpha, chlordane-gamma, trans-nonachlor, a primary ingredient in chlordane, and 4,4'-DDE were the only chlorinated pesticides detected in the wet weather sample at station DW237. Concentrations were 23.3 ng/L, 38.8 ng/L, 19.8 ng/L, and 18.5 ng/L, respectively. All PCBs, organophosphorus pesticides and synthetic pyrethroids were not detected.

Table 4-7. Wet Weather and Dry Weather Water Quality Analytical Results, B Street/Broadway Piers Station DW237.

Analyte	Units	WQO	B Street/Broadway Piers (DW237)				
			Wet Weather	Dry Weather			
			22-Mar-05	14-Jun-05	28-Jun-05	12-Jul-05	Dry Weather Average
Physical							
pH	units	6.5 - 9.0	6.84	8.33	7.79	8.38	8.17
Specific Conductance	µS/cm	BPJ	79.4	859	2,110	2,676	1,882
Temperature	°C	BPJ	16.5	21.5	22.7	25.2	23.1
Turbidity	NTU	BPJ	192	7.37	NA	7	7.19
General Chemistry							
Ammonia-N	mg/L	1.0	0.15	0.13	0.13	0.07	0.11
MBAS	mg/L	1.0	0.117	0.076	0.04	0.045	0.054
Nitrate-N	mg/L	10	0.57	1.92	2.8	1.61	2.11
Nitrite-N	mg/L	1.0	0.04E	0.41	0.16	0.14	0.24
Oil & Grease	mg/L	15	2.63E	<1	<1	1	0.67
Orthophosphate as P	mg/L	2.0	0.96	0.27	0.618	0.1	0.329
Total Hardness as CaCO3	mg/L		12	305	558	837	567
Total Suspended Solids	mg/L	100.0	**337**	10.6	33	2.3	15.3
Total Kjeldahl Nitrogen	mg/L		1.8	<0.50	2.2	0.7	1.05
Carbon, Total Organic	mg/L		7.3	16	17	16	16.33
Bacterial							
Total Coliform	MPN/100 mL	50,000	**110,000**	**500,000**	**50,000**	13,000	187,667
Fecal Coliform	MPN/100 mL	20,000	**70,000**	**500,000**	8,000	700	169,567
Enterococcus	MPN/100 mL	10,000	6,266	4,611	8,088	206	4,302
Total Metals							
Aluminum (Al)	µg/L		2310	142	84.4	31.4	86
Antimony (Sb)	µg/L		0.85	0.46E	2.31	0.77	1.18
Arsenic (As)	µg/L		1.38	3.87	1.86	2.21	2.65
Barium (Ba)	µg/L		70.2	74.3	135	191	133.4
Beryllium (Be)	µg/L		0.11E	<0.1	<0.1	<0.1	0.05
Cadmium (Cd)	µg/L	a	**0.43**[1]	0.08[2]	0.4[1]	0.14E[1]	0.21
Chromium (Cr)	µg/L	a	8.85	1.88	2.77	1.34	2.00
Cobalt (Co)	µg/L		2.31	<0.1	0.99	<0.1	0.36
Copper (Cu)	µg/L	a	**24.7**	**126**	36.9	40.4	67.8
Iron (Fe)	µg/L		3310	926	471	501	633
Lead (Pb)	µg/L	a	**38.1**	10	2	1.09	4.36
Manganese (Mn)	µg/L		97.6	46.5	34.1	20.8	33.8
Mercury (Hg)	µg/L		<0.05	0.021	0.031	0.026	0.026
Molybdenum (Mo)	µg/L		0.49E	2.82	184	200	128.94
Nickel (Ni)	µg/L	a	3.84	4.35	4.27	3.43	4.02
Selenium (Se)	µg/L		0.18E	6.65	6.14	4.8	5.86
Silver (Ag)	µg/L	a	<0.1	<0.1	1.41	<0.1	0.50
Strontium (Sr)	µg/L		82.9	1190	2010	2550	1917
Thallium (Tl)	µg/L		<0.1	<0.1	<0.1	<0.1	0.05
Tin (Sn)	µg/L		<0.1	0.31E	0.13E	0.17E	0.20
Titanium (Ti)	µg/L		99.4	9.09	3.92	2.01	5.01
Vanadium (V)	µg/L		11.4	8.56	163	3.76	58.44
Zinc (Zn)	µg/L	a	**220**	83.7	87.4	40.8	70.6
Dissolved Metals							
Dissolved Aluminum (Al)	µg/L		47.9	16.7	3.15E	13.2	11.02
Dissolved Antimony (Sb)	µg/L		<0.1	0.2E	1.7	0.7	0.87
Dissolved Arsenic (As)	µg/L		0.92	3.73	2.61	2.41	2.92
Dissolved Barium (Ba)	µg/L		8.63	69.3	129	191	129.8
Dissolved Beryllium (Be)	µg/L		<0.1	<0.1	<0.1	<0.1	0.05
Dissolved Cadmium (Cd)	µg/L	a	<0.1	<0.1	0.25	0.13E	0.14
Dissolved Chromium (Cr)	µg/L	a	1.08	1.33	1.49	1.34	1.39
Dissolved Cobalt (Co)	µg/L		<0.1	<0.1	0.27E	<0.1	0.12
Dissolved Copper (Cu)	µg/L	a	**5.53**	28.1	26.5	35.7	30.10
Dissolved Iron (Fe)	µg/L		63.5	311	151	386	283
Dissolved Lead (Pb)	µg/L	a	1.56	0.26	0.15	0.1E	0.17

Analyte	Units	WQO	B Street/Broadway Piers (DW237)				
			Wet Weather	Dry Weather			
			22-Mar-05	14-Jun-05	28-Jun-05	12-Jul-05	Dry Weather Average
Dissolved Manganese (Mn)	µg/L		4.37	10.2	0.37E	14.3	8.29
Dissolved Mercury (Hg)	µg/L		<0.05	0.007	0.012	0.007	0.009
Dissolved Molybdenum (Mo)	µg/L		0.61	4.01	158	194	118.67
Dissolved Nickel (Ni)	µg/L	a	0.66	3.48	3.26	3.65	3.46
Dissolved Selenium (Se)	µg/L		0.33E	6.66	8.41	5.41	6.83
Dissolved Silver (Ag)	µg/L	a	<0.1	<0.1	<0.1	<0.1	0.05
Dissolved Strontium (Sr)	µg/L		45.8	1,170	1,860	2,580	1,870
Dissolved Thallium (Tl)	µg/L		<0.1	<0.1	<0.1	<0.1	0.05
Dissolved Tin (Sn)	µg/L		<0.1	<0.1	<0.1	0.13E	0.08
Dissolved Titanium (Ti)	µg/L		1.44	0.89	0.93	1.12	0.98
Dissolved Vanadium (V)	µg/L		2.05	6.9	145	3.79	51.90
Dissolved Zinc (Zn)	µg/L	a	**22**	19.1	56.7	32.7	36.2
Polynuclear Aromatic Hydrocarbons (PAHs)							
1-Methylnaphthalene	ng/L		12.3	4.7E	<1	3E	2.7
1-Methylphenanthrene	ng/L		38.7	16.3	47.2	<1	21.3
2,3,5-Trimethylnaphthalene	ng/L		<1	<1	<1	<1	0.5
2,6-Dimethylnaphthalene	ng/L		10.7	<1	<1	<1	0.5
2-Methylnaphthalene	ng/L		21.9	8.1	9.4	9.5	9
Acenaphthene	ng/L		9.9	20.9	<1	8.1	9.8
Acenaphthylene	ng/L		8.8	<1	<1	<1	0.5
Anthracene	ng/L		19.5	27.8	<1	<1	9.6
Benz[a]anthracene	ng/L		93.6	87.4	13.4	<1	33.8
Benzo[a]pyrene	ng/L		113	84.7	19.5	<1	34.9
Benzo[b]fluoranthene	ng/L		149	91.9	15.9	<1	36.1
Benzo[e]pyrene	ng/L		162	70.7	33.8	<1	35
Benzo[g,h,i]perylene	ng/L		251	95.6	28.7	<1	42
Benzo[k]fluoranthene	ng/L		118	99	<1	<1	33.3
Biphenyl	ng/L		13.2	<1	<1	<1	0.5
Chrysene	ng/L		204	139	53	<1	64
Dibenz[a,h]anthracene	ng/L		17	<1	<1	<1	0.5
Dibenzothiophene	ng/L		<1	<1	<1	<1	0.5
Fluoranthene	ng/L		345	217	37.2	9.1	87.8
Fluorene	ng/L		13	18.4	9.8	<1	9.6
Indeno[1,2,3-c,d]pyrene	ng/L		122	86.3	<1	<1	29.1
Naphthalene	ng/L		38.6	15.3	7.6	12.5	11.8
Perylene	ng/L		46	22.1	25.5	<1	16.0
Phenanthrene	ng/L		181	121	54.3	15	63.4
Pyrene	ng/L		333	211	58.3	8	92.4
Total Detectable PAHs	ng/L		2321.2	1,437.20	413.6	65.2	638.7
PCBs							
Aroclor 1016	ng/L		<10	<10	<10	<10	5
Aroclor 1221	ng/L		<10	<10	<10	<10	5
Aroclor 1232	ng/L		<10	<10	<10	<10	5
Aroclor 1242	ng/L		<10	<10	<10	<10	5
Aroclor 1248	ng/L		<10	<10	<10	<10	5
Aroclor 1254	ng/L		<10	<10	<10	<10	5
Aroclor 1260	ng/L		<10	<10	<10	<10	5
Total Detectable PCBs	ng/L		0	0	0	0	0
Chlorinated Pesticides							
2,4'-DDD	ng/L		<1	<1	<1	<1	0.5
2,4'-DDE	ng/L		<1	<1	<1	<1	0.5
2,4'-DDT	ng/L		<1	<1	<1	<1	0.5
4,4'-DDD	ng/L		<1	<1	<1	<1	0.5
4,4'-DDE	ng/L		18.5	<1	<1	<1	0.5
4,4'-DDT	ng/L		<1	<1	<1	<1	0.5
Total Detectable DDTs	ng/L		18.5	0	0	0	0
Aldrin	ng/L		<1	<1	<1	<1	0.5
BHC-alpha	ng/L		<1	<1	<1	<1	0.5
BHC-beta	ng/L		<1	<1	<1	<1	0.5
BHC-delta	ng/L		<1	<1	<1	<1	0.5

Analyte	Units	WQO	B Street/Broadway Piers (DW237)				
			Wet Weather	Dry Weather			
			22-Mar-05	14-Jun-05	28-Jun-05	12-Jul-05	Dry Weather Average
BHC-gamma	ng/L		<1	<1	<1	<1	0.5
Chlordane-alpha	ng/L		23.3	<1	<1	<1	0.5
Chlordane-gamma	ng/L		38.8	<1	<1	<1	0.5
Dieldrin	ng/L		<1	<1	<1	<1	0.5
Endosulfan Sulfate	ng/L		<1	<1	<1	<1	0.5
Endosulfan-I	ng/L		<1	<1	<1	<1	0.5
Endosulfan-II	ng/L		<1	<1	<1	<1	0.5
Endrin	ng/L		<1	<1	<1	<1	0.5
Endrin Aldehyde	ng/L		<1	<1	<1	<1	0.5
Endrin Ketone	ng/L		<1	<1	<1	<1	0.5
Heptachlor	ng/L		<1	<1	<1	<1	0.5
Heptachlor Epoxide	ng/L		<1	<1	<1	<1	0.5
Methoxychlor	ng/L		<1	<1	<1	<1	0.5
Mirex	ng/L		<1	<1	<1	<1	0.5
Oxychlordane	ng/L		<1	<1	<1	<1	0.5
Toxaphene	ng/L		<10	<10	<10	<10	5
cis-Nonachlor	ng/L				<1	<1	0.5
trans-Nonachlor	ng/L		19.8	<1	<1	<1	0.5
Organophosphorus Pesticides							
Bolstar (Sulprofos)	ng/L		<10	<10	<10	<10	5
Chlorpyrifos	ng/L	500	<5	<5	<5	<5	2.5
Demeton	ng/L		<10	<10	<10	<10	5
Diazinon	ng/L	500	<5	<5	<5	<5	2.5
Dichlorvos	ng/L		<10	<10	<10	<10	5
Dimethoate	ng/L		<5	<5	<5	<5	2.5
Disulfoton	ng/L		<10	<10	<10	<10	5
Ethoprop (Ethoprofos)	ng/L		<10	<10	<10	<10	5
Fenchlorphos (Ronnel)	ng/L			<10	<10	<10	5
Fensulfothion	ng/L		<10	<10	<10	<10	5
Fenthion	ng/L		<10	<10	<10	<10	5
Malathion	ng/L		<5	<5	<5	<5	2.5
Merphos	ng/L		<10	<10	<10	<10	5
Methyl Parathion	ng/L		<10	<10	<10	<10	5
Mevinphos (Phosdrin)	ng/L		<10	<10	<10	<10	5
Phorate	ng/L		<10	<10	<10	<10	5
Tetrachlorvinphos (Stirofos)	ng/L		<10	<10	<10	<10	5
Tokuthion	ng/L		<10	<10	<10	<10	5
Trichloronate	ng/L		<10	<10	<10	<10	5
Synthetic Pyrethroids							
Allethrin	ng/L		<5	<5	<5	<5	2.5
Bifenthrin	ng/L		<5	<5	<5	<5	2.5
Cyfluthrin	ng/L		<5	<5	<5	<5	2.5
Cypermethrin	ng/L		<5	<5	<5	<5	2.5
Danitol	ng/L		<5	<5	<5	<5	2.5
Deltamethrin	ng/L		<5	<5	<5	<5	2.5
L-Cyhalothrin	ng/L		<5	<5	<5	<5	2.5
Permethrin	ng/L		<5	<5	<5	<5	2.5
Prallethrin	ng/L		<5	<5	<5	<5	2.5

BOLD - Exceeds water quality objective
[1] EPA 200.8
[2] EPA 1640
(a) WQO for total and dissolved metal fractions are based on Total Hardness (as $CaCO_3$) and are calculated as described by Title 40 of the Code of Federal Regulations (Part 131) (USEPA 2000).
NA - Not Assessed

4.2.2 Dry Weather Monitoring

On May 16, 2005, station DW237 was not sampled due to insufficient water volumes. The field crews documented no flow or ponded water at this site. Three dry weather samples were collected on subsequent visits to the site. On June 14, the field crews documented the water flow tended to increase and decrease at random intervals. A summary of the water quality visual observations is presented in Table 4-8. The means of the triplicate readings for pH, temperature, conductivity and turbidity values are presented.

Table 4-8. Dry Weather Visual Observations at B Street/Broadway Piers, Station DW237.

Observation/Parameter	June 14, 2005	June 28, 2005	July 12, 2005
Odor	Musty	None	Musty
Color	Colorless	Colorless	Yellow
Floating Materials	None	Organic Material	Organic Material
Oil and Grease	None	None	None
Turbidity (visual)	None	None	None
pH	8.33	7.79	8.38
Temperature (°C)	21.5	22.7	25.2
Conductivity (µS/cm)	859	2110	2676
Turbidity (NTU)	7.37[1]	-[2]	7.0

[1] – Single measurement; triplicate readings not conducted
[2] – Parameter not assessed

There were only three water quality objective exceedances observed at Station DW237 during dry weather events (Table 4-7). None of the general chemistry constituents exceeded WQOs at station DW237. All general chemistry constituents, though, were measured at low concentrations, with the exception of oil and grease which was not detected in two samples and TKN which was not detected in one sample.

