

**SANTA MONICA BAY SHORELINE MONITORING  
MUNICIPAL SEPARATE STORM SEWER SYSTEM (MS4) REPORT  
(June 1, 2010 – May 30, 2011)**

**Monitoring and Assessment by the City of Los Angeles Environmental Monitoring Division**

## **I. INTRODUCTION**

Increasing population and ongoing urban developments within the Santa Monica Bay area have the potential to create significant impacts on beach water quality. Human activities, including, but not limited to, car washing, landscape irrigation, neglecting to pick up and properly dispose of pet waste, homelessness, improper disposal of car oil, illicit connections, and leaky septic tanks, contribute various pollutants that are washed into local waters through storm drains and through urban runoff during rain events. These are considered as point and non-point sources of pollutants. These sources contain flows that are untreated. Although improvements have been made in treating point source flows from wastewater treatment plants and industrial facilities, the Environmental Protection Agency (EPA) has estimated that non-point sources of pollution is now the single largest cause of deterioration of water quality (Ohio State University 2009; Dojiri et al., 2003). Storm drains have been identified as potentially large sources of bacteria discharged to receiving waters around the country. This is particularly true in California where sanitary sewer and storm drain sewer systems are separate. Therefore, the storm drain discharges are not treated before they discharge across the beach directly into the water-contact zones (Schiff and Kinney 2001).

The EPA established a municipal storm water management program known as the Municipal Separate Storm Sewage System (MS4) Program that is intended to improve the nation's waters by reducing the quantities of pollutants that urban runoff and storm water pick up and carry into the storm water systems from normal or routine urban activities or during storm events. An MS4 is a conveyance system made up of catch basins, curbs, gutters, ditches, and storm drains owned by a state, city, county, town, or other public body that is designed to collect or convey storm water and urban runoff to waters of the US (CRWQCB 2001). Unless diverted to treatment plants, these discharges are untreated, carrying pollutants to local water bodies. The City of Los Angeles (CLA) as a co-permittee of the Los Angeles County MS4 Program discharges storm water into local waterways. The permit for the MS4 Program requires the City to design a storm water management program that reduces the discharge of pollutants to the maximum extent practicable, that protects water quality, and that satisfies the water quality requirements of the Clean Water Act (CRWQCB 2001).

The Santa Monica Bay Beaches were designated as impaired and included on California's 1998 Clean Water Act 303(d) list of impaired waters due to excessive amounts of coliform bacteria. The California Regional Water Quality Control Board, Los Angeles Region (Regional Board) released a first draft of the Santa Monica Bay Beaches Bacterial TMDL (SMBBB TMDL) on November 9, 2001. Regional Board staff bifurcated the SMBBB TMDL into two TMDLs, one for dry-weather and one for wet-weather. Both the SMBBB Dry and Wet-Weather TMDLs were approved by EPA in June 2003 and became effective on July 15, 2003. The SMBBB TMDLs divide the year into three separate periods for compliance purposes: summer-dry weather (April

1 – October 31), winter-dry weather (November 1 – March 31), and wet weather. A single Coordinated Shoreline Monitoring Plan (CSMP) was developed by the TMDL’s responsible agencies to comply with the monitoring requirements of both the dry- and wet-weather TMDLs; monitoring of SMBBB TMDL compliance monitoring stations began November 1, 2004. In addition to bacteria monitoring sites, the CSMP established multiple shoreline observation sites for dry-weather flow observations. One year from the initiation of the monitoring program, the Regional Board was to evaluate the accumulated flow observation data to determine whether any of the observation sites warranted inclusion to the list of compliance monitoring sites.

Four years after the effective date of the TMDLs, the Regional Board was to have re-opened the TMDLs to reconsider certain provisions based on new data, including waste load allocations (Table 1). Waste load allocations are expressed as the number of sample days at a shoreline-sampling site that may exceed a single sample target (Table 2). Waste load allocations are expressed as allowable exceedances days because the bacterial density and frequency of single sample exceedances are the most relevant to public health protection (CRWQCB 2004).

**Table 1. Santa Monica Bay Waste Load Allocations**

Frequency	Allowable Single-Sample Exceedance Days			Allowable Geometric Mean Exceedance Days	
	Summer Dry	Winter Dry	Wet Weather	Summer Dry	Winter Dry
Daily	0	3	17	0	0
Weekly	0	1	3	0	0

Current state water quality standards require the use of bacteria as indicators of human fecal contamination. The TMDLs establish multi-part numeric targets based on three bacteriological analytical parameters: Total coliform density, fecal coliform/*E. coli* density, and enterococcus density with density reported in bacteria counts per 100 milliliters of water sampled. Their presence in water, especially fecal coliform/*E. coli* and enterococci, is considered to be an indication of recent fecal contamination, which is the major source of many waterborne diseases (Csuros and Csuros 1999).

Numeric targets established by the SMBBB TMDLs have been established based on the Los Angeles Basin Plan objectives for body-contact recreation (REC-1) and are equivalent to the State bacteriological standards pursuant to Assembly Bill 411. Basin Plan objectives include both single-sample limits and geometric mean limits (Table 2). EMD evaluates and reports data relative to REC-1 bathing water quality standards for bacterial densities.

