COUNTY OF SAN DIEGO SOUTHERN WATERSHEDS WATER MONITORING PROGRAM REPORT

Prepared for

County of San Diego

Department of Public Works, Watershed Protection Program

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1. INTRODUCTION

1.1 Background

The County of San Diego Department of Public Works, Watershed Protection Program (County) desired to collect dry weather and wet-weather samples at five mass loading stations located in creeks in the southern portion of San Diego County. Brown and Caldwell was selected to perform these services, which consisted of verifying the sampling locations, installing automated sampling equipment, collecting the water samples, submitting the samples to an analytical laboratory for analysis, removal of the sampling equipment, and preparation of this report summarizing the activities and findings..

The agreement for this work was signed in July 2007, with the intent that two dry-weather and two wet-weather events be sampled between July 2007 and October 2008. In late October 2007, several major wildfires devastated large portions of the County, including much of the watershed lands draining to the mass loading stations that were to be monitored under this program. Subsequently, the County decided to postpone monitoring activities in these watersheds. The County elected to resume activities under this agreement in February 2008, and monitoring was conducted between July 2008 and March 2009.

1.2 Purpose

The County routinely collects water samples from creeks located throughout San Diego County. However, these samples are generally collected as grab samples that provide data for one point in time only. Also, samples are collected during dry weather only. The monitoring described in this report provides more representative samples because the samples were collected over a longer period of time (24 hours for dry weather samples, and flow-weighted across the duration of storms, with the exception of bacteria which must always be collected as grab samples). The data also provide some information about water quality following a major wildfire.

2. MONITORING PROGRAM DESIGN

This section describes the monitoring program design, including the locations of the monitored sites, equipment used, laboratory analyses conducted, and field procedures implemented to conduct the monitoring.

2.1 Monitoring Locations

The monitoring locations for this project were specified in the Request for Proposals, and included the following sites:

Table 2-1. Monitoring Site Locations				
Site ID	Watershed	Site Location	Latitude	Longitude
SWT21	Sweetwater	North Fork of Sweetwater River @ Tavern Road	32.80879	-116.78036
SWT07	Sweetwater	Drainage Channel @ Quarry Road and Swap Meet Road	32.70114	-117.00927
OTY03	Otay	Dulzura Creek @ Otay Lakes Road	32.63624	-116.88456
TIJ02	Tijuana	Pine Valley Creek @ Old Highway 80	32.83776	-116.53725
TIJ04	Tijuana	Campo Creek @ Highway 94	32.60917	-116.47419

On August 9, 2007, Brown and Caldwell staff conducted a field reconnaissance visit to all 5 sites. The visit was conducted with Steve Di Donna of the County, who was familiar with the specific features of each site. The purpose of the visit was to verify the locations and determine the physical layout of equipment at each of the sites.

Site Descriptions

- **Site SWT21 (North Fork of Sweetwater River at Tavern Road).** This site is located adjacent to the Tavern Road bridge over the river in the unincorporated community of Alpine. The surrounding land use is rural residential, with some equestrian and agricultural uses. At the location of the bridge, the creek is constrained between rock walls and passes through a box culvert beneath the bridge that is divided into two conduits. The monitoring location was sited on the downstream side of the bridge where the creek is not longer constrained by armored banks.


Sampling Site
SWT 21 (Alpine)

- **Site TIJ02 (Pine Valley Creek @ Old Highway 80).** This site is located beneath the Old Highway 80 bridge spanning Pine Valley Creek in the community of Pine Valley. The area immediately surrounding the site is open space and rural residential. The bridge is approximately 50 feet above the creek, and the valley constraining the creek is several hundred feet across at that point. Due to concerns about the ability of a pump to draw water so far, it was decided that the sampling equipment would be housed on the bank of the creek below the bridge, adjacent to one of the support structures (yet above the level of the creek in wet weather).