Total and fecal coliform densities exceeded water quality objectives during the first sampling event with a value of 500,000 MPN/100mL for both indicators. During the second dry weather sampling event, total coliform densities were equal to the WQO (50,000 MPN/100 mL). Enterococcus densities were below the WQO during all three dry weather events.

Total copper was the only metal with concentrations measured above the hardness dependent WQO with a value of 126 µg/L. Total and dissolved beryllium and thallium and dissolved silver were not detected in any of the three dry weather samples at station DW237. All other metals were detected at low concentrations in at least one of the three dry weather samples. Total hardness as $CaCO_3$ ranged from 305 to 837 mg/L during dry weather sampling events conducted at this station.

Total PAHs ranged from 1437.2 ng/L in the sample collected on June 14 to 65.2 ng/L in the sample collected on July 12. A greater number of PAH compounds (19 out of 25) were detected in the June 14 sample, whereas only seven compounds were detected in the July 12 sample.

Concentrations of all PCBs, chlorinated pesticides, organophosphorus pesticides and synthetic pyrethroids were either non-detect or below their respective water quality objectives during all dry weather sampling events.

4.2.3 Sediment Quality Monitoring

Sediments collected from within the storm drain at station DW237 were predominantly silty sand (11.87% silt and 85.16% sand content) (Table 4-9). Silt comprised the remaining 2.98% of material. TOC content was 0.37%.

Mercury was the only metal that exceeded the PEL with a value of 32.3 µg/dry g, which was more than 60 times the PEL of 0.486 µg/dry g. Two metals, copper and zinc, exceeded their respective TEL values. Copper exceeded the TEL of 35.7 µg/dry g with a concentration of 55.3 µg/dry g and zinc's concentration of 166 µg/dry g exceeded its TEL of 123.1 µg/dry g. Silver was the only metal not detected in the sample. All remaining metals were detected at low concentrations. None of the organophosphorus pesticides or synthetic pyrethroids was detected in the sediment sample collected at DW237.

Table 4-9. Sediment Quality Analytical Results, B Street Broadway Piers Station DW237.

Analyte	Units	TEL	PEL	B Street/Broadway Piers (DW237)
				14-Jun-05
Grain Size				
Gravel	%			0.00
Sand	%			85.16
Silt	%			11.87
Clay	%			2.98
TOC	%			0.37
Trace Metals				
Aluminum (Al)	µg/dry g			10800
Antimony (Sb)	µg/dry g			0.73
Arsenic (As)	µg/dry g	5.9	17	2.71
Barium (Ba)	µg/dry g			65.2
Beryllium (Be)	µg/dry g			0.2
Cadmium (Cd)	µg/dry g	0.596	3.53	0.24
Chromium (Cr)	µg/dry g	37.3	90	19.1
Cobalt (Co)	µg/dry g			3.2
Copper (Cu)	µg/dry g	35.7	197	*55.3*
Iron (Fe)	µg/dry g			15200
Lead (Pb)	µg/dry g	35	91.3	20.3
Manganese (Mn)	µg/dry g			190
Mercury (Hg)	µg/dry g	0.174	0.486	**32.3**
Molybdenum (Mo)	µg/dry g			1.19
Nickel (Ni)	µg/dry g	18	35.9	7.31
Selenium (Se)	µg/dry g			0.29
Silver (Ag)	µg/dry g			<0.025
Strontium (Sr)	µg/dry g			34.7
Thallium (Tl)	µg/dry g			0.07
Tin (Sn)	µg/dry g			3.75
Titanium (Ti)	µg/dry g			690
Vanadium (V)	µg/dry g			31.9
Zinc (Zn)	µg/dry g	123.1	315	*166*

Analyte	Units	TEL	PEL	B Street/Broadway Piers (DW237)
				14-Jun-05
Organophosphorus Pesticides				
Bolstar (Sulprofos)	ng/dry g			<10
Chlorpyrifos	ng/dry g			<5
Demeton	ng/dry g			<10
Diazinon	ng/dry g			<5
Dichlorvos	ng/dry g			<10
Dimethoate	ng/dry g			<5
Disulfoton	ng/dry g			<10
Ethoprop (Ethoprofos)	ng/dry g			<10
Fenchlorphos (Ronnel)	ng/dry g			<10
Fensulfothion	ng/dry g			<10
Fenthion	ng/dry g			<10
Malathion	ng/dry g			<5
Merphos	ng/dry g			<10
Methyl Parathion	ng/dry g			<10
Mevinphos (Phosdrin)	ng/dry g			<10
Phorate	ng/dry g			<10
Tetrachlorvinphos (Stirofos)	ng/dry g			<10
Tokuthion	ng/dry g			<10
Trichloronate	ng/dry g			<10
Synthetic Pyrethroids				
Allethrin	ng/dry g			<5
Bifenthrin	ng/dry g			<5
Cyfluthrin	ng/dry g			<5
Cypermethrin	ng/dry g			<5
Danitol	ng/dry g			<5
Deltamethrin	ng/dry g			<5
L-Cyhalothrin	ng/dry g			<5
Permethrin	ng/dry g			<5
Prallethrin	ng/dry g			<5

Italic - Exceeds TEL
BOLD - Exceeds PEL

4.3 Switzer Creek (Station CGSC1)

4.3.1 Wet Weather Monitoring

It was not raining when sampling at station CGSC1 was conducted. The water quality sample collected at CGSC1 was colorless and clear, with no apparent odor. There was no sheen apparent and no other floatables were observed. Triplicate readings were taken of pH, temperature, conductivity and turbidity. The mean results of each parameter were 6.81 units, 17.4 °C, 108.1 µS/cm and 11 NTU, respectively (Table 4-10).

Concentrations of all general chemistry constituents were below their respective water quality objectives at Station CGSC1 during the wet weather sampling event. Oil and grease was not detected. The measured TSS concentration, 10 mg/L, was consistent with visual observations indicating the water was very clear.

Table 4-10. Wet Weather and Dry Weather Water Quality Analytical Results, Switzer Creek Station CGSC1.

Analyte	Units	WQO	Switzer Creek (CGSC1)				
			Wet Weather	Dry Weather			
			22-Mar-05	14-Jun-05	28-Jun-05	12-Jul-05	Dry Weather Average
Physical							
pH	units	6.5 - 9.0	6.81	8.27	7.21	8.05	7.84
Specific Conductance	µS/cm	BPJ	108.1	936	1,060	1,510	1,169
Temperature	°C	BPJ	17.4	20.1	23.6	22.6	22.1
Turbidity	NTU	BPJ	11	2.04	NA	12	7.02
General Chemistry							
Ammonia-N	mg/L	1.0	0.14	0.14	0.21	0.04E	0.13
MBAS	mg/L	1.0	0.268	0.061	**1.5**	0.125	0.562
Nitrate-N	mg/L	10	0.42	2.05	0.87	2.06	1.66
Nitrite-N	mg/L	1.0	0.05E	0.06	0.13	<0.02	0.07
Oil & Grease	mg/L	15	<1	<1	6.20	2	2.90
Orthophosphate as P	mg/L	2.0	0.79	0.72	0.745	0.47	0.645
Total Hardness as CaCO3	mg/L		16	174	235	319	243
Total Suspended Solids	mg/L	100.0	10	6.8	**281**	35	107.6
Total Kjeldahl Nitrogen	mg/L		0.56	<0.50	3.9	1.3	1.82
Carbon, Total Organic	mg/L		8.8	15	18	18	17
Bacterial							
Total Coliform	MPN/100 mL	50,000	30,000	**80,000**	**80,000**	**50,000**	70,000
Fecal Coliform	MPN/100 mL	20,000	11,000	8,000	17,000	5,000	10,000
Enterococcus	MPN/100 mL	10,000	5,794	3,654	5,493	583	3,243
Total Metals							
Aluminum (Al)	µg/L		345	294	8,680	303	3,092
Antimony (Sb)	µg/L		0.94	<0.1	0.76	0.91	0.57
Arsenic (As)	µg/L		1.26	2.64	3.46	2.33	2.81
Barium (Ba)	µg/L		15.9	88.9	313	151	184.3
Beryllium (Be)	µg/L		<0.1	<0.1	0.35E	<0.1	0.15
Cadmium (Cd)	µg/L	a	0.13E[1]	0.087[2]	2.18[1]	0.18E[1]	0.82
Chromium (Cr)	µg/L	a	3.25	1.13	14.9	0.95	5.66
Cobalt (Co)	µg/L		0.28E	<0.1	7.78	<0.1	2.63
Copper (Cu)	µg/L	a	**11.6**	**61.2**	**366**	38.2	155.1
Iron (Fe)	µg/L		213	817	12,000	551	4,456
Lead (Pb)	µg/L	a	6.83	8.09	238	17.2	87.76
Manganese (Mn)	µg/L		17.4	26.5	516	40.1	194.2
Mercury (Hg)	µg/L		<0.05	0.010	0.197	0.012	0.073
Molybdenum (Mo)	µg/L		1.01	2.3	2.07	5.82	3.40
Nickel (Ni)	µg/L	a	1.61	4.76	19.8	4.12	9.56
Selenium (Se)	µg/L		<0.1	2.18	<0.1	1.78	1.34
Silver (Ag)	µg/L	a	<0.1	<0.1	<0.1	<0.1	0.05
Strontium (Sr)	µg/L		64.6	813	833	1,030	892
Thallium (Tl)	µg/L		<0.1	<0.1	0.21E	<0.1	0.10
Tin (Sn)	µg/L		<0.1	<0.1	1.82	0.24E	0.70
Titanium (Ti)	µg/L		8	6.59	278	8.42	97.67
Vanadium (V)	µg/L		2.5	4.36	26.8	4.09	11.75
Zinc (Zn)	µg/L	a	**89.1**	63.7	**1,010**	67.4	380.4
Dissolved Metals							
Dissolved Aluminum (Al)	µg/L		32.4	14.4	4.05E	6.69	8.38
Dissolved Antimony (Sb)	µg/L		0.69	<0.1	0.55	0.71	0.44
Dissolved Arsenic (As)	µg/L		1.21	2.15	1.27	2.39	1.94
Dissolved Barium (Ba)	µg/L		11.4	85.3	149	141	125.1
Dissolved Beryllium (Be)	µg/L		<0.1	<0.1	<0.1	<0.1	0.05
Dissolved Cadmium (Cd)	µg/L	a	<0.1	<0.1	<0.1	0.1E	0.07

Analyte	Units	WQO	Switzer Creek (CGSC1)				
			Wet Weather	Dry Weather			
			22-Mar-05	14-Jun-05	28-Jun-05	12-Jul-05	Dry Weather Average
Dissolved Chromium (Cr)	µg/L	a	1.09	0.56	1.01	0.57	0.71
Dissolved Cobalt (Co)	µg/L		0.43E	<0.1	1.38	<0.1	0.49
Dissolved Copper (Cu)	µg/L	a	**9.14**	**47.6**	3.55	24.7	25.28
Dissolved Iron (Fe)	µg/L		54.8	224	981	84.7	429.9
Dissolved Lead (Pb)	µg/L	a	1.04	0.62	0.95	0.63	0.73
Dissolved Manganese (Mn)	µg/L		2.19	1.79	797	0.85	266.55
Dissolved Mercury (Hg)	µg/L		<0.05	0.005	0.004	0.008	0.006
Dissolved Molybdenum (Mo)	µg/L		2.02	2.7	3.33	7.97	4.67
Dissolved Nickel (Ni)	µg/L	a	1.24	3.86	5.96	3.61	4.48
Dissolved Selenium (Se)	µg/L		<0.1	1.89	<0.1	2.18	1.37
Dissolved Silver (Ag)	µg/L	a	<0.1	<0.1	<0.1	<0.1	0.05
Dissolved Strontium (Sr)	µg/L		61.5	802	727	1010	846
Dissolved Thallium (Tl)	µg/L		<0.1	<0.1	<0.1	<0.1	0.05
Dissolved Tin (Sn)	µg/L		<0.1	<0.1	<0.1	<0.1	0.05
Dissolved Titanium (Ti)	µg/L		1.61	1.15	3.62	0.95	1.91
Dissolved Vanadium (V)	µg/L		2.01	3.7	1.89	3.38	2.99
Dissolved Zinc (Zn)	µg/L	a	**66.3**	33.6	3.1	25	20.6
Polynuclear Aromatic Hydrocarbons (PAHs)							
1-Methylnaphthalene	ng/L		9.5	3.5E	6.7	7.1	5.8
1-Methylphenanthrene	ng/L		11.2	19.5	16.2	<1	12.1
2,3,5-Trimethylnaphthalene	ng/L		<1	<1	<1	<1	0.5
2,6-Dimethylnaphthalene	ng/L		9.8	<1	<1	<1	0.5
2-Methylnaphthalene	ng/L		21.5	6.3	12.2	13.6	10.7
Acenaphthene	ng/L		6.1	19.6	13.5	20.9	18
Acenaphthylene	ng/L		<1	<1	7.9	<1	3.0
Anthracene	ng/L		<1	<1	16.1	<1	5.7
Benz[a]anthracene	ng/L		9.7	<1	55.7	<1	18.9
Benzo[a]pyrene	ng/L		<1	<1	64.1	<1	21.7
Benzo[b]fluoranthene	ng/L		<1	<1	84.5	<1	28.5
Benzo[e]pyrene	ng/L		20.3	<1	102	<1	34
Benzo[g,h,i]perylene	ng/L		29.6	<1	148	<1	50
Benzo[k]fluoranthene	ng/L		<1	<1	66.3	<1	22.4
Biphenyl	ng/L		7.5	<1	10.7	<1	3.9
Chrysene	ng/L		34.5	<1	140	<1	47
Dibenz[a,h]anthracene	ng/L		<1	<1	<1	<1	0.5
Dibenzothiophene	ng/L		<1	<1	<1	<1	0.5
Fluoranthene	ng/L		68.6	10.3	200	26.6	79.0
Fluorene	ng/L		5.7	20.2	9.8	10.4	13.5
Indeno[1,2,3-c,d]pyrene	ng/L		9.7	<1	68	<1	23
Naphthalene	ng/L		21.7	11.1	26.6	18.3	18.7
Perylene	ng/L		<1	<1	65.6	<1	22.2
Phenanthrene	ng/L		53.9	32.7	85.1	24.7	47.5
Pyrene	ng/L		63.2	35.3	259	33.9	109.4
Total Detectable PAHs	ng/L		382.5	158.5	1458	155.5	590.7
PCBs							
Aroclor 1016	ng/L		<10	<10	<10	<10	5
Aroclor 1221	ng/L		<10	<10	<10	<10	5
Aroclor 1232	ng/L		<10	<10	<10	<10	5
Aroclor 1242	ng/L		<10	<10	<10	<10	5
Aroclor 1248	ng/L		<10	<10	<10	<10	5
Aroclor 1254	ng/L		<10	<10	<10	<10	5
Aroclor 1260	ng/L		<10	<10	<10	<10	5
Total Detectable PCBs	ng/L		0	0	0	0	0