**Table 2. Los Angeles Basin Plan bacteriological water quality standards (REC-1)**

Single Sample Limits shall not exceed	Rolling 30-day Geometric Mean Limits shall not exceed
10,000 total coliform bacteria/100 ml; or	1,000 total coliform bacteria/100 ml; or
400 fecal coliform/ <i>E.coli</i> bacteria/100 ml; or	200 fecal coliform/ <i>E.coli</i> bacteria/100 ml; or
104 <i>Enterococcus</i> bacteria/100 ml; or	35 <i>Enterococcus</i> bacteria/100 ml
1,000 total coliform bacteria/100 ml, if the ratio of fecal/total coliform exceeds 0.1	

Monitoring indicator bacteria currently is one of the most efficient means of predicting the presence of pathogens in marine waters. These indicators are used because the methods for their detection are comparatively rapid, relatively inexpensive, and are easy to perform. Current indicator bacterial quantification methods depend on incubation and growth of bacteria in the laboratory. Chromogenic substrate results presently are obtained approximately 18 to 24 hours after sample collection, thus preventing early notification of potential public health risks and contamination source identifications. The chromogenic substrate method was used for all SMBBB shoreline indicator bacterial quantifications.

As part of the Annual Report for the NPDES MS4 Permit, CLA has been submitting the Santa Monica Bay Shoreline Monitoring Annual Report that includes water quality and analysis at eighteen (18) MS4 monitoring stations over the period from July 1 through June 30. The time between the end of the reporting period date June 30 and the submittal deadline is not sufficient for lab analysis, data compilation, data analysis, and preparation of the final report. CLA requested and received approval from the Regional Board to modify the reporting period from July 1 thru June 30 to **June 1 thru May 30**. Beginning this fiscal year the monitoring report will expand to include bacterial data from SMBBB TMDL shoreline monitoring stations established in the SMBBB TMDL that are monitored by CLA, thereby increasing the number of monitoring stations from 18 to 34. Unforeseen at the time of the request, an added benefit of moving the reporting period to June 1 thru May 30 is the additional time required for data compilation, data analysis, and analysis reporting of 34 monitoring stations into summer-dry, winter-dry, and wet-weather periods as set forth by the SMBBB TMDLs. This report summarizes the City of Los Angeles EMD's Santa Monica Bay shoreline bacteriological data for the Fiscal Year 2010-2011 (June 1, 2010 through May 31, 2011).

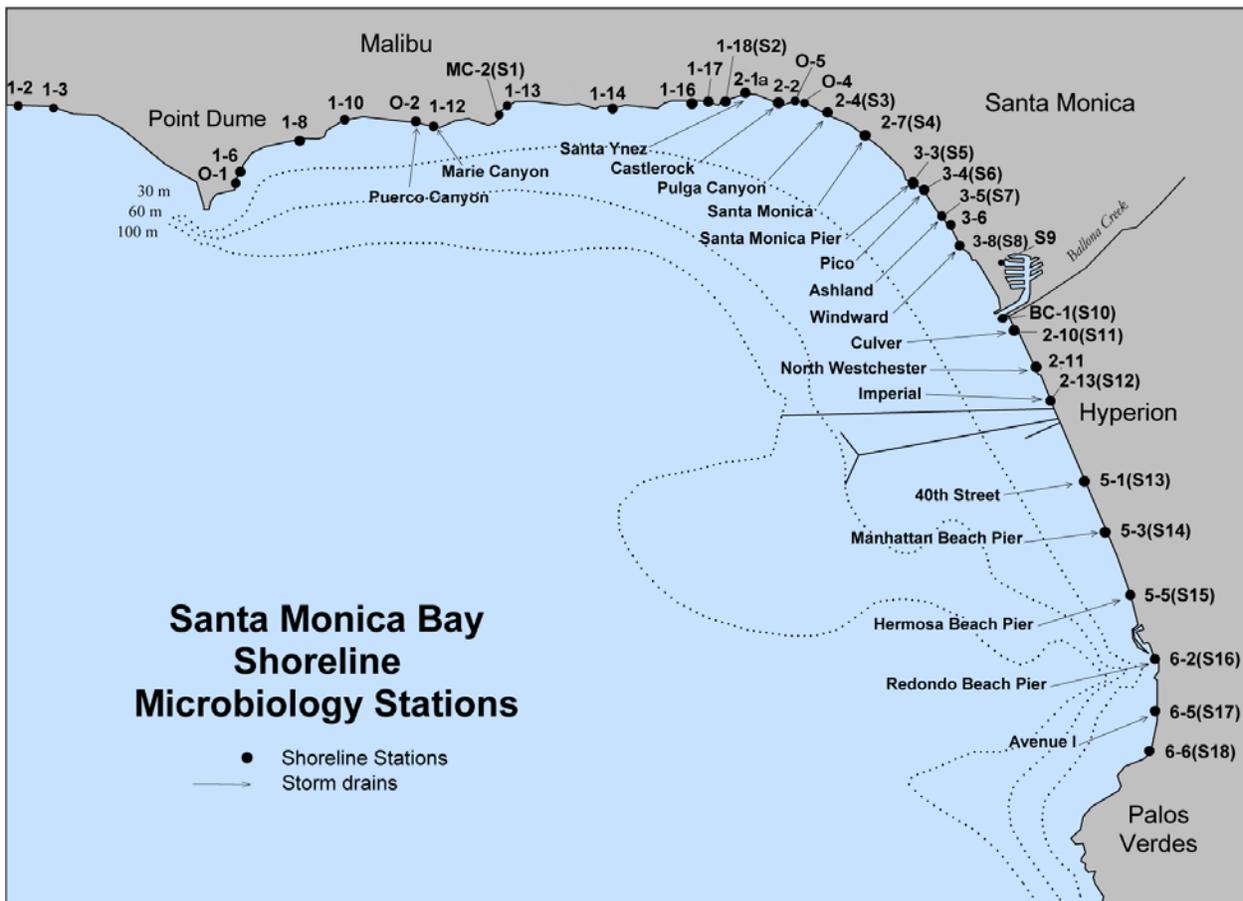
The Santa Monica Bay shoreline bacterial data collected by the City are reported daily to the Los Angeles County Department of Public Health (LACDPH). Subsequently, LACDPH takes steps (such as posting health hazard warning signs for beach users) to notify beach goers whenever an exceedance of bacterial standards occurs.