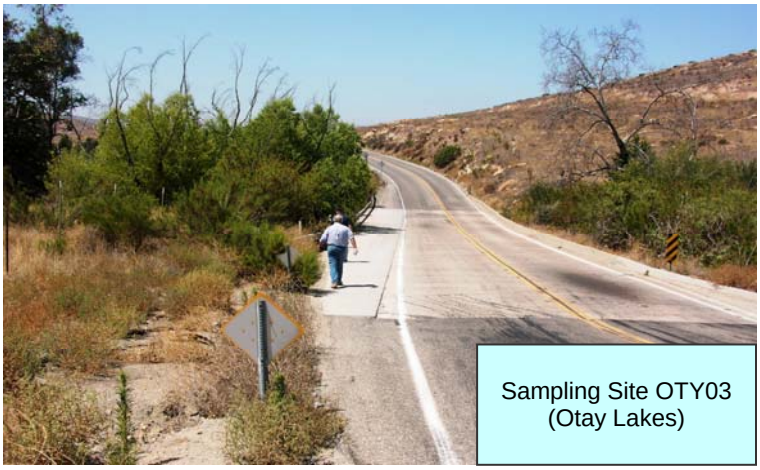

Sampling Site TIJ02
(Pine Valley)

This monitoring site is accessed via a dirt trail from the side of the bridge.

- **Site TIJ04 (Campo Creek at Highway 94).** The site is located adjacent to the Highway 94 crossing of Campo Creek in the community of Campo. At the location of the bridge, the creek is constrained within a box culvert that is divided into three conduits. The area surrounding the creek is heavily vegetated.

Sampling Site TIJ04 (Campo)

- **Site OTY03 (Dulzura Creek @ Otay Lakes Road).** This site is located at the creek crossing of Otay Lakes Rd., northeast of Chula Vista. There is a small box culvert conveying the creek across the road that functions during low flows; however, water flows over the road under high flow conditions. The monitoring equipment was installed along the bank of the creek. This area was severely burned during the Cedar Fire in October 2007, eliminating nearly all vegetation on the surrounding hillsides (except for riparian vegetation along the creek bed).



Sampling Site OTY03 (Otay Lakes)

- **Site SWT07 (Drainage Channel @ Quarry Road and Swap Meet Road).** Site SWT07 is located in the community of Spring Valley, adjacent to newly constructed State Highway 125, and near a vacant parcel used to hold weekend swap meets. The surrounding land uses are residential in nature. The equipment was installed on the bank of the creek (right side of photo).

Sampling Site SWT07
(Spring Valley)

2.2 Analytical Parameters

The field and laboratory analyses for this project were specified in the RFP. The specific field and laboratory parameters to be analyzed are presented in Tables 2-2 and 2-3, along with information regarding field instrument specifications and laboratory methods, sample volume, preservative, holding time, and reporting limit. The analytical laboratories selected for this project included CRG Marine Laboratories (Torrance, CA) for most analyses, and Weston Solutions (Carlsbad, CA) for bacteria analyses (due to short holding times).

Table 2-2 Field Parameters

Parameter	Principle	Units	Range	TRL	Accuracy	Precision	Recovery	Completeness
Temperature	Thermistor	Degrees Celsius (°C)	0 – 50 oC	N/A	+/- 0.1 °C	No SWAMP requirement; will use + 0.5 or 5%	N/A	No SWAMP requirement; will use 90%
Dissolved Oxygen	Membrane/ galvanic cell	mg/L	0 – 19.9	0.2	+/- 0.1 mg/L	No SWAMP requirement; will use + 0.5 or 10%	N/A	No SWAMP requirement; will use 90%
pH	Glass Electrode	s.u.	0 – 14.0	N/A	+/-0.1 s.u.	No SWAMP requirement; will use + 0.5 or 5%	N/A	No SWAMP requirement; will use 90%
Conductivity	Alternating four-electrode	uS/cm	0 - 100	2	+/-1 uS/cm	No SWAMP requirement; will use + 5%	N/A	No SWAMP requirement; will use 90%
Turbidity	Scattering/ transmitting light	NTUs	0 - 800	5	+/-1 NTU	No SWAMP requirement; will use + 10% or 0.1, whichever is greater	N/A	No SWAMP requirement; will use 90%

*Equipment is Horiba U-10 or other multi-parameter meter; accuracy verified with the manufacturer.