Analyte	Units	WQO	Switzer Creek (CGSC1)				
			Wet Weather	Dry Weather			
			22-Mar-05	14-Jun-05	28-Jun-05	12-Jul-05	Dry Weather Average
Chlorinated Pesticides							
2,4'-DDD	ng/L		<1	<1	<1	<1	0.5
2,4'-DDE	ng/L		<1	<1	<1	<1	0.5
2,4'-DDT	ng/L		<1	<1	<1	<1	0.5
4,4'-DDD	ng/L		<1	<1	<1	<1	0.5
4,4'-DDE	ng/L		<1	<1	<1	<1	0.5
4,4'-DDT	ng/L		<1	<1	<1	<1	0.5
Total Detectable DDTs	ng/L		0	0	0	0	0
Aldrin	ng/L		<1	<1	<1	<1	0.5
BHC-alpha	ng/L		<1	<1	<1	<1	0.5
BHC-beta	ng/L		<1	<1	<1	<1	0.5
BHC-delta	ng/L		<1	<1	<1	<1	0.5
BHC-gamma	ng/L		<1	<1	<1	<1	0.5
Chlordane-alpha	ng/L		<1	<1	<1	<1	0.5
Chlordane-gamma	ng/L		<1	<1	<1	<1	0.5
Dieldrin	ng/L		<1	<1	<1	<1	0.5
Endosulfan Sulfate	ng/L		<1	<1	<1	<1	0.5
Endosulfan-I	ng/L		<1	<1	<1	<1	0.5
Endosulfan-II	ng/L		<1	<1	<1	<1	0.5
Endrin	ng/L		<1	<1	<1	<1	0.5
Endrin Aldehyde	ng/L		<1	<1	<1	<1	0.5
Endrin Ketone	ng/L		<1	<1	<1	<1	0.5
Heptachlor	ng/L		<1	<1	<1	<1	0.5
Heptachlor Epoxide	ng/L		<1	<1	<1	<1	0.5
Methoxychlor	ng/L		<1	<1	<1	<1	0.5
Mirex	ng/L		<1	<1	<1	<1	0.5
Oxychlordane	ng/L		<1	<1	<1	<1	0.5
Toxaphene	ng/L		<10	<10	<10	<10	5
cis-Nonachlor	ng/L				<1	<1	0.5
trans-Nonachlor	ng/L		<1	<1	<1	<1	0.5
Organophosphorus Pesticides							
Bolstar (Sulprofos)	ng/L		<10	<10	<10	<10	5
Chlorpyrifos	ng/L	500	<5	<5	<5	<5	2.5
Demeton	ng/L		<10	<10	<10	<10	5
Diazinon	ng/L	500	<5	<5	<5	<5	2.5
Dichlorvos	ng/L		<10	<10	<10	<10	5
Dimethoate	ng/L		<5	<5	<5	<5	2.5
Disulfoton	ng/L		<10	<10	<10	<10	5
Ethoprop (Ethoprofos)	ng/L		<10	<10	<10	<10	5
Fenchlorphos (Ronnel)	ng/L			<10	<10	<10	5
Fensulfothion	ng/L		<10	<10	<10	<10	5
Fenthion	ng/L		<10	<10	<10	<10	5
Malathion	ng/L		<5	<5	<5	<5	2.5
Merphos	ng/L		<10	<10	<10	<10	5
Methyl Parathion	ng/L		<10	<10	<10	<10	5
Mevinphos (Phosdrin)	ng/L		<10	<10	<10	<10	5
Phorate	ng/L		<10	<10	<10	<10	5
Tetrachlorvinphos (Stirofos)	ng/L		<10	<10	<10	<10	5
Tokuthion	ng/L		<10	<10	<10	<10	5
Trichloronate	ng/L		<10	<10	<10	<10	5
Synthetic Pyrethroids							
Allethrin	ng/L		<5	<5	<5	<5	2.5
Bifenthrin	ng/L		<5	<5	<5	<5	2.5
Cyfluthrin	ng/L		<5	<5	<5	<5	2.5
Cypermethrin	ng/L		<5	<5	<5	<5	2.5

Analyte	Units	WQO	Switzer Creek (CGSC1)				
			Wet Weather	Dry Weather			
			22-Mar-05	14-Jun-05	28-Jun-05	12-Jul-05	Dry Weather Average
Danitol	ng/L		<5	<5	<5	<5	2.5
Deltamethrin	ng/L		<5	<5	<5	<5	2.5
L-Cyhalothrin	ng/L		<5	<5	<5	<5	2.5
Permethrin	ng/L		<5	<5	<5	<5	2.5
Prallethrin	ng/L		<5	<5	<5	<5	2.5

BOLD - Exceeds water quality objective
[1] EPA 200.8
[2] EPA 1640
(a) WQO for total and dissolved metal fractions are based on Total Hardness (as CaCO3) and are calculated as described by Title 40 of the Code of Federal Regulations (Part 131) (USEPA 2000).
NA - Not Assessed

All bacteriological densities were below water quality standards during the wet weather event. Total coliform was measured at 30,000 MPN/100 mL, fecal coliform densities were 11,000 MPN/100 mL and enterococcus densities were measured at 5,794 MPN/100 mL.

Concentrations of two metals, copper and zinc, exceeded water quality objectives in both the total and dissolved state. Total copper and zinc concentrations were 11.6 µg/L and 89.1 µg/L, respectively, while dissolved copper and zinc concentrations were 9.14 µg/L and 66.3 µg/L, respectively. Total and dissolved, beryllium, mercury, selenium, silver, thallium and tin and dissolved cadmium were not detected in the storm water sample. All other metals were detected at low concentrations or were below water quality objectives. Total hardness was measured at 16 mg/L.

The storm water sample collected at station CGSC1 had the lowest measurable concentration of total detectable PAHs (382.5 ng/L) of the four stations. Nine PAH compounds were not detected. All PCBs, chlorinated pesticides, organophosphorus pesticides and synthetic pyrethroids were not detected in the sample.

4.3.2 Dry Weather Monitoring

On May 16, 2005, station CGSC1 was not sampled due to insufficient water volumes. The field crews documented ponded water less than 0.25 in deep with a “trickle” flow. Three dry weather samples were collected on subsequent visits to the site. A summary of the water quality visual observations is presented in Table 4-11. The means of the triplicate readings for pH, temperature, conductivity and turbidity values are presented.

Two general chemistry constituents exceeded water quality objectives at Station CGSC1 (Table 4-10). MBAS and TSS concentrations exceeded objectives on June 28, 2005 with values of 1.5 mg/L and 281 mg/L, respectively. All other general chemistry parameters were below water quality objectives during all dry weather events.

Table 4-11. Dry Weather Visual Observations at Switzer Creek, Station CGSC1.

Observation/Parameter	June 14, 2005	June 28, 2005	July 12, 2005
Odor	None	None	None
Color	Yellow	Colorless	Brown
Floating Materials	Trash or Debris; Organic Material	Trash or Debris	Organic Material
Oil and Grease	Light Sheen	None	None
Turbidity (visual)	Some Cloudiness	None	Some Cloudiness
pH	8.27	7.21	8.05
Temperature (°C)	20.1	23.6	22.6
Conductivity (µS/cm)	936	1060	1510
Turbidity (NTU)	2.0[1]	-[2]	12

[1] – Single measurement; triplicate readings not conducted
[2] – Parameter not assessed

Total coliform densities exceeded WQO during the first two dry weather events with a value of 80,000 MPN/100 mL for each event. Total coliform densities were equal to the WQO (50,000 MPN/100 mL) during the last dry weather sampling event. Fecal coliform and enterococcus densities were below water quality objectives during all sampling events.

Only two metals, copper and zinc exceeded water quality objectives. Total copper concentrations exceeded objectives during the first two sampling events with values of 61.2 µg/L and 366 µg/L, respectively, and total zinc concentrations exceeded objectives only during the second sampling event with a value of 1010 µg/L. Total cadmium and lead were measured below WQOs with concentrations ranging from 0.08 to 2.18 µg/L and 8.09 to 238 µg/L, respectively. Only dissolved copper exceeded objectives during the first sampling event with a concentration of 47.6 µg/L. Dissolved cadmium was not detected in the first two samples and was estimated at a value of 0.1 (equal to the MDL) in the third sample. Dissolved lead ranged from 0.62 to 0.95 µg/L while dissolved zinc ranged from 3.1 to 33.6 µg/L. Total silver and dissolved beryllium, silver, thallium and tin were not detected in any dry weather sample. The remaining metals were detected at low concentrations in at least one of the samples. Total hardness as $CaCO_3$ at Station CGSC1 ranged between 174 and 319 mg/L during dry weather sampling events.

Total PAHs ranged from 1458 ng/L in the sample collected on June 28 to 155.5 ng/L in the sample collected on July 12. A greater number of PAH compounds (21 out of 25) were detected in the June 28 sample, whereas only 8 compounds were detected in the July 12 sample and 9 compounds were detected in the June 14 sample.

Concentrations of all PCBs, chlorinated pesticides, organophosphorus pesticides and synthetic pyrethroids were either non-detect or below their respective water quality objectives during all dry weather sampling events.

4.3.3 Sediment Quality Monitoring

Sediments collected from within the storm drain at station CGSC1 were predominantly sand (97.16%) (Table 4-12). Silt comprised 2.05% of the sample and gravel accounted for the remaining 0.78%. TOC content was 0.74%.

Mercury was the only metal that exceeded the PEL with a value of 18.6 µg/dry g. Three metals exceeded their respective TEL values. Copper exceeded its TEL of 35.7 µg/dry g with a concentration of 166 µg/dry g; lead only slightly exceeded its TEL of 35 µg/dry g with a concentration of 38.3 µg/dry g, and zinc's concentration of 138 µg/dry g exceeded its TEL of 123.1 µg/dry g. Silver was the only metal not detected in the sample. All remaining metals were detected at low concentrations. None of the organophosphorus pesticides or synthetic pyrethroids was detected in the sediment sample collected at CGSC1.

Table 4-12. Sediment Quality Analytical Results, Switzer Creek Station CGSC1.

Analyte	Units	TEL	PEL	Switzer Creek (CGSC1)
				14-Jun-05
Grain Size				
Gravel	%			0.78
Sand	%			97.16
Silt	%			2.05
Clay	%			0.00
TOC	%			0.74
Trace Metals				
Aluminum (Al)	µg/dry g			5570
Antimony (Sb)	µg/dry g			1.3
Arsenic (As)	µg/dry g	5.9	17	3.45
Barium (Ba)	µg/dry g			92.1
Beryllium (Be)	µg/dry g			0.15
Cadmium (Cd)	µg/dry g	0.596	3.53	0.17
Chromium (Cr)	µg/dry g	37.3	90	11.4
Cobalt (Co)	µg/dry g			4.28
Copper (Cu)	µg/dry g	35.7	197	*166*
Iron (Fe)	µg/dry g			19000
Lead (Pb)	µg/dry g	35	91.3	*38.3*
Manganese (Mn)	µg/dry g			195
Mercury (Hg)	µg/dry g	0.174	0.486	**18.6**
Molybdenum (Mo)	µg/dry g			11.9
Nickel (Ni)	µg/dry g	18	35.9	6.14
Selenium (Se)	µg/dry g			0.34
Silver (Ag)	µg/dry g			<0.025
Strontium (Sr)	µg/dry g			28.2
Thallium (Tl)	µg/dry g			0.03E
Tin (Sn)	µg/dry g			1.34
Titanium (Ti)	µg/dry g			371
Vanadium (V)	µg/dry g			20.6
Zinc (Zn)	µg/dry g	123.1	315	*138*
Organophosphorus Pesticides				
Bolstar (Sulprofos)	ng/dry g			<10
Chlorpyrifos	ng/dry g			<5
Demeton	ng/dry g			<10
Diazinon	ng/dry g			<5
Dichlorvos	ng/dry g			<10

Analyte	Units	TEL	PEL	Switzer Creek (CGSC1)
				14-Jun-05
Dimethoate	ng/dry g			<5
Disulfoton	ng/dry g			<10
Ethoprop (Ethoprofos)	ng/dry g			<10
Fenchlorphos (Ronnel)	ng/dry g			<10
Fensulfothion	ng/dry g			<10
Fenthion	ng/dry g			<10
Malathion	ng/dry g			<5
Merphos	ng/dry g			<10
Methyl Parathion	ng/dry g			<10
Mevinphos (Phosdrin)	ng/dry g			<10
Phorate	ng/dry g			<10
Tetrachlorvinphos (Stirofos)	ng/dry g			<10
Tokuthion	ng/dry g			<10
Trichloronate	ng/dry g			<10
Synthetic Pyrethroids				
Allethrin	ng/dry g			<5
Bifenthrin	ng/dry g			<5
Cyfluthrin	ng/dry g			<5
Cypermethrin	ng/dry g			<5
Danitol	ng/dry g			<5
Deltamethrin	ng/dry g			<5
L-Cyhalothrin	ng/dry g			<5
Permethrin	ng/dry g			<5
Prallethrin	ng/dry g			<5

Italic - Exceeds TEL
BOLD - Exceeds PEL

4.3.4 Biological Assessment Monitoring

4.3.4.1 Benthic Invertebrate Community Structure

A complete taxonomic listing of the benthic macroinvertebrates identified at all stations and replicates are presented in Table 4-13, and the ranked abundance and percent composition of each taxa are presented in Table 4-14. The taxonomic listing also shows the assigned TV and FFG of each taxon.

May 2005

A total of 21 taxa representing 916 individual organisms were identified from the monitoring reach. Chironomid midges were the most abundant organism with 532 individuals comprising 58% of the community, followed by the black fly *Simulium* with 152 individuals, and Oligochaete earthworms with 148 individuals (Table 4-14).

October 2005

A total of 20 taxa representing 878 individual organisms were identified from the monitoring reach. Oligochaete earthworms were the most abundant organism with 436 individuals comprising 49% of the community, followed by the snail *Physa* with 160 individuals, and the mosquito *Culex* with 60 individuals (Table 4-14).

Table 4-13. Taxonomic Listing of Macroinvertebrates Collected from Switzer Creek, 2005.

TV=Tolerance Value: range is 0-10; 0 is intolerant to impairment, 10 is highly tolerant to impairment. FFG=Functional Feeding Group: cg=collector gatherer, cf=collector filterer, sc=scraper, sh=shredder, pa=parasite, mh=macrophyte herbivore, ph=piercer herbivore, om=omnivore

			May-05			Oct-05		
	TV	FFG	T1	T2	T3	T1	T2	T3
Insecta								
Ephemeroptera (mayflies)								
Baetidae								
Baetis sp	5	cg	5	1				
Fallceon quilleri	4	cg		1		13		
Odonata (dragonflies and damselflies)								
Aeshindae								
Anax sp	8	p				1		
Coenagrionidae								
Argia sp	7	p	6		1			
Ischnura sp	9	p				5		
Libellulidae	9	p				1		
Coleoptera (beetles)								
Dytiscidae								
Colymbetinae	5	p			1			
Ilybius sp	5	p			1			
Rhantus sp	5	p			1			
Lepidoptera (aquatic moths)								
Nepticulidae								
Nepticula sp	5	sh						3
Diptera (true flies)								
Ceratopogonidae								
Culicoides sp	6	p			1			
Chironomidae	6	cg	159	185	188		3	2
Culicidae								
Culex	8	cg	5	5	23	9	1	5
Dolichopodidae	4	p			3			
Ephydridae	6		1	1				43
Muscidae	6	p			1	4	6	
Psychodidae								
Psychoda sp	10	cg		2				
Pericoma/Telmatoscopus	4	cg	3	1	4	14	7	6
Sciomyzidae	6	p				4	1	1
Simuliidae								
Simulium sp	6	cf	44	79	29			
Stratiomyidae								
Caloparyphus/Euparyphus	8	cg	1			4	1	1
Tipulidae								
Holorusia hespera	5	sh		1				
Limonia sp	6	sh				1		
Tipula sp	4	om	1		1			
PHYLUM CNIDARIA (hydroids)								
Hydrozoa								
Hydroida								
Hydridae								
Hydra sp	5	p	1			4	4	
PHYLUM PLATYHELMINTHES (flatworms)								
Turbelleria	4	p		2		3		
PHYLUM ANNELIDA (segmented worms)								
Oligochaeta	5	cg	83	7	58	64	234	138
PHYLUM MOLLUSCA								
Gastropoda (snails)								
Lymnaeidae								
Fossaria sp	6	sc				26	17	4
Pulmonata								
Physidae								
Physa sp	8	sc	1			11	14	36
PHYLUM ARTHROPODA								
Ostracoda (seed shrimp)	8	cg				3	8	4
Malacostraca								
Amphipoda (scuds)								
Hyalellidae								
Hyalella sp	8	cg					1	

Table 4-14. Ranked Total Abundance and Percent Composition of Benthic Macroinvertebrates Collected From Switzer Creek, 2005.