## **II. MATERIALS AND METHODS**

### **Sample Collection**

Historically, EMD has monitored eighteen MS4, SMB shoreline stations ranging from Surfrider Beach (S1, Malibu Lagoon) in Malibu southward to Malaga Cove (S18, Palos Verdes Estates; Figure 1). On November 1, 2004, the City of Los Angeles began participating in the Coordinated Shoreline Monitoring Plan (CSMP) for the Santa Monica Bay Beaches Bacterial TMDLs (SMBBB TMDL), monitoring 25 SMBBB TMDL compliance stations ranging from El Pescador State Beach in Malibu, southward to Dockweiler State Beach. In addition to the compliance sampling sites, the CSMP established that CLA EMD would record weekly dry-weather flow observations at five observation sites, with the caveat that, after a year of observations, the Regional Board would determine whether these sites would warrant being added to the list of compliance sites, based on observations of persistent runoff.

In September of 2009, the City submitted a letter to the Regional Board requesting either the removal or re-location of SMBBB TMDL sites that were consistently inaccessible to sampling and/or observations. In December 2009, the Regional Board approved CLA's proposed changes for some sampling locations and observation stations listed in the CSMP. Due to problems of constant inaccessibility to the site, SMB-2-1 (Castlerock SD) was relocated from point zero to just north of the storm drain where it is accessible and safe to sample. Observation stations SMB-O-1 and SMB-O-2 (Puerco Canyon SD, Puerco Beach) were upgraded to bacterial monitoring stations based on persistent runoff and accessibility. Station SMB-O-3 (Pierda Gorda, 36" SD ) was removed as an observation site due to its continued inaccessibility. These proposed changes became effective January 2010, and EMD began sampling 27 SMBBB TMDL compliance-monitoring stations and recording dry-weather flow observations, at two observation sites: SMB-O-4 and SMB-O-5.



**Figure 1:** Current EMD shoreline sampling locations of Santa Monica Bay, including storm drains and piers.

The CSMP and the Memoranda of Agreement reached between CLA and the other SMBBB TMDL responsible agencies established that CLA was responsible for monitoring 7 compliance stations solely as MS4 stations, 18 compliance stations solely as SMBBB TMDL stations, and 11 compliance stations as both MS4 and SMBBB TMDL sites, i.e., Malibu Creek at Surfrider Beach is both S1 and SMB MC-2 for MS4 and SMBBB TMDL compliance monitoring, respectively (Table 3). With the aforementioned RB-approved changes, CLA currently monitors a combination of thirty-three MS4 and SMBBB TMDL compliance sites.

In addition to adopting MS4 stations as TMDL stations, some TMDL monitoring requirements were incorporated into the MS4 permit. In November 2004, the monitoring frequency of all MS4 stations decreased from seven to six days per week. Additional changes to the MS4 monitoring program became effective July 2005: sampling of nine MS4 stations, S3, S8, S11 through S15, S17, and S18, was reduced from six days to one day per week and sampling of the remaining nine stations, S1, S2, S4 through S7, S9, S10, and S16, was changed from six to five days per week (Table 3). SMBBB TMDL stations are monitored on a weekly basis. Accelerated monitoring of TMDL stations is conducted 48 hours after the initial sample exceeds bacterial standards and 96 hours for sites that exceed bacterial limits after 48 hours.

With the exception of a few sites, all shoreline stations are sampled at point zero, which is defined as the point at which the discharge from a storm drain or creek initially mixes with the receiving water. A station having no storm drain or creek associated with it is referred to as an open beach site and is sampled at the midpoint of the beach (CSMP 2004). The exception is SMB-2-1 (Castlerock SD), which was relocated from point zero to just north of the storm drain in January 2010. High tide and large slippery rocks made SMB-2-1 constantly inaccessible and a safety concern to field personnel. It was re-designated SMB-2-1a to reflect the change in sampling point.

All samples were collected at ankle-depth level during daylight hours, with the exception of station SMB-2-2. Accessing SMB-2-2 is difficult; there is a tall fence surrounding the storm drain, large boulders in both directions, and a “Keep off Rocks” sign. Sampling is attainable from the top of the storm drain and only at high tide can a point zero (mixed) sample be collected.