Table 2-3. Laboratory Analytical Requirements					
Parameter	Method	Volume	Preservative	Holding Time	Reporting Limit
Ammonia-N	EPA 350.2	250 mL	Acidify to pH<2 with H2SO4	28 days	0.50 mg/L
Antimony (Dissolved)	EPA 200.7/200.8	250 mL	None	6 months after filtration and preservation with HNO3	5.0 ug/L
Antimony (Total)	EPA 200.7/200.8	250 mL	HNO3	6 months	5.0 ug/L
Arsenic (Dissolved)	EPA 200.7/200.8	250 mL	None	6 months after filtration and preservation with HNO3	1.0 ug/L
Arsenic (Total)	EPA 200.7/200.8	250 mL	HNO3	6 months	1.0 ug/L
Cadmium (Dissolved)	EPA 200.7/200.8	250 mL	None	6 months after filtration and preservation with HNO3	1.0 ug/L
Cadmium (Total)	EPA 200.7/200.8	250 mL	HNO3	6 months	1.0 ug/L
Chlorpyrifos	EPA 8081	1000 mL	None	7 days	0.05 ug/L
Chromium (Dissolved)	EPA 200.7/200.8	250 mL	None	6 months after filtration and preservation with HNO3	5.0 ug/L
Chromium (Total)	EPA 200.7/200.8	250 mL	HNO3	6 months	5.0 ug/L
Coliform (Fecal)	SM 9221 C	100 mL	Na2S2O3	6 hours @ 4ºC	20 MPN/100 mL
Coliform (Total)	SM 9221 C	100 mL	Na2S2O3	6 hours @ 4ºC	20 MPN/100 mL
Copper (Dissolved)	EPA 200.7/200.8	250 mL	None	6 months after filtration and preservation with HNO3	5.0 ug/L
Copper (Total)	EPA 200.7/200.8	250 mL	HNO3	6 months	5.0 ug/L
Diazinon	EPA 8081	1000 mL	None	7 days	0.05 ug/L
Enterococcus	SM 9230 B	100 mL	Na2S2O3	6 hours @ 4ºC	20 MPN/100 mL
Hardness (Total)	SM 2340 C	250 mL	None	6 months	2.0 mg CaCO3/mL
Iron (Total)	EPA 200.7/200.8	250 mL	Acidify to pH<2 with HNO3	6 months	20.0 ug/L
Lead (Dissolved)	EPA 200.7/200.8	250 mL	None	6 months after filtration and preservation with HNO3	2.0 ug/L
Lead (Total)	EPA 200.7/200.8	250 mL	HNO3	6 months	2.0 ug/L
Manganese (Total)	EPA 200.7/200.8	250 mL	HNO3	6 months	1.0 ug/L
Malathion	EPA 8081	1000 mL	None	7 days	0.05 ug/L
Nickel (Dissolved)	EPA 200.7/200.8	250 mL	None	6 months after filtration and preservation with	2.0 ug/L

Table 2-3. Laboratory Analytical Requirements					
Parameter	Method	Volume	Preservative	Holding Time	Reporting Limit
				HNO3	
Nickel (Total)	EPA 200.7/200.8	250 mL	HNO3	6 months	2.0 ug/L
Nitrate-N	EPA 300.0	250 mL	None	48 hours	0.2 mg/L
Nitrite-N	EPA 354.1	250 mL	None	48 hours	0.005 mg/L
Orthophosphate-P	EPA 365.2	250 mL	None	48 hours	0.02 mg/L
Selenium (Dissolved)	EPA 200.7/200.8	250 mL	None	6 months after filtration and preservation with HNO3	5.0 ug/L
Selenium (Total)	EPA 200.7/200.8	250 mL	HNO3	6 months	5.0 ug/L
Total Dissolved Solids	EPA 160.1	1000 mL	None	7 days	25.0 mg/L
Total Kjeldahl Nitrogen	EPA 351.3	1000 mL	H2SO4	28 days	0.80 mg/L
Total Phosphate-P	EPA 365.3	250 mL	H2SO4	28 days	0.02 mg/L
Total Suspended Solids	EPA 160.2	1000 mL	None	7 days	2.5 mg/L
Zinc (Dissolved)	EPA 200.7/200.8	250 mL	None	6 months after filtration and preservation with HNO3	5.0 ug/L
Zinc (Total)	EPA 200.7/200.8	250 mL	HNO3	6 months	5.0 ug/L