Taxon	May-05		Oct-05		Grand Total
	Abundance	Percent Composition	Abundance	Percent Composition	
Oligochaeta	148	16.2%	436	49.7%	584
Chironomidae	532	58.1%	5	0.6%	537
Physa sp	1	0.1%	160	18.2%	161
Simulium sp	152	16.6%			152
Culex	33	3.6%	60	6.8%	93
Fossaria sp			47	5.4%	47
Ephydridae	2	0.2%	43	4.9%	45
Pericoma/Telmatoscopus	17	1.9%	27	3.1%	44
Ostracoda			42	4.8%	42
Fallceon quilleri	1	0.1%	13	1.5%	14
Muscidae	1	0.1%	10	1.1%	11
Hydra sp	1	0.1%	8	0.9%	9
Argia sp	7	0.8%			7
Caloparyphus/Euparyphus	1	0.1%	6	0.7%	7
Baetis sp	6	0.7%			6
Sciomyzidae			6	0.7%	6
Ischnura sp			5	0.6%	5
Turbellaria	2	0.2%	3	0.3%	5
Dolichopodidae	3	0.3%			3
Nepticula sp			3	0.3%	3
Psychoda sp	2	0.2%			2
Tipula sp	2	0.2%			2
Anax sp			1	0.1%	1
Colymbetinae	1	0.1%			1
Culicoides sp	1	0.1%			1
Holorusia hespera	1	0.1%			1
Hyalella sp			1	0.1%	1
Ilybius sp	1	0.1%			1
Libellulidae			1	0.1%	1
Limonia sp			1	0.1%	1
Rhantus sp	1	0.1%			1
Grand Total	916	100%	878	100%	1794

4.3.4.2 Benthic Invertebrate Community Metrics

The values for benthic macroinvertebrate community metrics for the monitoring reach are presented in Table 4-15. Community metric values were calculated based on a 500 organism count for each survey, which were randomly selected from the original 900 organisms processed.

Table 4-15. Bioassessment Metric Values for Switzer Creek, 2005.

Metric	May-05	Oct-05
Taxa Richness	17	18
Ephemeropteran Taxa	2	1
Plecopteran Taxa	0	0
Trichopteran Taxa	0	0
EPT Taxa	2	1
Dipteran Taxa	9	8
Non Insect Taxa	3	6
% EPT	0.7%	1.4%
Sensitive EPT %	0.0%	0.0%
Shannon Diversity	1.3	1.7
Margalef Diversity	2.5	2.7
Tolerance Value	5.9	6.0
% Dominant Taxa	57.9%	49.4%
% Chironomidae	57.9%	0.6%
% Intolerant	0.0%	0.0%
% Tolerant	3.9%	31.8%
% Grazer	0.0%	0.0%
% Collector Gatherer	80.8%	66.7%
% Collector Filterer	16.5%	0.0%
% Predator	2.1%	4.0%
% Shredder	0.1%	0.5%
% Scraper	0.1%	24.1%
% Other	0.2%	0.0%

Species Diversity and Dominance

Overall macroinvertebrate diversity in Switzer Creek was moderate relative to other urban streams in San Diego County (MEC-Weston 2005). Shannon Diversity values (weighted for evenness) were 1.3 and 1.7, and Margalef Diversity values were 2.5 and 2.7 for the May and October surveys, respectively. The site was dominated by Chironomid midges in May, and by Oligochaetes in October.

EPT Taxa

There were two different EPT taxa collected in the two surveys. The Baetid mayflies *Baetis* and *Fallceon quilleri* were collected in small numbers, representing 0.7% of the community in May, and 1.4% of the community in October. Both of these mayfly taxa are moderately tolerant to impairment and are often abundant in streams dominated by urban runoff.

Tolerance Measures

For the majority of stream macroinvertebrates, a TV has been determined for each genera or species through prior research on the animals' life history (e.g., Hilsenhoff 1987). TVs range from 0 for animals highly sensitive to impairments, to 10 for animals that are highly tolerant to impairments. The presence of impairment tolerant animals does not always imply impairment (SDRWQCB 2001), but the presence of intolerant animals is unlikely when impairment has occurred.

The average TVs of the macroinvertebrates collected in Switzer Creek were 5.9 in May and 6.0 in October. The higher TV in October was due to higher abundances of the snail *Physa* and the mosquito *Culex*. Both of these organisms are indicative of slow current velocities, which were observed during the October survey. There were no highly intolerant organisms (TV 0, 1, or 2) collected in either survey.

Functional Feeding Groups

As with TVs, FFG designations have been determined through prior life-history research of each taxon. Collector gatherers dominated the benthic community in Switzer Creek in both surveys, comprising 81% of the community in May, and 67% of the community in October. Collector gatherers feed on fine particulate organic detritus, algae, and various micro-organisms (Pennak 2001, Usinger 1956) and are often associated with high levels of urbanization and runoff (SLSI 2003). Collector filterers were abundant only in May due to the presence of the black fly *Simulium*, which is generally observed thriving in high velocity currents. Scrapers were abundant in October, when high numbers of the snail *Physa* were collected.

4.3.4.3 Physical Habitat Quality Assessment

Ten parameters of the physical habitat were scored on a 1 to 20 scale, thus 200 was the highest possible score. Most of the physical habitat quality parameters are scored in a qualitative manner, and provide a good comparative tool for sites within a sampling region. Table 4-16 lists the physical habitat scores.

Table 4-16. Physical Habitat Measures of Switzer Creek, 2005.

Physical Habitat Measure	May 2005	Oct 2005
1. Epifaunal Substrate	16	17
2. Substrate Embeddedness	16	13
3. Velocity / Depth Regimes	11	2
4. Sediment Deposition	17	18
5. Channel Flow Status	9	1
6. Channel Alteration	7	10
7. Riffle Frequency	8	1
8. Bank Stability	12	17
9. Bank Vegetative Protection	14	14
10. Riparian Vegetative Zone Width	9	9
Physical Habitat Total	**119**	**102**
Elevation (feet above sea level)		
Average Riffle Depth (inches)	3.0	3.3
Average Riffle Velocity (ft/sec)	1.1	0.1
Percent Embeddedness	8%	37%
Substrate Composition (average of 3 riffles):		
Percent Silt (<0.1")		2%
Percent Sand (0.1-0.2")	3%	8%
Percent Gravel (0.2-2")	23%	37%
Percent Cobble (2-10"	74%	43%
Percent Boulder(<10")		10%
Percent Root Mat		

The physical habitat quality of the site was in the low range of sub-optimal, with total habitat scores of 119 in May and 102 in October. The primary difference in habitat quality between the two surveys related to stream flow, which was good in May but was very low in October. The October sampling transects included one riffle and two pools due to lack of flow, and this is reflected in the higher abundances of the snails *Fossaria* and *Physa*, and the mosquito *Culex*, which prefer still waters. The site had very good substrate characteristics, with cobble, large gravel, and tree roots dominating the streambed. The banks were thickly vegetated, although non-native plants and trees were prevalent. The riparian zone was narrow due to the proximity of Florida Street on the eastern side of the reach.

Water quality measurements taken at the time of sampling are presented in Table 4-17. Values for pH were 7.65 in May and 7.48 in October. Specific conductance, a general measure of dissolved metals and salts, was relatively high in May with a value of 2.740 ms/cm, and was substantially lower in October with a value of 0.779 ms/cm in October, which is a value typical of reference conditions (MEC-Weston 2005). DO levels were moderate, with values of 9.33 mg/l and 8.84 mg/l in May and October, respectively.

Table 4-17. Water Quality Measures of Switzer Creek, 2005.

Survey	pH	Specific Conductance (mS/cm)	Water Temperature (C)	Turbidity (NTU)	Relative Chlorophyll (ug/L)	Dissolved Oxygen (mg/l)
May 2005	7.65	2.740	18.44	14.4	3.4	9.33
Oct 2005	7.48	0.779	17.71	1.2	7.6	8.84

4.3.4.4 Index of Biotic Integrity

In 2003, a southern California IBI was developed to cover the region extending from southern Monterey County to the Mexican border (Ode et al. 2005). The IBI gives a single quantified score to a site based on a multi-metric evaluation technique, and the scores may be compared across seasons and years of a monitoring program to give an indication of trends over time. The CDFG developed the IBI based on a multi-year comprehensive assessment of reference and non-reference conditions in southern California to establish an expected range of benthic invertebrate community structure in the region.

Seven metrics that showed a strong and predictable response to ecological impacts and stressors were selected to calculate the IBI. Some of these metrics (percent non-insect taxa, percent tolerant taxa, number Coleoptera taxa, number predator taxa) were not in the original standard list of bioassessment metrics (Table 3-4), but were selected because they showed a strong correlation to stressor gradients.

Each metric value is given a score from 0 to 10, and the scores added to give an IBI score. Each final score is then classified into five rating categories ranging from Very Poor to Very Good. Table 4-18 shows the IBI metrics, scoring ranges, and quality rating categories. The threshold for designating a site "impaired" is an IBI score of 26 or less, with quality ratings of Poor and Very Poor.

Table 4-18. Index of Biotic Integrity Scoring Ranges.

Metric Score	Number Coleoptera Taxa	Number EPT Taxa	Number Predator Taxa	Percent CF+CG Individuals	Percent Intolerant Individuals	Percent Non-Insect Taxa	Percent Tolerant Taxa
10	>5	>17	>12	0-59	25-100	0-8	0-4
9		16-17	12	60-63	23-24	9-12	5-8
8	5	15	11	64-67	21-22	13-17	9-12
7	4	13-14	10	68-71	19-20	18-21	13-16
6		11-12	9	72-75	16-18	22-25	17-19
5	3	9-10	8	76-80	13-15	26-29	20-22
4	2	7-8	7	81-84	10-12	30-34	23-25
3		5-6	6	85-88	7-9	35-38	26-29
2	1	4	5	89-92	4-6	39-42	30-33
1		2-3	4	93-96	1-3	43-46	34-37
0	0	0-1	0-3	97-100	0	47-100	38-100
Very Poor: 0-13 Poor: 14-26 Fair: 27-40 Good: 41-55 Very Good: 56-70							

Source: Ode et al. 2005

The IBI metric scores and total IBI score for Switzer Creek are presented in Table 4-19 and Figure 4-1. The total IBI scores for the Switzer Creek monitoring site were 22 in May and 15 in October, with quality ratings of Poor for both surveys. The May survey had greater biotic integrity due to a low percentage of non-insect taxa, a low percentage of highly tolerant taxa, and several Coleopteran taxa. The May survey also had a very high percentage of collector filterers and collector gatherers (97% of the community), and this is a typical seasonal pattern in Southern California (MEC-Weston 2005).

Table 4-19. Index of Biotic Integrity Scores for Switzer Creek, 2005.

Monitoring Reach	Total IBI Score	IBI Rating	% CF+CG		% Non-Insect		% Tolerant Taxa		Coleoptera Taxa		Predator Taxa		% Intolerant		EPT Taxa	
			Metric score	IBI score	Metric score	IBI score	Metric score	IBI score	Metric score	IBI score	Metric score	IBI score	Metric score	IBI score	Metric score	IBI score
May-05	**22**	**Poor**	97%	**0**	17%	**8**	17%	**6**	2	**4**	6	**3**	0%	**0**	2	**1**
Oct-05	**15**	**Poor**	67%	**8**	36%	**3**	36%	**1**	0	**0**	6	**3**	0%	**0**	1	**0**

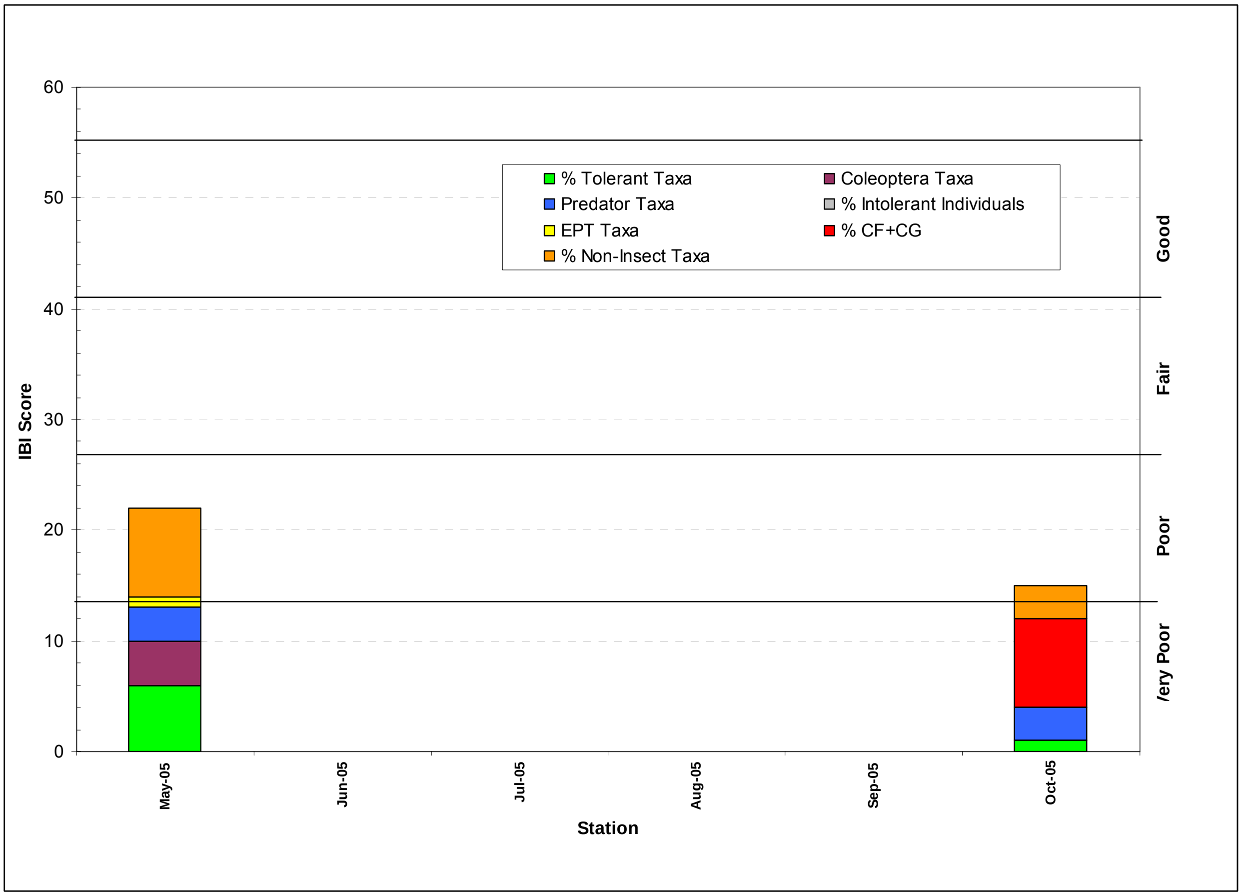

Figure 4-1. Index Biotic Integrity Scores for Switzer Creek, 2005.