Station Name	SMB TMDL	MS4	Frequency	Station Name	SMB TMDL	MS4	Frequency
El Pescador State Beach	1-2		Weekly	Santa Monica Pier SD, Santa Monica SB	3-3	S05	5 days/Week
El Matador State Beach	1-3		Weekly	Pico-Kenter SD, Santa Monica SB	3-4	S06	5 days/Week
Zumirez Dr, Point Dume	O-1		Weekly	Ashland SD, Santa Monica SB	3-5	S07	5 days/Week
Walnut Creek, Paradise Cove	1-6		Weekly	Rose SD, Venice Bch	3-6		Weekly
Escondido Crk, Escondido SB	1-8		Weekly	Windward SD, Venice Bch	3-8	S08	Weekly
Soltice Crk, Dan Blocker County Bch	1-10		Weekly	Marina del Rey, MDR		S09	5 days/Week
Marie Cyn SD, Puerco Bch	1-12		Weekly	Ballona Creek, Dockweiler SB	BC-1	S10	5 days/Week
Puerco Cyn SD, Puerco Bch	O-2		Weekly	Culver SD, Dockweiler SB	2-10	S11	Weekly
Malibu Creek, Malibu Lagoon CB	MC-2	S01	5 days/Week	North Westchester SD, Dockweiler SB	2-11		Weekly
Sweetwater Cyn, Carbon Bch	1-13		Weekly	Imperial Hwy SD, Dockweiler SB	2-13	S12	Weekly
Las Flores Crk, Las Flores SB	1-14		Weekly	40th St. SD, Manhattan Bch	5-1	S13	Weekly
Pena Crk, Las Tunas CB	1-16		Weekly	Manhattan Bch Pier	5-3	S14	Weekly
Tuna Cyn, Las Tunas CB	1-17		Weekly	Hermosa Bch Pier	5-5	S15	Weekly
Topanga Cyn, Topanga CB	1-18	S02	5 days/Week	Redondo Bch Pier	6-2	S16	5 days/Week
Castle Rock SD, Topanga CB	2-1		Weekly	Ave I SD, Redondo Bch	6-5	S17	Weekly
Santa Ynez SD, Will Rogers SB	2-2		Weekly	Malaga Cove, Palo Verdes Estates	6-6	S18	Weekly
Pulga Cyn SD, Will Rogers SB	2-4	S03	Weekly	24" corrugated pipe near O-5	O-4		Weekly
Santa Monica Cyn SD, Santa Monica SB	2-7	S04	5 days/Week	Marquez SD, Santa Ynez subwatershed	O-5		Weekly

**Table 3.** Summary of compliance monitoring stations and observation sites in Santa Monica Bay with monitoring frequency and corresponding MS4 and/or SMBBB TMDL station identification (sampling by EMD).

Because of spatial, logistical, and time constraints, simultaneous sample collection (within a 3 – 4 hour period) of SMB TMDL and MS4 stations are divided into northern stations, from SMB-1-2 (El Pescador State Beach) to SMB-1-16 (Pena Creek); central stations, from SMB-1-17 (Tuna Canyon) to S9 (Mother’s Beach) in Marina Del Rey; and southern stations, S10 (SMB BC-1, Ballona Creek) to S18 (Malaga Cove) in Palos Verdes Estates.

For FY2010-2011, 3,638 samples were collected for the MS4 and SMBBB TMDL Programs combined.

## **Sample Analysis**

Total coliform (TC) and *E. coli* (EC) bacterial densities were determined by the chromogenic substrate method following Standard Methods section 9223 (APHA 1998), and enterococcus (ENT) densities were determined by Enterolert™, per manufacturer’s instructions. Fecal indicator bacterial analyses totaling 10,914 were performed during the 2010 – 2011 fiscal year.

Visual field observations for shoreline stations were made along a 20-foot stretch of shoreline up and down coast of each station. This area around each station was observed for the presence of materials of sewage and non-sewage origin, any unusual odors of sewage and non-sewage origin, plankton color, and the presence of flow and flow rate (visual rating only) from storm drains. Storm drain flow data and Low-Flow-Diversion structures operation information is available upon request. Materials of sewage origin include plastic goods, rubber goods, and grease particles. Non-sewage origin materials include ocean debris, seaweed, refuse, tar, and dead marine animals. Station S8 was used as the shoreline weather station for observations of air and water temperature, weather conditions, wind speed and direction, wave height, and sea conditions.

Quality assurance and quality control procedures were conducted to confirm the validity of the analytical data collected. All areas impacting reported data were subjected to standard microbiological quality control procedures in accordance with Standard Methods (APHA 1998). These areas include sampling techniques, sample storage and holding time, facilities, personnel, equipment, supplies, media, and analytical test procedures. Duplicate analyses also were performed on ten percent of all samples. When quality control results were not within acceptable limits, corrective action was taken. This quality assurance program helped ensure the production of uniformly high quality and defensible data. In addition, EMD participates annually in the performance evaluation program managed by the California State Department of Public Health (CSDPH) as part of its Environmental Laboratory Accreditation Program (ELAP); CSDPH biennially certifies EMD.

## **Data Analysis**

The results obtained from microbiological samples do not generally follow a normal distribution. To compensate for a skewed distribution and to obtain a nearly normal distribution, data must be log-normalized prior to analysis. Seasonal Geometric means are the best estimate of central tendency for log-normalized data and were calculated for each bacterial indicator group. Seasonal geometric means were calculated for all sampling sites and were categorized into summer-dry, winter-dry, and

wet-weather to examine the effects of runoff from storm drains on indicator bacterial concentrations.