2.3 Field Equipment Installation and Calibration

The monitoring stations were installed at the locations described above during Spring 2008. At each location, a concrete pad measuring approximately 4 feet square was formed and poured in place as a base for the equipment. Knaack utility boxes were then mounted on the pads and bolted from the inside to the concrete pad to provide secure housing for the automated sampling equipment. Flow was monitored at all stations using American Sigma (Hach) autosamplers and flow meters. Field crews measured the flow rate of each stream using a hand held flow meter (Marsh McBirney FloMate). Based on these data, discharge rates were developed for each of the streams at the locations of the monitoring stations. These discharge rates were used to calculate a discharge equation, which was used to program the flow monitoring equipment. Each station was also equipped with a solar panel to recharge the batteries and a rain gauge mounted on a pole to record rainfall at each location. The installations were performed in April, 2008. Most of the installations were straightforward, with the exception of Station TIJ02 (Pine Valley Creek @ Old Highway 80) which required the use of a crane to lower the utility box and equipment down from the bridge to the sampling location.

Autosampler installation at Pine Valley site TIJ04

3. MONITORING ACTIVITIES AND RESULTS

3.1 Sampling Schedule

Monitoring was conducted on the following dates and stations:

Table 3-1: Sampling Schedule

Date of Sampling	Rainfall Amount*	Type of Sampling	Stations Monitored	Comments
July 30-31, 2008	N/A	Dry-weather, 24-hour time weighted composite	SWT07, SWT21, and TIJ02	Stations OTY03 and TIJ04 were dry.
February 6-7, 2009	1.23 in.	Wet-weather, flow-weighted composite	OTY03, SWT07, SWT21, and TIJ04	Insufficient rainfall at Station TIJ02 to capture the storm event.
March 30-31, 2009	N/A	Dry-weather, 24-hour time weighted composite	OTY03, SWT07, SWT21, TIJ02, and TIJ04	All stations captured.

* Rainfall measured at Campo Rain Gauge No. MCMNC1 (Cameron Fire Station).

This project was intended to capture a second storm event; however, a second event was not sampled due to limited rain events that produced adequate runoff in the southeastern part of the County, or because the rain events occurred on holidays.

3.2 Sampling Protocols

Field Data sheets were completed at each sample location, for each event, and are included in Appendix A. Digital photographs were also taken at each site, showing the actual sample collection point, as well as conditions upstream and downstream of the sampling site.

CRG Marine Laboratories and Weston Solutions provided chain of custody (COC) forms for the project. Sampling crews completed these forms while on site in the field. Copies of all COC forms are included in Appendix A.

In the field, all samples were placed on wet ice or frozen ice packs until shipment. Identification information for each sample was recorded on the field data sheets and chain-of-custody forms). Samples were handled, prepared, transported, and stored in a manner so as to minimize loss, misidentification, contamination, and/or degradation. Samples were transported on ice and in insulated containers (e.g., insulated cooler). All caps and lids were checked for tightness prior to shipping. Efforts were taken to minimize the leakage of any melted ice from the sample shipment container. Sample packaging included the following steps:

- Grab samples (for bacteria) were placed in a sealed plastic bag (Ziploc) to prevent leakage. Ice (double bagged in plastic trash bags) was placed in the cooler with the samples to maintain the samples at 4° C during transport to Weston Solutions' Carlsbad facility for analysis.
- Grab samples were delivered to Weston Solutions in time to meet 6-hour holding times for bacteria.
- 19-liter glass bottles were placed in individual trash containers sized small enough to fit them for transport to CRG Marine Laboratories.

- The Chain-of-Custody (COC) records were placed in a waterproof plastic bag and placed inside the cooler with the grab samples or taped to the outside of the trash containers (for 19-liter samples).
- 19-liter samples were picked up by the CRG Marine Lab courier in time to meet sample holding times.