On a regional scale, the IBI rating of Switzer Creek is relatively high compared to other urban bioassessment monitoring sites in San Diego County, the majority of which have been rated Very Poor (MEC-Weston 2005). The macroinvertebrate community of Switzer Creek consisted of many organisms (e.g., mayflies, dragonflies, predaceous diving beetles) that are tolerant to urban runoff if it lacks substantial levels of contaminants (SLSI 2003). The location of the bioassessment monitoring reach within the watershed likely contributed to the relative integrity of the biotic community, as a very small geographic drainage area was contributing to the flow in the monitoring reach. Field biologists noted that the source for nearly all of the water in the reach was runoff from Balboa Park and the Naval Medical Center to the west, while the drainage from Florida Canyon to the north was dry at the time of both surveys.

4.4 QA/QC Results

The analyses of chemistry, bacterial, benthic and bioassessment samples were performed under the strict guidelines of the quality assurance and quality control programs established by CRG and Weston's Microbiology and Benthic Laboratories as set forth in the *San Diego Watersheds Common Grounds Project* Quality Assurance Project Plan (QAPP). All data results met QA/QC criteria established in the *San Diego Watersheds Common Grounds Project* QAPP. The following sections confirm the QA/QC procedures met and discuss any exceptions.

4.4.1 Field Measurements

All field equipment was calibrated each day prior to field operations. Field measurements for pH, temperature, conductivity and turbidity were conducted in triplicate with a few exceptions. A single measurement for turbidity was made on June 14 at stations DW240, DW239 and CGSC1. Only visual observations of turbidity were made in the field on June 28; turbidity was not measured with the Hach 2100P Turbidity Meter.

The QAPP specifies that pH, temperature and turbidity would meet precision requirements of ±0.5 units and conductivity would meet precision requirements of ±5%. One measure of precision is to use the relative standard deviation (RSD) which is the standard deviation divided by the mean multiplied by 100 to achieve a percentage number. RSD is used to determine the precision of triplicate conductivity measurements. For the criteria (pH, temperature and turbidity) which precision requirements are based on per unit differences of the criteria rather than a percentage, the absolute difference of the measured value from the mean was used to determine precision.

Precision requirements for pH were met in all cases. Temperature failed in two samples, one storm water sample, and one dry weather sample. On March 22, at station DW239, one temperature reading was 0.6 units from the mean, 0.1 units above the 0.5 unit criteria. On July 12, at station DW240, all three temperature readings were greater than 0.5 units from the mean. Temperature readings were 22.6 °C, 22.6 °C and 27.7 °C with a mean of 24.3 °C. Turbidity measurements did not meet the precision requirements at all stations for which triplicate readings were taken.

Collection methods were examined to determine if the precision failures were due to technician error or natural, environmental variation in the sample. It was determined that the turbidity measurements made during the wet weather event were of triplicate grab samples, rather than triplicate readings of a single grab. Triplicate grabs show the variation inherent in an environmental sample. Although the turbidity measurements made during the final dry weather sample (July 12) were of a single grab, the turbidity concentrations were slightly above and below the accuracy of the instrument (±2 NTU).

4.4.2 Chemistry Analyses

4.4.2.1 Water Quality

All water quality samples were collected in laboratory supplied, laboratory-certified, contaminant free sample bottles. One field blank per sampling event was collected to verify that field cleansing procedures were adequate and sample handling and transportation did not introduce any analytes of interest. The field blank consisted of analyte-free water that was poured into the sample collection device and sub-sampled for chemistry analyses.

Results from the field blanks were all non-detect with some exceptions. On March 22, 2005, analysis of the field blank collected during the wet weather monitoring event showed low levels of total and dissolved copper (0.28 µg/L and 0.31 µg/L, respectively), total lead (0.05 µg/L) and total zinc (0.6 µg/L). Further, MBAS were detected in the blank sample at 0.11 mg/L. Although the analytical results of the wet weather samples were not blank adjusted, it should be noted that the concentrations of metals and MBAS in the blank sample each comprised a small percentage of the concentration in the actual sample. On June 28, analysis of the field blank collected during the dry weather monitoring event showed low levels of dissolved barium (0.11 µg/L). The actual measured concentration was 75.4 µg/L. Finally, on July 12, dissolved nickel had a concentration of 0.18 µg/L in the field blank.

On March 22 and May 16, orthophosphate was analyzed using SM 4500 PC compared to EPA 300 for all subsequent analyses. The switch to EPA 300 did not change the target detection limit as specified in the QAPP. Further, EPA 300 is a more direct, ion chromatographic method which eliminates the interferences associated with the spectrophotometric method (SM 4500).

On March 22 and May 16, dissolved and total mercury was analyzed using EPA 200.8, however on subsequent analyses, EPA 1631E was utilized. The switch to EPA 1631E actually decreased the method detection limit from 0.05 to 0.0005 µg/L, therefore increasing the ability of the laboratory to detect trace amounts of mercury. EPA 1631E utilizes a cold vapor atomic fluorescence spectrometer (CV-AFS) which is more sensitive to detecting mercury compared to the Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) technique (EPA 200.8).

4.4.2.2 Sediment Quality

None of the constituents in the field blank collected during the sediment sampling event were detected. All sediment quality samples were collected in laboratory supplied, laboratory-certified, contaminant free sample bottles. One field blank per sampling event was collected to verify that field cleansing procedures were adequate and sample handling and transportation did not introduce any analytes of interest. The field blank consisted of analyte-free water that was poured into the sample collection device and sub-sampled for chemistry analyses.

4.4.3 Bioassessment

All of the procedures outlined in Appendix L of the project's QAPP were followed. All field instruments were calibrated each day prior to field operations. A minimum of 10% of the samples and at least one sample by each sorting technician were examined by a senior scientist. Removal rates were better than those specified in the QAPP, with at least 95% removal in all samples.

4.4.4 Microbiology

All of the procedures outlined in Appendix M of the project's QAPP were followed. The Weston Solutions Microbiology Laboratory adheres to strict ELAP and NELAP quality control guidelines; all of these guidelines were met (ELAP Certification No. 2613 and NELAP Certification No. 01113CA).

4.5 Electronic Data Submittal

In support of the primary goals of the *San Diego Watersheds Common Grounds Project*, all data generated during sampling and monitoring activities conducted as part of the biological, water and sediment quality monitoring will be provided in electronic format for inclusion into the Common Grounds database and for posting on the website. The Common Grounds database, which will incorporate all monitoring data collected by local and state agencies, citizen groups, educational and research institutions and local businesses, will help to develop a Geographic Information System and a comprehensive outreach and education program in order to increase awareness and understanding of watershed issues.

Weston is currently working with San Diego State University in order to develop the appropriate electronic format in which to submit the monitoring data. Data will be submitted by Weston as soon as the appropriate format is generated.

5.0 DISCUSSION

5.1 Constituents of Concern

The BPTCP identified metals (specifically copper), PAHs and chlordane as constituents of concern. The 303d list identifies PAHs, chlordane and lindane as constituents of concern. To address these concerns, the following presentation of results tends to highlight these constituents as appropriate. Charts have been developed for key constituents that pertain to the TMDL development.

5.1.1 Downtown Anchorage

5.1.1.1 DW240

Cadmium, copper, lead and zinc were consistently the four metals which had the highest ratios of measured concentration to WQOs at Station DW240. Analyzing the concentrations of total recoverable metals, copper always had the highest ratio, exceeding its WQO in each wet and dry weather sample (Table 5-1). In every sample, zinc had the next highest concentration relative to its WQO, exceeding its WQO in all samples except one dry weather sample. Lead had the next highest concentration relative to its WQO and cadmium was next. Similarly, dissolved copper always had the highest ratio, exceeding its WQO in the wet weather sample and two of the dry weather samples. Dissolved zinc had the next highest concentration relative to its WQO, but only exceeded its WQO in the wet weather sample. Figure 5-1(a) compares wet weather results to an average concentration of the three dry weather results for dissolved and total cadmium, copper, lead and zinc.

Table 5-1. Total and Dissolved Metals Ranked Relative to the Ratio of the Measured Concentration to the Hardness Dependent WQO for Samples Collected at Station DW240, Downtown Anchorage.

Wet Weather		Dry Weather					
22-Mar-05		14-Jun-05		28-Jun-05		12-Jul-05	
Metal	Ratio	Metal	Ratio	Metal	Ratio	Metal	Ratio
Copper	12.862	Copper	6.790	Copper	1.343	Copper	5.737
Zinc	8.363	Zinc	2.095	Zinc	0.520	Zinc	1.546
Lead	1.132	Lead	0.267	Lead	0.042	Lead	0.120
Cadmium	0.547	Cadmium	0.055	Cadmium	0.019	Cadmium	0.050
Nickel	0.053	Nickel	0.025	Nickel	0.008	Nickel	0.011
Silver	0.044	Silver	0.006	Silver	0.003	Silver	0.003
Chromium	0.009	Chromium	0.002	Chromium	0.001	Chromium	0.002
Dissolved Copper	7.450	Dissolved Copper	1.333	Dissolved Copper	0.507	Dissolved Copper	1.166
Dissolved Zinc	3.322	Dissolved Zinc	0.345	Dissolved Zinc	0.311	Dissolved Zinc	0.208
Dissolved Cadmium	0.166	Dissolved Lead	0.062	Dissolved Nickel	0.008	Dissolved Lead	0.021
Dissolved Lead	0.080	Dissolved Nickel	0.019	Dissolved Lead	0.005	Dissolved Cadmium	0.015
Dissolved Silver	0.051	Dissolved Cadmium	0.008	Dissolved Cadmium	0.005	Dissolved Nickel	0.007
Dissolved Nickel	0.034	Dissolved Silver	0.007	Dissolved Silver	0.003	Dissolved Silver	0.003
Dissolved Chromium	0.010	Dissolved Chromium	0.002	Dissolved Chromium	0.001	Dissolved Chromium	0.002

Red = Exceedance ratios greater than one indicate metal exceeded WQO

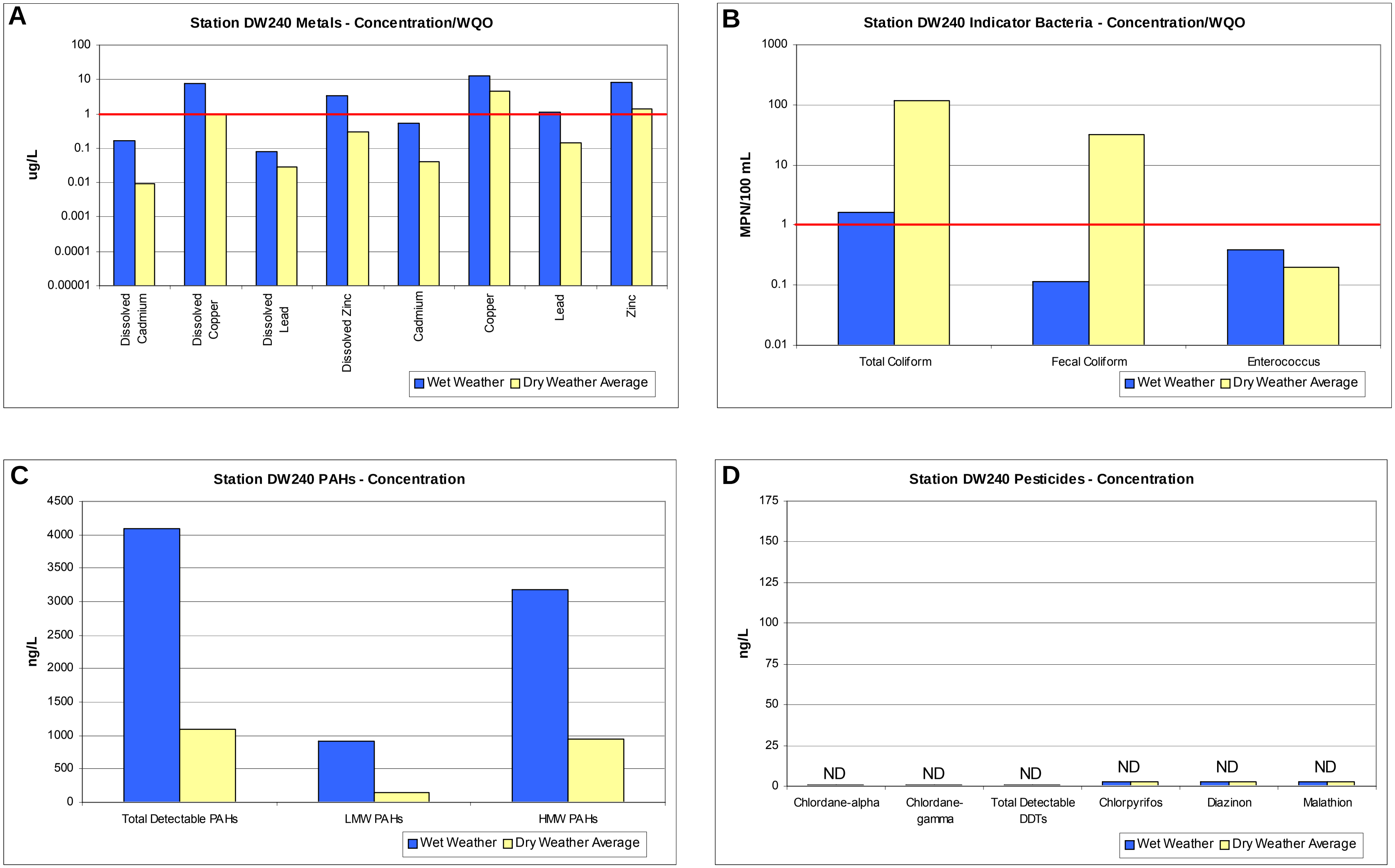

Figure 5-1. Wet Weather Results Compared to Average Dry Weather Results: Ratio of Select Metal Concentrations to WQO (a), Ratio of Indicator Bacteria to WQO (b), PAH Concentrations (c) and Select Pesticides Concentrations (d) at Station DW240.

Total hardness was lower at Station DW240 during the wet weather event compared all three dry weather events by an order of magnitude. Therefore, water quality criteria were lower (more restrictive) during the wet weather sampling event. As described previously (Section 3.5), stormwater runoff typically has a lower hardness than dry weather (municipal) runoff.