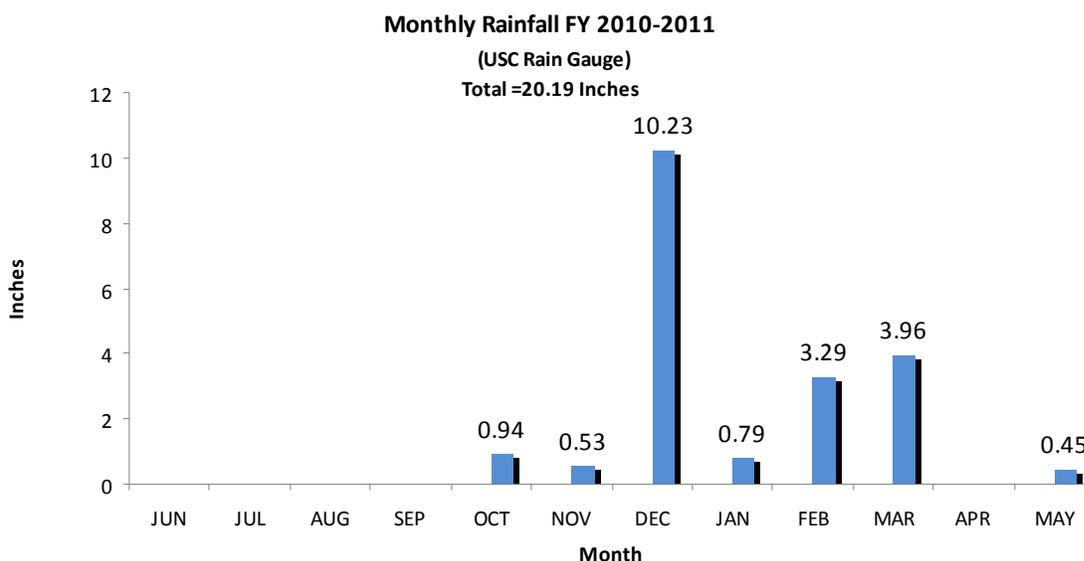
The geometric mean is defined in Webster's Dictionary as "the  $n^{\text{th}}$  root of the product of  $n$  numbers." Seasonal geometric mean values presented in Figures 3-5 were calculated by using all data from sampling events during each of summer dry, winter dry, and wet-weather periods. The TMDL rolling 30-day geometric mean was calculated as the 30th root of the product of 30 numbers (the most recent 30-day results). For weekly sampling, the 30 numbers are obtained by assigning the weekly test result to the remaining days of the week. If more samples are tested within the same week, each test result superseded the previous result and was assigned to the remaining days of the week until the next sample was collected. A rolling 30-day geometric mean was calculated for each day, regardless of whether a weekly or daily schedule was selected. The rolling 30-day geometric-mean exceedance days are presented in Tables 4 and 6.

The SMBBB TMDLs define wet weather as days with rain events of  $\geq 0.1$  inches of precipitation and the three days following the end of the rain event. Rain data were obtained from the National Weather Service's Downtown Los Angeles, University of Southern California (USC) records.

### III. RESULTS

#### Rainfall

Rainfall recorded during Fiscal Year 2010-2011, totaling 20.19 inches, was 3.74 inches greater than the previous Fiscal Year 2009-2010, and 5.15 inches above the seasonal average (15.04 inches) for the Los Angeles area. The majority of rainfall, approximately 18.27 inches, was recorded from December 2010 to March 2011, with December having the most rainfall, 10.23 inches; more than two-thirds the seasonal average. February and March had second and third highest rainfall amounts, with 3.29 and 3.96 inches of rain, respectively. No rain was recorded from June through September 2010 or in Apr 2011 (Figure 2).



**Figure 2.** Monthly rainfall at downtown Los Angeles, USC, June 2010 – May 2011.

#### Compliance Stations

Sample collection from Santa Monica Bay compliance monitoring stations is conducted year round to assess water quality and compliance to water quality standards. Bacterial densities obtained from fiscal year 2010-2011 were computed and graphed for geometric mean values. Graphical representations of summer-dry, winter-dry, and wet-weather period geometric mean values are illustrated in Figures 3, 4, and 5. With the incorporation of sixteen SMBBB TMDL stations in this fiscal year report, in addition to the 18 historical SMB MS4 sites, variations and significant geometric mean observations are presented below.

##### *Summer-Dry Weather (April 1 to October 30)*

The highest geometric means overall, for indicator bacteria in the summer-dry weather period (Figure 3) were found at stations SMB-1-8 (Escondido Creek), SMB-1-10 (Soltice Creek), S1 (Malibu Lagoon), SMB-1-12 (Marie Cyn), and S2 (Topanga Cyn). The highest (in descending