The collected samples were delivered to the laboratory for analyses as soon as practicable. Any delay in the receipt of the samples by the laboratory could necessitate a re-sampling and analysis effort.

At the end of the sampling activities, each crew will deliver the samples for chemical analyses with the respective COC forms to Babcock, or coordinate with a reliable courier for sample drop off. Table 4-4 provides contact information and driving directions to Babcock Laboratories. In the event that samples need to be dropped off on a weekend or after standard hours of operation, the Brown and Caldwell Project Manager contacted CRG and Weston to make special arrangements for laboratory staff to be available.

The sample receipt personnel at the laboratory will open the container and perform an initial inspection of the contents to check for evidence of breakage and/or leakage. The container will be inspected for COC documents and any other information or instructions. The sample custodian will verify that all information on the sample bottle labels is correct and in accordance with the COC documents and will sign for receipt. If discrepancies are noted between the COC and the sample labels, the project contact will be notified immediately. Contract laboratories will follow the sample custody procedures outlined in their QA plans. These QA plans are on file with each respective laboratory. All samples will be stored in a refrigerated, secure area. Samples will be removed from storage as needed by the analyst; analysts check out samples by signing a logbook maintained in sample control for tracking samples.

3.3 Quality Assurance/Quality Control

Water quality samples were collected in order to ensure the collection of representative water samples. CRG Marine Laboratories and Weston Solutions implemented quality assurance and quality control programs in accordance with guidelines established by the State of California and the U.S. EPA., and are certified under the State Environmental Laboratory Accreditation Program (ELAP). Field duplicates were collected at the rate of 10 percent and analyzed blind by the laboratories.

3.4 Results

The following sections provide a summary and interpretation of the data collected during the three water sampling events that were analyzed. Laboratory analytical results are summarized in Table 3-2.