Figure 5-1(b) shows the ratio of indicator bacteria densities to the dry weather action levels at station DW240. The bar chart illustrates that the densities of total and fecal coliform during dry weather were approximately 2 orders of magnitude greater than the wet weather results. Enterococcus tended to have similar results between wet and dry weather. The elevated indicator bacterial densities at this site are consistent with sewage contamination, however, the lack of associated elevated nutrient levels suggest a different source, such as illicit discharges of gray water or dumpster washing.

Figure 5-1(c) and (d) show the actual concentrations of PAHs and select pesticides at Station DW240. Wet weather results showed greater concentrations of TPAHs than in dry weather. High molecular weight (HMW) PAHs were more prevalent than low molecular weight (LMW) PAHs. There were no detections of any pesticide at station DW240. The bars in Figure 5-1(d) represent one-half the constituents' MDL.

5.1.1.2 DW239

Copper, lead and zinc were consistently three metals which had the highest ratios of measured concentration to WQOs at Station DW239 (Table 5-2). Dissolved lead had the lowest ratio of measured concentration to WQOs in the dry weather samples. Analyzing the concentrations of total recoverable metals, copper always had the highest ratio, exceeding its WQO only in the wet weather sample. In every sample, zinc had the next highest concentration relative to its WQO, also only exceeding its WQO in the wet weather sample. Lead had the next highest concentration relative to its WQO and cadmium was next. Dissolved copper and zinc had the two highest concentrations relative to their WQOs in all samples at Station DW239. Figure 5-2(a) compares wet weather results to an average concentration of the three dry weather results for dissolved and total cadmium, copper, lead and zinc.

Total hardness was lower at Station DW239 during the wet weather event compared all three dry weather events by an order of magnitude. Therefore, water quality criteria were lower (more restrictive) during the wet weather sampling event. As described previously (Section 3.5), stormwater runoff typically has a lower hardness than dry weather (municipal) runoff.

Figure 5-2(b) shows the ratio of indicator bacteria densities to the dry weather action levels at station DW239. The bar chart illustrates that the densities of indicator bacteria during dry weather were approximately an order of magnitude less than the wet weather results. Interestingly, total and fecal coliform densities at Station DW239 during dry weather are approximately 3 orders of magnitude lower than at Station DW240, in the same drainage area.

Table 5-2. Total and Dissolved Metals Ranked Relative to the Ratio of the Measured Concentration to the Hardness Dependent WQO for Samples Collected at Station DW239, Downtown Anchorage.

Wet Weather		Dry Weather					
22-Mar-05		16-May-05		14-Jun-05		28-Jun-05	
Metal	Ratio	Metal	Ratio	Metal	Ratio	Metal	Ratio
Copper	17.452	Copper	0.063	Copper	0.077	Copper	0.177
Zinc	10.023	Zinc	0.016	Zinc	0.016	Zinc	0.033
Lead	9.068	Cadmium	0.012	Lead	0.002	Lead	0.005
Cadmium	1.546	Silver	0.001	Cadmium	0.002	Cadmium	0.003
Silver	0.362	Nickel	0.001	Nickel	0.001	Nickel	0.002
Nickel	0.107	Lead	0.001	Silver	0.001	Chromium	0.001
Chromium	0.048	Chromium	0.000	Chromium	0.001	Silver	0.001
Dissolved Copper	4.300	Dissolved Copper	0.066	Dissolved Copper	0.061	Dissolved Copper	0.115
Dissolved Zinc	0.650	Dissolved Zinc	0.015	Dissolved Zinc	0.010	Dissolved Zinc	0.029
Dissolved Silver	0.426	Dissolved Cadmium	0.007	Dissolved Chromium	0.002	Dissolved Cadmium	0.002
Dissolved Lead	0.157	Dissolved Silver	0.001	Dissolved Cadmium	0.002	Dissolved Nickel	0.002
Dissolved Cadmium	0.099	Dissolved Chromium	0.001	Dissolved Nickel	0.001	Dissolved Chromium	0.002
Dissolved Nickel	0.014	Dissolved Nickel	0.001	Dissolved Silver	0.001	Dissolved Silver	0.001
Dissolved Chromium	0.009	Dissolved Lead	0.000	Dissolved Lead	0.000	Dissolved Lead	0.000

Red - Exceedance ratios greater than one indicate metal exceeded WQO

Figure 5-2(c) and (d) show the actual concentrations of PAHs and select pesticides at Station DW239. TPAHs were found at low concentrations in wet weather and were practically not detected in dry weather samples. HMW PAHs were more prevalent than LMW PAHs. A few pesticides were measured in the wet weather sample at Station DW239, including chlordane-alpha and gamma and malathion. There were no detections of any pesticide in dry weather samples at this station. The bars in Figure 5-2(d) corresponding to all the dry weather results and the wet weather results for total detectable DDTs, chlorpyrifos and diazinon represent one-half the constituents' MDL.

The low levels of alpha and gamma chlordane measured in the wet weather samples at this station do not suggest a potential new source of concern, rather, these results are illustrating the persistency of this chemical in the environment. Chlordane is a manufactured chemical that was used as a pesticide in the United States from 1948 to 1988. Until 1983, chlordane was used as a pesticide on crops like corn and citrus and on home lawns and gardens. Because of concern about damage to the environment and harm to human health, the USEPA banned all uses of chlordane in 1983 except to control termites. In 1988, USEPA banned all uses.

The term chlordane actually refers to a complex mixture of chlordane isomers, other chlorinated hydrocarbons and by-products. In most temperate climates, only the two chlordane isomers: alpha and gamma chlordane, generally persist. Chlordane adheres strongly to soil particles and may persist for over 20 years in sediment.

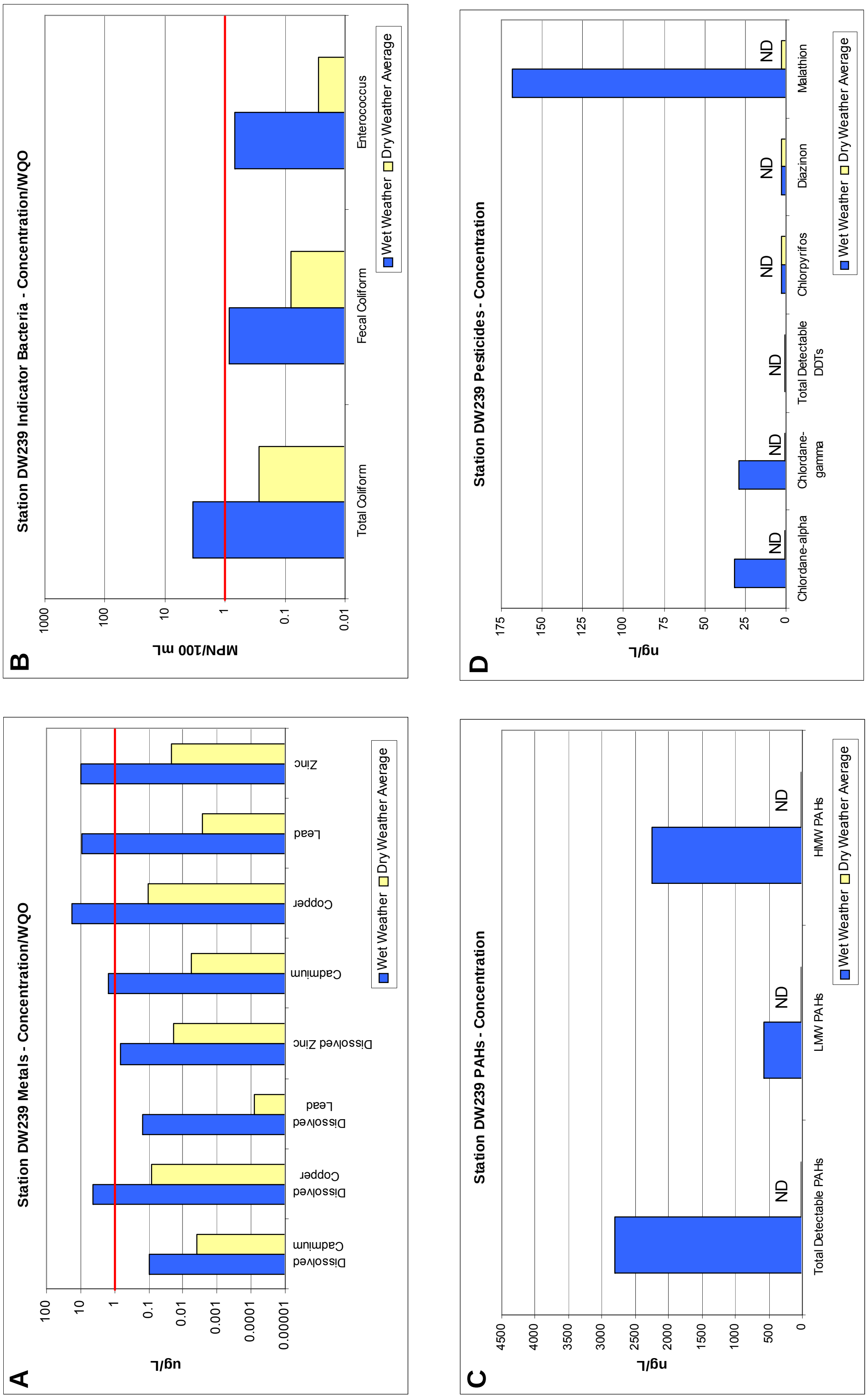

Figure 5-2. Wet Weather Results Compared to Average Dry Weather Results: Ratio of Select Metal Concentrations to WQO (a), Ratio of Indicator Bacteria to WQO (b), PAH Concentrations (c) and Select Pesticides Concentrations (d) at Station DW239.

Concentrations of alpha and gamma chlordane, and trans-Nonachlor, a component of chlordane, were detected only during the wet weather event. Sediment transport is much greater during wet weather than dry weather, which most likely resulted in higher total suspended solid concentrations during the wet weather event. Since chlordane binds easily to particulates, this may explain the higher levels of chlordane components found during the wet weather event.

5.1.2 B Street/Broadway Piers

Cadmium, copper, and zinc were consistently three metals which had the highest ratios of measured concentration to WQOs at Station DW237 (Table 5-3). Total and dissolved zinc only had a high ratio of measured concentration to WQOs in the wet weather samples. Analyzing the concentrations of total recoverable metals, copper always had the highest ratio, exceeding its WQO in the wet weather sample and one dry weather sample. In every sample, zinc had the next highest concentration relative to its WQO, only exceeding its WQO in the wet weather sample. Dissolved copper and zinc had the two highest concentrations relative to their WQOs in all samples at Station DW237. Figure 5-3(a) compares wet weather results to an average concentration of the three dry weather results for dissolved and total cadmium, copper, lead and zinc.

Table 5-3. Total and Dissolved Metals Ranked Relative to the Ratio of the Measured Concentration to the Hardness Dependent WQO for Samples Collected at Station DW237, B Street/Broadway Piers.

Wet Weather		Dry Weather					
22-Mar-05		14-Jun-05		28-Jun-05		12-Jul-05	
Metal	Ratio	Metal	Ratio	Metal	Ratio	Metal	Ratio
Copper	13.014	Copper	3.151	Copper	0.522	Copper	0.390
Zinc	11.069	Zinc	0.272	Zinc	0.170	Zinc	0.056
Lead	6.937	Lead	0.030	Silver	0.018	Cadmium	0.003
Cadmium	1.041	Cadmium	0.005	Cadmium	0.013	Nickel	0.001
Silver	0.472	Nickel	0.004	Lead	0.003	Lead	0.001
Nickel	0.049	Silver	0.002	Nickel	0.002	Silver	0.000
Chromium	0.029	Chromium	0.000	Chromium	0.000	Chromium	0.000
Dissolved Copper	3.035	Dissolved Copper	0.732	Dissolved Copper	0.391	Dissolved Copper	0.359
Dissolved Zinc	1.132	Dissolved Zinc	0.063	Dissolved Zinc	0.113	Dissolved Zinc	0.046
Dissolved Silver	0.556	Dissolved Cadmium	0.004	Dissolved Cadmium	0.009	Dissolved Cadmium	0.003
Dissolved Lead	0.258	Dissolved Nickel	0.003	Dissolved Nickel	0.002	Dissolved Nickel	0.001
Dissolved Cadmium	0.117	Dissolved Silver	0.002	Dissolved Silver	0.001	Dissolved Chromium	0.000
Dissolved Chromium	0.011	Dissolved Lead	0.001	Dissolved Chromium	0.001	Dissolved Silver	0.000
Dissolved Nickel	0.008	Dissolved Chromium	0.001	Dissolved Lead	0.000	Dissolved Lead	0.000

Red - Exceedance ratios greater than one indicate metal exceeded WQO

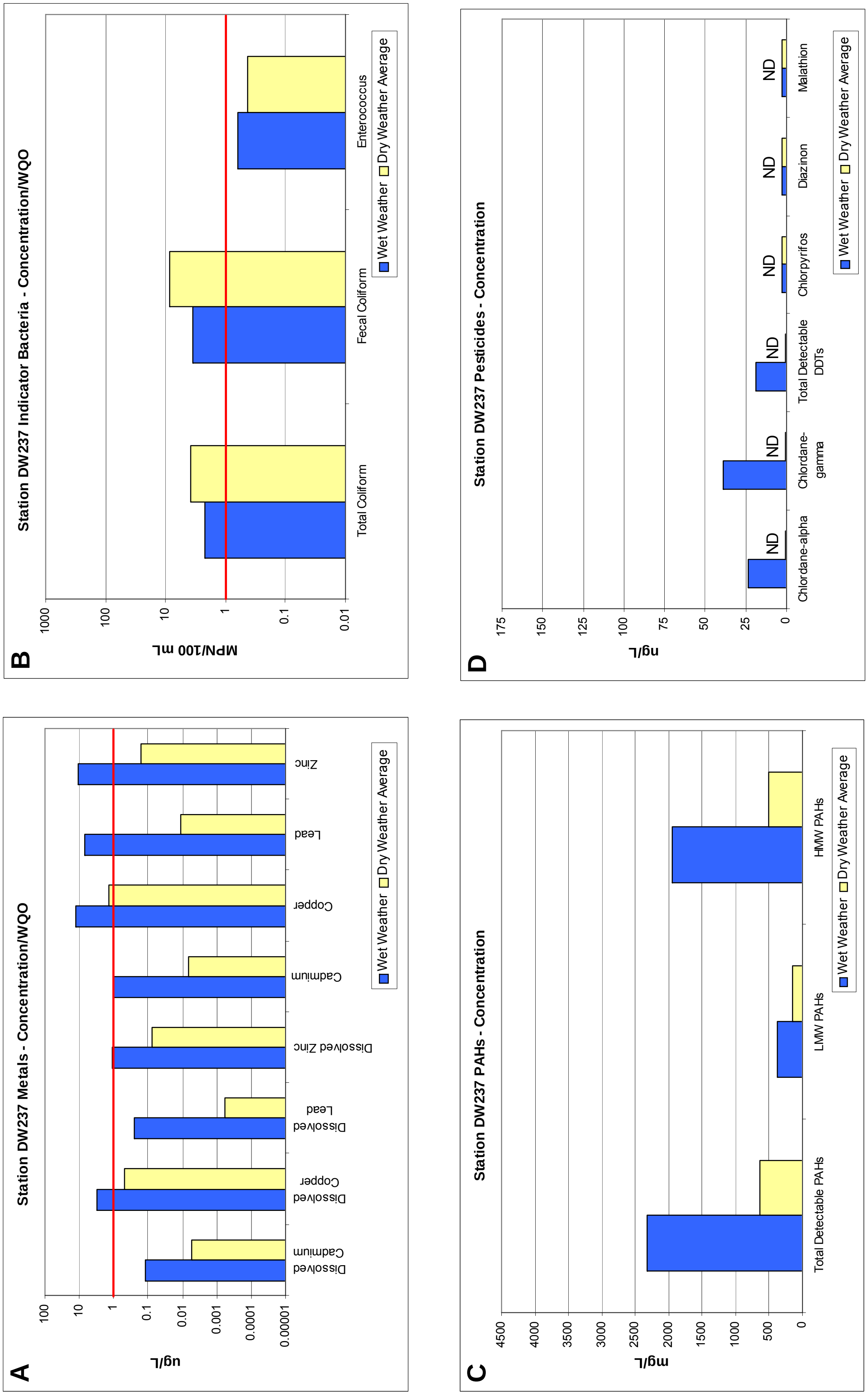

Figure 5-3. Wet Weather Results Compared to Average Dry Weather Results: Ratio of Select Metal Concentrations to WQO (a), Ratio of Indicator Bacteria to WQO (b), PAH Concentrations (c) and Select Pesticides Concentrations (d) at Station DW237.