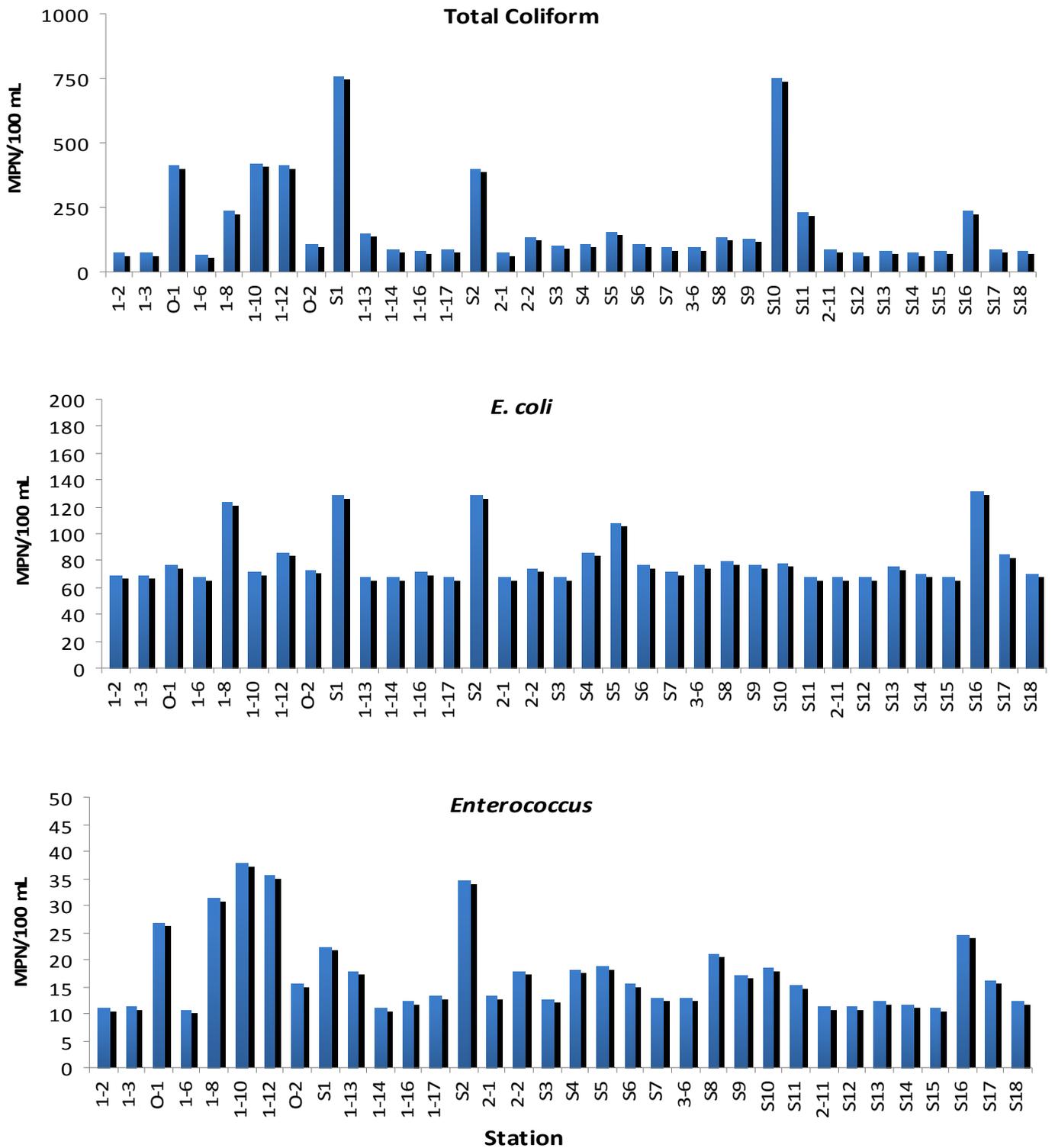
order) total coliform densities were recorded at stations S1, S10 (Ballona Creek), and SMB-1-12; and the highest *E. coli* densities at stations SMB-1-8, S16 (Redondo Pier) and S2, and enterococcus densities at stations SMB-1-10, 1-8, and SMB-1-12. With the exception of total coliform densities at station S10, station S16, located in the southern section of the Bay, had higher fecal indicator geometric means compared to its neighboring southern Bay sites. However, station S16 is collected daily and has more data points, whereas the others are weekly monitored sites. As in the findings of previous assessment reports, fecal indicator densities found at northern stations (sites north of Ballona Creek) were higher than densities found at sites south of the Creek. Also, bacterial densities during the summer-dry weather period were lower than densities in the winter-dry and wet-weather seasonal periods.