Table 3-2. Analytical Results and Comparison to Water Quality Objectives

			Dry Weather Event July 31, 2008			Dry Weather Event March 2009					Wet Weather Event February 6, 2009			
Parameter/Units	WQO	Source	TIJ02 (Pine Valley)	SWT07 (Spr. Valley)	SWT21 (Alpine)	OTY03 (Otay Lakes)	SWT07 (Spr. Valley)	SWT21 (Alpine)	TIJ02 (Pine Valley)	TIJ04 (Campo)	OTY03 (Otay Lakes)	SWT07 (Spr. Valley)	SWT21 (Alpine)	TIJ04 (Campo)
Ammonia-N, mg/L			ND	0.07	0.05	ND	0.1	ND	0.03	ND	0.03	0.12	0.08	0.12
Antimony (Dissolved), ug/L	calculated	40CFR 131	ND	0.4	0.1	0.1	0.5	0.1	ND	0.1	NA	NA	NA	NA
Antimony (Total), ug/L	6	Basin Plan	ND	0.4	0.1	0.1	0.5	0.1	ND	0.1	NA	NA	NA	NA
Arsenic (Dissolved), ug/L	340	40CFR 131	0.3	4.4	2.2	1.3	4.4	1.9	0.3	1.6	1.3	2.7	1	1.9
Arsenic (Total), ug/L	340/50	40CFR131/ Basin Plan	0.5	4.6	2.3	1.2	4.6	1.7	0.5	1.5	1.4	2.8	1.3	2.6
Cadmium (Dissolved), ug/L	calculated	40CFR 131	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cadmium (Total), ug/L	4.3	40 CFR 131	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlorpyrifos, ng/L	20	CA Dept. of Fish & Game	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chromium (Dissolved), ug/L	calculated	40CFR 131	ND	0.1	3.9	ND	0.1	5.7	ND	ND	0.1	0.4	0.9	ND
Chromium (Total), ug/L	550	40CFR 131	ND	0.2	4	0.1	0.4	5.7	ND	ND	0.3	1.1	1.8	0.5
Coliform (Fecal), MPN/100 mL	400	Basin Plan	40	170	500	<20	220	40	<20	<20	20	3,500	1,100	160,000
Coliform (Total), MPN/100 mL			500	14,000	700	1,100	8,000	3,000	2,200	1,300	3,500	160,000	13,000	160,000
Copper (Dissolved), ug/L	calculated	40CFR 131	ND	1.8	ND	1.7	2.8	0.8	0.4	0.5	1.4	4.3	2.4	1
Copper (Total), ug/L	13	40CFR 131	0.4	2.7	0.8	1.4	3	0.8	ND	0.5	2.4	10.3	4.9	2.5
Diazinon, ng/L	80	CA Dept. of Fish & Game	ND	35.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Enterococcus. MPN/100 mL			80	80	340	<20	800	220	70	300	500	50,000	5,000	17,000
Hardness (Total), mg/L			149.7	795.1	574.3	321.1	757.8	585.6	137	397.6	354.8	93.6	157.8	385.8
Iron (Total), ug/L			68	80	47	97	70	37	64	86	267	704	897	1046
Lead (Dissolved), ug/L	calculated	40CFR 131	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.15	ND	ND
Lead (Total), ug/L	65	40CFR 131	ND	0.19	0.06	0.21	0.21	ND	ND	0.06	1.09	7.71	2.22	3.97
Manganese (Total), ug/L			19.8	102.9	47.6	20.9	134.4	18.1	23.3	62.6	92	82.6	91.5	212.3
Malathion, ng/L	430	CA Dept. of Fish & Game	ND	ND	ND	ND	ND	ND	ND	ND	ND	34.8	18.9	ND
Nickel (Dissolved), ug/L	calculated	40CFR 131	0.4	2.1	0.9	0.4	2.2	1	0.4	0.3	0.5	1.2	0.8	0.6
Nickel (Total),ug/L	100	Basin Plan	0.5	2.2	1.1	0.4	2.2	1	0.4	0.3	0.9	2	1.5	1
Nitrate-N, mg/L	10	Basin Plan	0.8	8.1	16.26	0.03	7.21	14.37	0.47	ND	0.68	1.04	2.96	0.09
Nitrite-N, mg/L	1	Basin Plan	ND	0.07	ND	ND	0.14	ND	ND	ND	ND	0.09	0.09	ND
Orthophosphate-P (Dissolved), mg/L			0.0363	0.0812	0.0644	ND	0.1238	0.0505	0.0075	0.0075	ND	0.1411	0.1208	0.0721
Orthophosphate-P (Total), mg/L			ND	0.07	0.05	0.03	0.16	0.06	0.03	0.1	0.03	0.2	0.19	0.15
Selenium (Dissolved), ug/L	20	40 CFR 131	2.4	6	1.3	0.4	4.8	1.8	2.1	0.2	0.5	0.4	0.3	0.2
Selenium (Total), ug/L	20	40 CFR 131	2.2	5.8	1.2	0.3	4.9	1.5	2.3	ND	0.5	0.4	0.3	0.2
Total Dissolved Solids, mg/L	1500	Basin Plan	388	3226	1116	936	3008	1206	332	1086	994	358	410	1114
Total Kjeldahl Nitrogen, mg/L			0.63	1.8	0.98	0.91	1.1	0.84	0.84	0.98	0.84	1.5	1.7	1.1
Total Suspended Solids, mg/L	100	USEPA Multisector General Permit	1.5	4	8	10	2.3	4	2.3	0.7	51.6	93	86	52

Table 3-2. Analytical Results and Comparison to Water Quality Objectives														
			Dry Weather Event July 31, 2008			Dry Weather Event March 2009					Wet Weather Event February 6, 2009			
Parameter/Units	WQO	Source	TIJ02 (Pine Valley)	SWT07 (Spr. Valley)	SWT21 (Alpine)	OTY03 (Otay Lakes)	SWT07 (Spr. Valley)	SWT21 (Alpine)	TIJ02 (Pine Valley)	TIJ04 (Campo)	OTY03 (Otay Lakes)	SWT07 (Spr. Valley)	SWT21 (Alpine)	TIJ04 (Campo)
Zinc (Dissolved), ug/L	calculated	40CFR 131	0.6	3.6	0.5	0.1	7.8	ND	0.2	ND	1.5	10.8	4.8	4
Zinc (Total), ug/L	120	40CFR 131	2.3	6.8	4	0.1	10.6	2.2	3.1	ND	12.5	56.7	23.6	21.6