Total hardness was lower at Station DW237 during the wet weather event compared all three dry weather events by an order of magnitude. Therefore, water quality criteria were lower (more restrictive) during the wet weather sampling event. As described previously (Section 3.5), stormwater runoff typically has a lower hardness than dry weather (municipal) runoff.

Figure 5-3(b) shows the ratio of indicator bacteria densities to the dry weather action levels at station DW237. The bar chart illustrates that the densities of indicator bacteria during wet and dry weather were approximately equal. Total and fecal coliform results were greater than their respective WQOs in both wet and dry weather.

Figure 5-3(c) and (d) show the actual concentrations of PAHs and select pesticides at Station DW237. TPAHs were found at low concentrations in wet and dry weather samples. HMW PAHs were more prevalent than LMW PAHs. A few pesticides were measured in the wet weather sample at Station DW237, including chlordane-alpha and gamma and 4,4' DDE (represented on the bar chart as total detectable DDT). There were no detections of any pesticide in dry weather samples at this station. The bars in Figure 5-3(d) corresponding to all the dry weather results and the wet weather results for chlorpyrifos, diazinon and malathion represent one-half the constituents' MDL.

Although 4,4' DDE was measured at this station, this result does not indicate a source or concern of DDT as the breakdown products of DDT are persistent in the environment and are likely a result of historical use. DDT and its metabolites are found in the environment as residual deposits from extensive use prior to its ban in the United States in 1972. DDT is an organochlorine insecticide which is immobile and persistent in the environment. Degradation pathways include photolysis (sunlight), biodegradation (aerobic and anaerobic), volatilization, and runoff. These pathways are very slow. In soil, the metabolites of DDT are DDE and DDD, which have similar degradation properties as DDT. DDT is reported to have a half life of 2-15 years. DDT may be present in large amounts in soils and soil fractions with high organic content, where it is absorbed by organisms. However, it is also found in areas where it is unbound in the environment and available to organisms.

Studies in Arizona and Oregon have shown that DDT degradation varies by location. The Arizona study reported rapid volatilization losses in soils low in organic matter such as desert environments (absence of microbial community for biodegradation), although ample sunlight for photolysis was present. The study reported degradation due to the two processes with rates as high as 50% reduction in 5 months (Jorgensen *et al*. 1991; WHO 1989). The Oregon study, with sites located on the Hood River and in Medford reported a degradation rate of 17% – 18% over 5 years. The findings suggest that reduction in DDT is related to the amount applied, the proportion of organic matter, the proximity to soil-air interface and the amount of sunlight (USEPA 2000).

Similar to Station DW239 in Downtown Anchorage, low levels of alpha and gamma chlordane were measured at Station DW237 (B Street/Broadway Piers). These levels are likely indicative of historical usage and the persistency of the isomers which constitute chlordane rather than an indication of recent contamination.

5.1.3 Switzer Creek

Total cadmium, copper, lead and zinc were consistently the four metals which had the highest ratios of measured concentration to WQOs at Station CGSC1 (Table 5-4). In the dissolved state, lead was not one of the four metals with the highest measured concentration to WQO ratio. Analyzing the concentrations of total recoverable metals, copper always had the highest ratio, exceeding its WQO in the wet weather sample and two dry weather samples. In every sample, zinc had the next highest concentration relative to its WQO, exceeding its WQO in the wet weather sample and in one dry weather sample. Dissolved copper and zinc had the two highest concentrations relative to their WQOs in all samples at Station CGSC1. Figure 5-4(a) compares wet weather results to an average concentration of the three dry weather results for dissolved and total cadmium, copper, lead and zinc.

Table 5-4. Total and Dissolved Metals Ranked Relative to the Ratio of the Measured Concentration to the Hardness Dependent WQO for Samples Collected at Station CGSC1, Switzer Creek.

Wet Weather		Dry Weather					
22-Mar-05		14-Jun-05		28-Jun-05		12-Jul-05	
Metal	Ratio	Metal	Ratio	Metal	Ratio	Metal	Ratio
Copper	4.661	Copper	2.597	Copper	11.701	Copper	0.916
Zinc	3.513	Zinc	0.333	Zinc	4.087	Zinc	0.211
Lead	0.862	Lead	0.049	Lead	0.982	Lead	0.048
Silver	0.288	Cadmium	0.010	Cadmium	0.184	Cadmium	0.011
Cadmium	0.227	Nickel	0.006	Nickel	0.020	Nickel	0.003
Nickel	0.016	Silver	0.005	Chromium	0.004	Silver	0.002
Chromium	0.008	Chromium	0.000	Silver	0.003	Chromium	0.000
Dissolved Copper	3.826	Dissolved Copper	2.104	Dissolved Copper	0.118	Dissolved Copper	0.617
Dissolved Zinc	2.673	Dissolved Zinc	0.179	Dissolved Zinc	0.013	Dissolved Zinc	0.080
Dissolved Silver	0.339	Dissolved Cadmium	0.006	Dissolved Nickel	0.006	Dissolved Cadmium	0.007
Dissolved Lead	0.124	Dissolved Silver	0.006	Dissolved Lead	0.006	Dissolved Nickel	0.003
Dissolved Cadmium	0.086	Dissolved Lead	0.005	Dissolved Cadmium	0.005	Dissolved Lead	0.003
Dissolved Nickel	0.012	Dissolved Nickel	0.005	Dissolved Silver	0.003	Dissolved Silver	0.002
Dissolved Chromium	0.009	Dissolved Chromium	0.001	Dissolved Chromium	0.001	Dissolved Chromium	0.000

Red - Exceedance ratios greater than one indicate metal exceeded WQO

Total hardness was lower at Station CGSC1 during the wet weather event compared all three dry weather events by an order of magnitude. Therefore, water quality criteria were lower (more restrictive) during the wet weather sampling event. As described previously (Section 3.5), stormwater runoff typically has a lower hardness than dry weather (municipal) runoff.

Figure 5-4(b) shows the ratio of indicator bacteria densities to the dry weather action levels at station CGSC1. The bar chart illustrates that the densities of indicator bacteria during wet and dry weather were approximately equal.

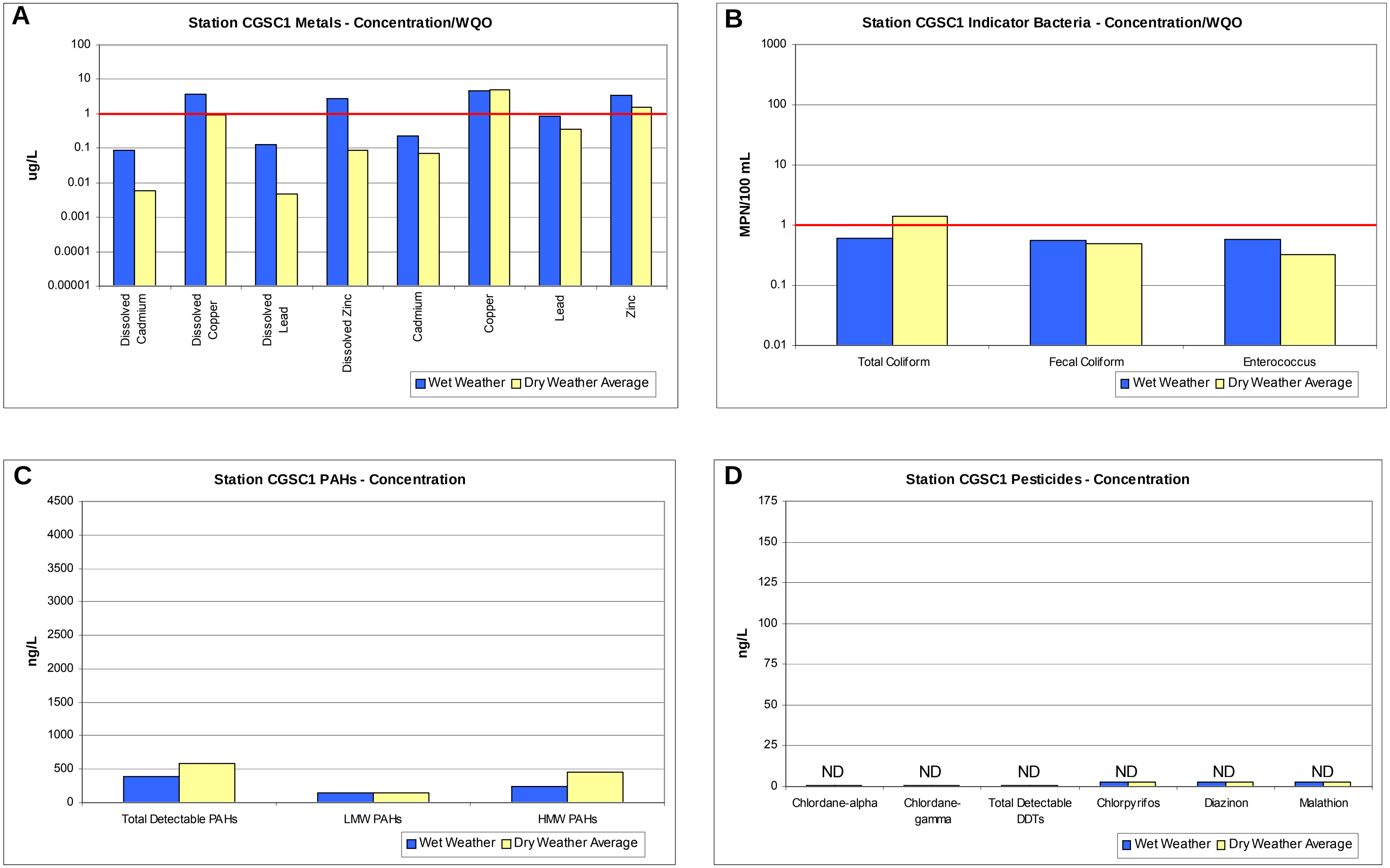

Figure 5-4. Wet Weather Results Compared to Average Dry Weather Results: Ratio of Select Metal Concentrations to WQO (a), Ratio of Indicator Bacteria to WQO (b), PAH Concentrations (c) and Select Pesticides Concentrations (d) at Station CGSC1.

Figure 5-4(c) and (d) show the actual concentrations of PAHs and select pesticides at Station CGSC1. Low concentrations of TPAHs were observed in both wet and dry weather samples. There were no detections of any pesticide at station CGSC1. The bars in Figure 5-4(d) represent one-half the constituents' MDL.

5.2 Estimate of Loading

Load estimates were calculated for the wet weather storm event using a modeled flow volume for the entire storm event. Estimates of load were not calculated using the measured and observed flow rate by the field technicians because these data were representative of only a single point in time, and not representative of the entire storm event. Load estimates were not calculated for the dry weather events.

Each load calculation is based on a measured constituent concentration multiplied by an estimated storm volume runoff. The runoff depth is calculated by multiplying a mean percent impervious value by the rainfall depth. The runoff volume is then the runoff depth multiplied by the drainage area. The mean percent impervious value for the drainage areas is calculated in GIS from a land use layer and estimates of percent impervious for each different land use type. Thus, the load estimation is based on the following equation:

$$\text{Load} = \text{Rainfall} \times \text{Mean Imperviousness} \times \text{Area} \times \text{Measured Concentration}$$

This procedure is based on the "Simple Method" (SMRC 2005). It only requires a modest amount of information but errors could result from poor estimates of impervious area or a measured concentration that does not well represent the event mean concentration.

Table 5-5 presents the load estimates for constituents which had measured concentrations above the MDL during the storm event on March 22, 2005. Loads were not estimated for constituents which were not detected in the sample.

The earlier discussion focused on four metals, cadmium, copper, lead and zinc, which tended to have the highest concentrations relative to WQOs in the water quality samples. Dissolved cadmium loading was estimated at 0.01 kg at one station (DW240); dissolved copper loading ranged from 0.11 kg at B Street and Broadway Piers to 0.97 kg at Station DW240 in Downtown Anchorage; dissolved lead loading ranged from 0.02 kg to 0.04 kg and dissolved zinc, which had the highest contribution of these four metals, ranged from 0.28 kg at Station DW239 to 4.04 kg at Station DW240. Total cadmium loading was estimated between 0.01 and 0.02 kg; total copper loading was estimated between 0.22 kg to 1.74 kg; total lead loading was estimated between 0.13 to 1.17 kg and total zinc, which also had the highest contribution of these four metals, ranged from 1.72 kg at Switzer Creek to 10.40 kg at Station DW240 in Downtown Anchorage.

Estimated loadings of total PAHs ranged from 7.39 g at Switzer Creek to 78.92 g at Station DW240 in Downtown Anchorage. Total chlordane estimates ranged 1.16 g at Station DW239 in Downtown Anchorage to 1.20 g at B Street and Broadway Piers. Approximately 3.25 g of malathion was estimated at Station DW239 in Downtown Anchorage.

Table 5-5. Estimate of Constituent Loading During the Wet Weather Sampling Event, March 22, 2005.