#### *Winter-Dry Weather (November 1 to March 30)*

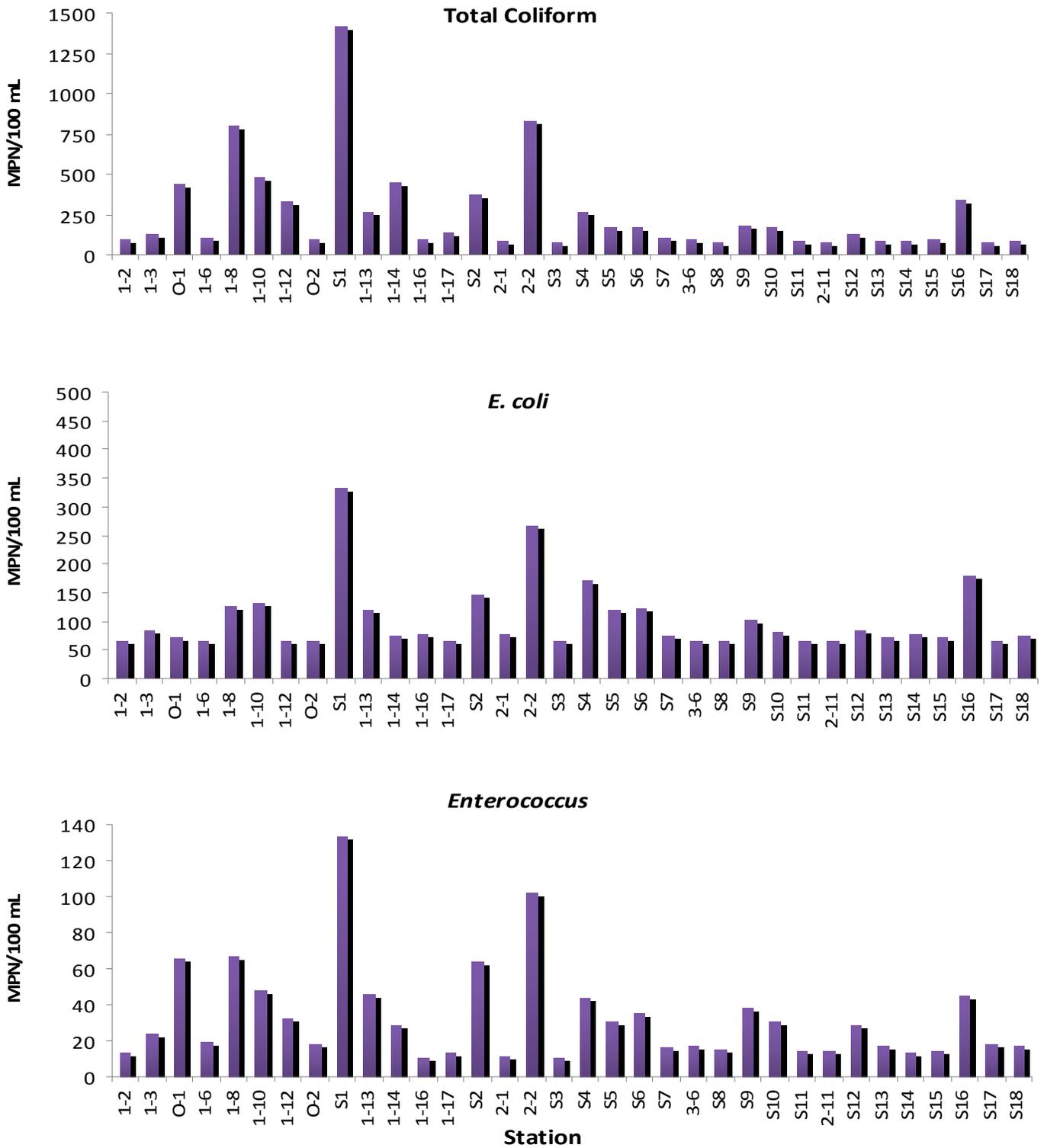
The highest geometric means computed for winter-dry weather were found mostly among stations in the northern Bay as were those observed in the summer-dry weather. Stations with the highest winter-dry geometric mean include, in descending order, stations S1 (Surfrider Beach, Malibu), SMB-2-2 (Castlerock SD), 1-10, 1-8, and O-1 (Figure 4). Station S1 had the highest geometric mean for total coliform, *E. coli*, and enterococcus during winter-dry weather, followed by station 2-2, also for all three FIB. While FIB densities at S16 were not as high as those found at sites with elevated counts in the northern Bay, as in the summer-dry period, S16 had the highest densities of all the southern Bay sites. Remaining Santa Monica Bay compliance stations had relatively low geometric means in the winter-dry weather. Comparatively, winter-dry geometric means were greater than summer-dry means over all indicators.

#### *Wet-Weather (Day of rain with 0.1 inches of rainfall plus three succeeding days)*

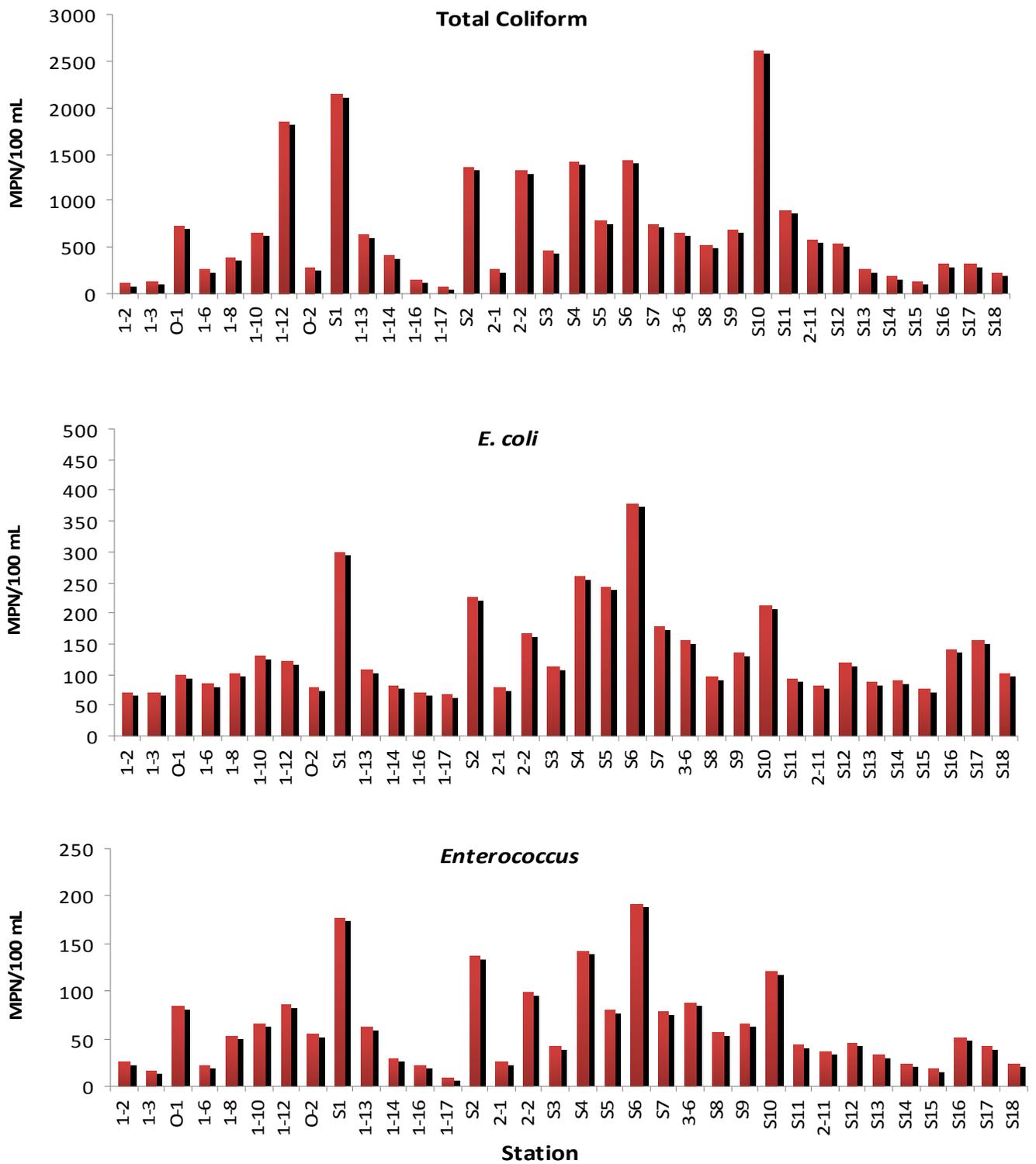
As expected, the wet-weather period registered higher geometric mean concentrations compared to both dry-weather periods. Geometric means computed for compliance stations during wet-weather are graphically illustrated in Figure 5. Stations S1, S6 and S4 were among the sites with the highest geometric means for all three indicators during wet weather. Stations S10, S1, and 1-12 were highest for total coliforms; Stations S6, S1, and S4 had the highest geometric means for *E. coli*; and, stations S6, S1, and S4 were sites with the highest enterococcus geometric means. Generally, higher geometric means observed in the wet-weather period appear more distributed among stations north of station S10, but as most sites are geographically located north of S10, it would be more reasonable to say that the majority of high densities were found north of Castlerock SD (2-1). Remaining stations had relatively low geometric means during wet weather.