ND: Non-detect NA: Not analyzed

3.5 Data Interpretation and Comparison to Data from Mass Loading Stations and Water Quality Objectives

The San Diego Stormwater Copermittees conduct dry and wet-weather monitoring for compliance with their areawide NPDES stormwater permit (RWQCB Order 2007-001). This sampling is conducted at mass loading stations (MLS), typically located toward the lower end of each major watershed, above the zone of tidal influence. Data from the southern watersheds study were compared to data collected at the Sweetwater and Tijuana River mass emissions stations reported in the 2006-07 Annual Monitoring Report, the most recent season these stations were monitored. These MLS stations were selected because 2 of the southern watersheds sites are located in the upstream portions of the Sweetwater River watershed, and 2 are located in the Tijuana River watershed. The fifst station is located in the Otay River watershed, but there is no downstream MLS station on the Otay River to compare to. The report provides a comparison of the southern watersheds data with MLS stormwater data collected over 6 years of monitoring (from 2001-02 through 2006-07).

The data from the southern watersheds study were also compared to the Water Quality Objectives (WQOs) established for a number of constituents. The following section provides a summary and discussion of these comparisons.

Metals

Water samples from the southern watersheds sites were analyzed for a large suite of total and dissolved metals including antimony, arsenic, cadmium, chromium, copper, iron, lead, manganese, nickel, selenium, and zinc. All of the metals except cadmium were detected in at least one sample. The highest metals concentrations were observed for iron. Total iron ranged between 137 ug/L and 795.1 ug/L in dry weather samples and between 93.6 ug/L and 385.8 ug/L in wet weather samples. This is likely due to the presence of iron in solids. Total metals concentrations of copper and zinc which are often used as indicators of heavy metals in urban runoff were similar to those observed at the Sweetwater MLS, but lower than those from the Tijuana River MLS. None of the southern watersheds samples exceeded the WQOs for either constituent. Total copper ranged between ND and 2.7 ug/L in dry weather samples and between 2.4 and 10.3 ug/L in wet weather samples. Total zinc ranged between ND and 10.6 ug/L in dry weather samples and between 12.5 and 56.7 ug/L in wet weather samples. By comparison, stormwater samples collected at the Sweetwater MLS ranges from <5 ug/L to 18 ug/L for total copper and between <20 ug/L to 47 ug/L for total zinc. in Total metals were higher in wet weather, suggesting a likely association with sediments. In contrast, stormwater samples at the Tijuana River MLS exceeded the WQO exceeded the WQO for copper in 9 of the 18 samples collected at this station since 2001-02, ranging in concentration from 8 ug/L to 197 ug/L. Similarly, zinc exceeded the WQO 6 times, with concentrations ranging from <20 ug/L to 1,530 ug/L. The Tijuana River receives significant inputs of industrial waste and municipal wastewater, in addition to urban runoff, which likely explains the elevated levels in the downstream portions of that watershed.

Nutrients

Water samples in this study were analyzed for several nutrient indicators (nitrate-N, nitrite-N, total orthophosphate-N, and dissolved orthophosphate-N). All results were below WQOs except both dry weather samples collected from the SWT21 (Alpine) site, which had concentrations of 16.26 mg/L and 14.37 mg/L, both above the Basin Plan objective of 10 mg/L. A possible source of the nitrate could be septic tank leakage from rural residential parcels in this area (this has not been confirmed). Nitrite was ND in 7 of the 8 dry weather samples and 2 of the 4 wet weather samples. All detections were less than or equal to 0.14 mg/L. Total orthophosphate ranged from ND to 0.16 mg/L in dry weather samples and between 0.03 mg/L and 0.2 mg/L in wet weather samples. In comparison the stormwater samples from the MLS stations, none of the

samples from the Sweetwater or the Tijuana River MLS exceeded the WQO for nitrate. One sample from the Tijuana River MLS exceeded the WQO of 0.1 mg/L for nitrite. The MLS samples were not analyzed for orthophosphate-P.