Analyte	Units	Estimated Loads - Storm Event March 22, 2005			
		Downtown Anchorage		B Street - Broadway Piers	Switzer Creek
		DW240	DW239	DW237	CGSC1
General Chemistry					
Ammonia-N	kg	8.9	2.5	5.4	13.5
MBAS	kg	21.3	7.4	4.2	25.8
Nitrate-N	kg	39.8	16.9	20.6	40.4
Nitrite-N	kg	2.1	0.7	1.4	4.8
Oil & Grease	kg	132.7	63.7	95.2	NA
Orthophosphate as P	kg	34	20	35	76
Total Suspended Solids	kg	5024	16261	12204	962
Total Kjeldahl Nitrogen	kg	52	25	65	54
Carbon, Total Organic	kg	734	154	264	847
Bacterial					
Total Coliform	MPN	2.E+13	3.E+13	2.E+13	6.E+12
Fecal Coliform	MPN	4.E+11	3.E+12	1.E+13	2.E+12
Enterococcus	MPN	7.E+11	1.E+12	1.E+12	1.E+12
Dissolved Metals					
Dissolved Aluminum (Al)	kg	1.47	1.03	0.93	0.63
Dissolved Antimony (Sb)	kg	0.09	0.01	NA	0.01
Dissolved Arsenic (As)	kg	0.05	0.03	0.02	0.02
Dissolved Barium (Ba)	kg	0.68	0.16	0.17	0.22
Dissolved Beryllium (Be)	kg	NA	NA	NA	NA
Dissolved Cadmium (Cd)	kg	0.01	NA	NA	NA
Dissolved Chromium (Cr)	kg	0.06	0.02	0.02	0.02
Dissolved Cobalt (Co)	kg	0.01	0.00	NA	0.01
Dissolved Copper (Cu)	kg	0.97	0.18	0.11	0.18
Dissolved Iron (Fe)	kg	2.80	1.67	1.23	1.06
Dissolved Lead (Pb)	kg	0.04	0.02	0.03	0.02
Dissolved Manganese (Mn)	kg	0.65	0.06	0.08	0.04
Dissolved Mercury (Hg)	kg	NA	NA	NA	NA
Dissolved Molybdenum (Mo)	kg	0.12	0.01	0.01	0.04
Dissolved Nickel (Ni)	kg	0.17	0.02	0.01	0.02
Dissolved Selenium (Se)	kg	0.01	0.00	0.01	NA
Dissolved Silver (Ag)	kg	NA	NA	NA	NA
Dissolved Strontium (Sr)	kg	2.72	0.55	0.88	1.19
Dissolved Thallium (Tl)	kg	NA	NA	NA	NA
Dissolved Tin (Sn)	kg	0.00	NA	NA	NA
Dissolved Titanium (Ti)	kg	0.07	0.04	0.03	0.03
Dissolved Vanadium (V)	kg	0.14	0.07	0.04	0.04
Dissolved Zinc (Zn)	kg	4.04	0.28	0.43	1.28
Total Metals					
Aluminum (Al)	kg	38.64	123.08	44.63	6.67
Antimony (Sb)	kg	0.11	0.01	0.02	0.02
Arsenic (As)	kg	0.05	0.03	0.03	0.02
Barium (Ba)	kg	1.77	2.36	1.36	0.31
Beryllium (Be)	kg	NA	0.01	0.00	NA
Cadmium (Cd)	kg	0.02	0.01	0.01	0.00
Chromium (Cr)	kg	0.17	0.32	0.17	0.06
Cobalt (Co)	kg	0.05	0.11	0.04	0.01
Copper (Cu)	kg	1.74	0.74	0.48	0.22
Iron (Fe)	kg	54.29	171.77	63.96	4.12
Lead (Pb)	kg	0.70	1.17	0.74	0.13
Manganese (Mn)	kg	2.57	4.19	1.89	0.34
Mercury (Hg)	kg	NA	NA	NA	NA

Analyte	Units	Estimated Loads - Storm Event March 22, 2005			
		Downtown Anchorage		B Street - Broadway Piers	Switzer Creek
		DW240	DW239	DW237	CGSC1
Molybdenum (Mo)	kg	0.09	0.01	0.01	0.02
Nickel (Ni)	kg	0.26	0.18	0.07	0.03
Selenium (Se)	kg	0.01	0.01	0.00	NA
Silver (Ag)	kg	NA	NA	NA	NA
Strontium (Sr)	kg	3.15	1.37	1.60	1.25
Thallium (Tl)	kg	NA	0.00	NA	NA
Tin (Sn)	kg	0.01	NA	NA	NA
Titanium (Ti)	kg	1.95	2.98	1.92	0.15
Vanadium (V)	kg	0.32	0.65	0.22	0.05
Zinc (Zn)	kg	10.40	4.39	4.25	1.72
PAHs					
1-Methylnaphthalene	g	0.30	0.12	0.24	0.18
1-Methylphenanthrene	g	1.58	0.97	0.75	0.22
2,3,5-Trimethylnaphthalene		NA	NA	NA	NA
2,6-Dimethylnaphthalene	g	0.33	0.15	0.21	0.19
2-Methylnaphthalene	g	0.51	0.39	0.42	0.42
Acenaphthene	g	0.36	0.16	0.19	0.12
Acenaphthylene	g	0.42	NA	0.17	NA
Anthracene	g	1.05	0.52	0.38	NA
Benz[a]anthracene	g	2.51	1.79	1.81	0.19
Benzo[a]pyrene	g	2.69	2.22	2.18	NA
Benzo[b]fluoranthene	g	4.41	3.30	2.88	NA
Benzo[e]pyrene	g	4.87	3.21	3.13	0.39
Benzo[g,h,i]perylene	g	7.73	4.54	4.85	0.57
Benzo[k]fluoranthene	g	2.47	2.09	2.28	NA
Biphenyl	g	1.15	0.36	0.26	0.14
Chrysene	g	6.07	4.56	3.94	0.67
Dibenz[a,h]anthracene	g	NA	0.32	0.33	NA
Dibenzothiophene	g	3.44	1.74	NA	NA
Fluoranthene	g	11.67	9.56	6.67	1.33
Fluorene	g	NA	0.25	0.25	0.11
Indeno[1,2,3-c,d]pyrene	g	3.07	2.59	2.36	0.19
Naphthalene	g	1.08	0.59	0.75	0.42
Perylene	g	2.96	0.89	0.89	NA
Phenanthrene	g	7.32	5.68	3.50	1.04
Pyrene	g	12.95	8.31	6.43	1.22
Total Detectable PAHs	g	78.92	54.31	44.85	7.39
PCBs					
Aroclor 1016	g	NA	NA	NA	NA
Aroclor 1221	g	NA	NA	NA	NA
Aroclor 1232	g	NA	NA	NA	NA
Aroclor 1242	g	NA	NA	NA	NA
Aroclor 1248	g	NA	NA	NA	NA
Aroclor 1254	g	NA	NA	NA	NA
Aroclor 1260	g	NA	NA	NA	NA
Total Detectable PCBs	g	NA	NA	NA	NA
Chlorinated Pesticides					
2,4'-DDD	g	NA	NA	NA	NA
2,4'-DDE	g	NA	NA	NA	NA
2,4'-DDT	g	NA	NA	NA	NA
4,4'-DDD	g	NA	NA	NA	NA
4,4'-DDE	g	NA	NA	NA	NA
4,4'-DDT	g	NA	NA	NA	NA
Aldrin	g	NA	NA	NA	NA
BHC-alpha	g	NA	NA	NA	NA
BHC-beta	g	NA	NA	NA	NA

Analyte	Units	Estimated Loads - Storm Event March 22, 2005			
		Downtown Anchorage		B Street - Broadway Piers	Switzer Creek
		DW240	DW239	DW237	CGSC1
BHC-delta	g	NA	NA	NA	NA
BHC-gamma	g	NA	NA	NA	NA
Chlordane-alpha	g	NA	0.60	0.45	NA
Chlordane-gamma	g	NA	0.56	0.75	NA
Dieldrin	g	NA	NA	NA	NA
Endosulfan Sulfate	g	NA	NA	NA	NA
Endosulfan-I	g	NA	NA	NA	NA
Endosulfan-II	g	NA	NA	NA	NA
Endrin	g	NA	NA	NA	NA
Endrin Aldehyde	g	NA	NA	NA	NA
Endrin Ketone	g	NA	NA	NA	NA
Heptachlor	g	NA	NA	NA	NA
Heptachlor Epoxide	g	NA	NA	NA	NA
Methoxychlor	g	NA	NA	NA	NA
Mirex	g	NA	NA	NA	NA
Oxychlordane	g	NA	NA	NA	NA
Total Detectable DDTs	g	NA	NA	0.36	NA
Toxaphene	g	NA	NA	NA	NA
trans-Nonachlor	g	NA	NA	NA	NA
Organophosphorus Pesticides					
Bolstar (Sulprofos)	g	NA	NA	NA	NA
Chlorpyrifos	g	NA	NA	NA	NA
Demeton	g	NA	NA	NA	NA
Diazinon	g	NA	NA	NA	NA
Dichlorvos	g	NA	NA	NA	NA
Dimethoate	g	NA	NA	NA	NA
Disulfoton	g	NA	NA	NA	NA
Ethoprop (Ethoprofos)	g	NA	NA	NA	NA
Fenchlorphos (Ronnel)					
Fensulfothion	g	NA	NA	NA	NA
Fenthion	g	NA	NA	NA	NA
Malathion	g	NA	3.25	NA	NA
Merphos	g	NA	NA	NA	NA
Methyl Parathion	g	NA	NA	NA	NA
Mevinphos (Phosdrin)	g	NA	NA	NA	NA
Phorate	g	NA	NA	NA	NA
Tetrachlorvinphos (Stirofos)	g	NA	NA	NA	NA
Tokuthion	g	NA	NA	NA	NA
Trichloronate	g	NA	NA	NA	NA
Synthetic Pyrethroids					
Allethrin	g	NA	NA	NA	NA
Bifenthrin	g	NA	NA	NA	NA
Cyfluthrin	g	NA	NA	NA	NA
Cypermethrin	g	NA	NA	NA	NA
Danitol	g	NA	NA	NA	NA
Deltamethrin	g	NA	NA	NA	NA
L-Cyhalothrin	g	NA	NA	NA	NA
Permethrin	g	NA	NA	NA	NA
Prallethrin	g	NA	NA	NA	NA

NA - Constituent Not Detected in Sample; Load Estimate Not Assessed

5.3 Sediment Samples

Unfortunately, only one sediment sample was collected within each drainage area concurrently with one dry weather water quality sampling event. Sufficient data do not exist to correlate sediment and water quality contaminants of concern. Qualitatively, though, it is interesting to note that three of the metals which most frequently exceeded WQOs or had the highest measured concentration to WQO ratio also exceeded the NOAA TEL guidelines in at least one sediment sample. These were copper, lead and zinc.

Mercury was the only constituent to exceed the NOAA PEL guidelines for freshwater sediment. It exceeded the PEL of 486 ppb at all four stations. The mercury levels in the sediment were also compared to the NOAA Effects Range - Median (ER-M) guideline (710 ppb). The ER-M is typically used when assessing potential contamination in marine sediments and represents the median concentration in which toxicity was observed in a database of sediment samples. The ER-M was used in this case because San Diego Bay is the receiving waterbody which these sediments would be transported to and deposited in. All four sediment samples also exceeded the ER-M.

Mercury is a naturally occurring element that is found in air, water and soil. It exists in several forms: elemental or metallic mercury, inorganic mercury compounds, and organic mercury compounds. Inorganic mercury compounds have been included in products such as fungicides, antiseptics or disinfectants. Mercury adheres strongly to soil particles and persists in the environment.

Mercury is found in many rocks including coal. When coal is burned, mercury is released into the environment. Coal-burning power plants are the largest human-caused source of mercury emissions to the air in the United States, accounting for over 40 percent of all domestic human-caused mercury emissions (USEPA 2005). The USEPA has estimated that about one quarter of U.S. emissions from coal-burning power plants is deposited within the contiguous U.S. and the remainder enters the global cycle. Although there are no coal-burning power plants within the San Diego area, mercury may be entering the region via air deposition from other locations. In addition, burning hazardous wastes, producing chlorine, breaking mercury products, and spilling mercury, as well as the improper treatment and disposal of products or wastes containing mercury, can also release mercury into the environment. Interestingly, there has been historical burning of hazardous waste at San Diego County burn sites within the region. Current estimates suggest that less than half of all mercury deposition within the U.S. comes from U.S. sources (USEPA 2005).

6.0 CONCLUSIONS/RECOMMENDATIONS

The primary objective of the *San Diego Bay Watersheds Common Grounds Project* is to further develop the region's capacity to understand processes affecting our water resources so that point and nonpoint pollution sources can be identified and abated. Water and sediment quality and bioassessment monitoring was conducted in three drainages including Downtown Anchorage, B Street/Broadway Piers and Switzer Creek in the Pueblo San Diego watershed in support of TMDL development. The results presented in this report provide an excellent qualitative assessment of the areas sampled and in addition provide data to serve for future quantitative analyses that will lead to linkages between COCs identified on the CWA 303(d) list, water quality, and San Diego Bay Toxic Hot spots. Although the data collected assesses the current conditions within these three drainages, it should be understood that these data represent only one storm event and one dry weather season and therefore cannot be the sole basis of TMDL development. Results from this study may also assist in directing future monitoring programs, data integration, communication and effective watershed management.

The wet and dry weather water quality results tended to show consistent patterns of which WQOs were being exceeded. Indicator bacteria (total and fecal coliform), dissolved and total metals (specifically copper, lead and zinc) as well as various general chemistry constituents (MBAS and TSS) exceeded WQOs in multiple samples. Conversely, PAHs were typically detected only at low levels while PCBs, chlorinated pesticides, organophosphorus pesticides and synthetic pyrethroids were not detected (with the exception of malathion in one storm water sample [DW239], chlordane in two storm water samples [DW239 and DW237] and 4,4' DDE (a derivative of DDT) in one storm water sample [DW237]).

Sediment samples collected from within each drainage indicated that mercury was the only metal that exceeded the NOAA freshwater sediment PEL guideline in each sample. Copper and zinc exceeded the TEL in the B Street/Broadway Piers and Switzer Creek drainages. Lead also exceeded the TEL in the Switzer Creek drainage. None of the organophosphorus pesticides or synthetic pyrethroids was detected in any sediment sample from either of the drainages.

Analysis of the benthic macroinvertebrate community of Switzer Creek indicated that the site was somewhat impaired relative to reference conditions in the region, but compared favorably to many other urban runoff influenced sites in San Diego County. The IBI scores were 22 and 15 for the May and October surveys, respectively, with quality ratings of Poor for both surveys. This rating, plus the presence of many macroinvertebrate taxa with moderate tolerance to impairment indicated that the water quality likely did not have severe contaminant issues, but contained some constituents that prevented the colonization of highly sensitive organisms.

Indicator bacteria densities at Station DW240 during the dry weather sampling events were significantly greater than the dry weather action levels. A bacteria source tracking study may be necessary to identify the potential sources of these elevated levels in this drainage. The study would likely include an adaptive sampling scheme throughout the storm drain system, traditional microbiological analyses for total and fecal coliforms and enterococcus, as well as bacteroides sampling by polymerase chain reaction (PCR) to determine whether there is a human source of bacteria in the sample.

Mercury concentrations were above the PEL guideline in each sediment sample at the four stations. A historical data review of potential mercury contamination in each of these drainages may identify sources and assist in directing future monitoring studies.

The loading estimates are based on grab sample concentrations measured during one storm event. The measured concentrations are not representative of an entire storm event nor are they representative of an entire storm season. They were calculated to provide an indication of the order of magnitude to which specific constituents are being discharged through the MS4 to San Diego Bay. Additional flow monitoring using flow meters installed directly into the MS4 would assist to refine the loading estimates. Further, flow-weighted composite samples would better represent a constituent's concentration.

The loading estimates were based on a GIS Specialists interpretation of storm drain maps and topography. Ground truthing of the drainage areas and MS4 would require field verification of the boundaries of the catchment areas and integrity and accuracy of the MS4. This would provide more accurate information for calculating loads.

Fresh water discharges to San Diego Bay would be subject to dilution through mixing with the ambient water column, transport from the point of discharge due to currents and potentially degradation due to physical and chemical processes. The 303(d) list and BPTCP findings indicate the sediments located near these drainages have benthic impairments and exhibit toxicity. An assessment of how the storm water and dry weather discharges to San Diego Bay directly impacts these sediments would be beneficial. A software modeling program, such as AquaTox, could assist in this assessment.

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