Bacteria

Bacterial indicators analyzed in this study included total and fecal coliform and enterococcus. In general, bacterial indicators were present at higher levels in wet weather samples than in dry weather samples. Monitoring indicated exceedance of the Basin Plan WQO for fecal colifom (400 MPN/100 mL0 in one dry weather sample and in 3 of the 4 wet weather samples. The highest level of fecal coliform (160,000 MPN/100 mL) was observed in the wet weather sample from site TIJ04 (Campo). Total coliform counts ranged from 500 MPN/100 mL to 14,000 MPN/100 mL in dry weather samples and between 500 MPN/100 mL and 50,000 MPN/100 mL in wet weather samples. Enterococcus counts ranged between <20 and 800 MPN/100 mL in the dry weather samples, with a median level of 80 MPN/100 mL. In wet-weather, counts were higher, from 500 MPN/100 mL at the Otay Lakes (OTY03) site to 50,000 MPN/100 mL at Spring Valley (SWT07). Similar counts of bacterial indicators were observed in stormwater at the Sweetwater River MLS. At the Tijuana River MLS, bacteria levels in stormwater samples were 3-4 orders of magnitude higher than in the southern watersheds samples (as high as >16,000,000 MPN/100 mL). This is consistent with the fact that portions of the Tijuana River receive inputs of sewage.

Pesticides

Diazinon and chlorpyrifos were generally non-detect (diazinon was observed in one dry weather sample from the Spring Valley SWT07 site at a concentration of 35.1 ng/L). Malathion was ND in the dry weather samples, but was detected twice in wet weather (at concentrations of 34.8 ng/L at Spring Valley site SWT07, and 18.9 ng/L at Alpine site SWT21). All pesticide detections were below their respective WQOs. Compared with the MLS data, the following observations were made. At the Sweetwater MLS site, diazinon and chlorpyrifos were detected at levels in excess of the WQOs in samples collected between 2001-02 and 2003-04. However, both pesticides were ND in samples collected since that time. Diazinon was banned for certain uses in the United States beginning in 2003, and the decreased concentrations in stream waters appear to correlate with this ban. In contrast, levels of diazinon at the Tijuana River MLS continued to exceed the WQO in samples collected through 2006-07. This may be partly because Mexico has not banned the use of diazinon and significant portions of this watershed are in Mexico. Over the six year MLS monitoring period, malathion was occasionally detected in stormwater samples from the Sweetwater River MLS (all below the WQO). Malathion was detected at levels above the WQO in 8 of the 15 samples at the Tijuana River MLS over this period.

Solids

Total suspended solids (TSS) concentrations were lower in dry weather than wet weather events. All TSS measurements were below the WQO of 100 mg/L. Specifically, TSS ranged between 0.7 and 15 mg/L in dry weather and between 51.6 and 93 mg/L in wet weather samples. Over the six years of stormwater monitoring at the Sweetwater River MLS, TSS ranges between <20 mg/L and 102 mg/L, with one exceedance of the WQO. By comparison, samples from the Tijuana River MLS exceeded the WQO in 16 of 18 samples, with concentrations ranging between 48 and 8,140 mg/L. Higher TSS levels may be correlative with sewage and industrial waste inputs.

Total dissolved solids (TDS) levels were high, especially in dry weather, and particularly at the Spring Valley site (SWT07), where concentrations exceeded the WQO of 1,500 mg/L during both dry weather events (3,226 mg/L and 3,008 mg/L, respectively).. Wet-weather TDS concentrations were lower, ranging from 358 mg/L at Spring Valley site SWT07 to 1,114 mg/L at the Campo site (TIJ04). Over six years of stormwater

monitoring at the Sweetwater River MLS, TDS exceeded the WQO in 13 out of 18 samples. In contrast, TDS in stormwater from the Tijuana River MLS did not exceed the WQO in any of the 18 samples.

APPENDIX A

Copies of Field Forms, Analytical Laboratory Reports and QA/QC Documentation

APPENDIX B

Copies of Weston Solutions' Wet-Weather Data for Sweetwater River and Tijuana River MLS (from 2006-07 Annual Monitoring Report)