**Figure 3.** Summer-dry weather geometric means for indicator bacteria at compliance monitoring stations in Santa Monica Bay, FY 2010-2011.



**Figure 4.** Winter-dry weather seasonal geometric means for indicator bacteria at compliance monitoring stations in Santa Monica Bay, FY 2010-2011.



**Figure 5.** Wet-weather seasonal geometric means for indicator bacteria at compliance monitoring stations in Santa Monica Bay, FY 2010-2011.

## Water Quality Standards Compliance

The purpose of collecting shoreline samples and reporting bacterial densities is to determine compliance with the state bathing water standards and to assess water quality and the impact it may have on public health. Los Angeles Basin Plan bacteriological objectives for REC-1 designation, compliance percentage, for FY 2010-2011 Santa Monica Bay shoreline stations collected by CLA EMD were examined and evaluated (Tables 4 to 8).

### *Summer-Dry Weather*

Of the 34 sites monitored during summer-dry weather, twenty-five (76.5 %) had one or more single-sample exceedances days (Table 4). For this period, this indicates that 76.5% of sites failed their waste load allocation (Table 2). Stations SMB1-8 (Escondido Crk), SMB1-12 (Marie Cyn), SMB MC-1 (Surfrider), SMB1-18 (Topanga Cyn), and S16 had the highest percent single-sample exceedances days. Even with weekly sampling frequency, as opposed to daily, Escondido Crk and Marie Cyn are among those with higher percent exceedances (29% and 21%, respectively). This suggests problematic sites. Although stations SMB3-3 (S5) and BC-1 (S10) were not among the highest sites for percent exceedance days, they were among the sites with the higher number of single-sample exceedance days. Stations 1-8 and S2 also were locations with low percent compliance. All aforementioned sites also were among those with high geometric mean exceedances, in addition to O-1 (Point Dume) and 2-2 (Santa Ynez SD). The majority of the sites that exceeded this parameter are weekly monitored sites, which is to be expected.

For sites with the higher exceedances, *E. coli* and enterococcus were the indicators most exceeded. Station MC-1 had the highest total coliform and fecal coliform/*E. coli* exceedances and station 1-18 had the most exceedances for enterococcus. Enterococcus was the indicator most exceeded at all sites.

Twenty-four percent of all sites monitored (8 sites) had no exceedance days during this period; Stations SMB 1-2, 1-3, 1-6, 1-14, 1-17, 2-1, S9, 2-11, and S12 are all monitored weekly, although station 1-17 was accessible to collection only 10 out of a possible 28 sampling days for the summer-dry period. These sites were 100 % compliant for this period.

MS4-only monitored sites were among those with the lowest number of exceedances and percent exceedance rates (Table 7). With the exception of station S3, all these sites are located in the southern Bay area. TMDL data assessment for stations S9 and S13 through S16 is not covered in this report as CLA conducts MS4 monitoring only for these sites. Data for these sites is assessed for the MS4 permit only and is not subject to the SMBBB TMDL rolling 30-day geometric mean or waste load allocations for the three weather periods.

Table 4. Fiscal Year 2010-2011 Summer-Dry Weather Exceedances

Station	Total Sample Days	Single-Sample Exceedance Days	Percent Single-Sample Exceedance Days	Exceedances Per Indicator				Total Indicator Exceedances	Rolling 30-Day Geometric Mean Exceedance Days <sup>5</sup>
				Total <sup>1</sup>	E.coli <sup>2</sup>	Entero <sup>3</sup>	Ratio <sup>4</sup>		
1-2	28	0	0	0	0	0	0	0	0
1-3	28	0	0	0	0	0	0	0	0
O-1	27	3	11	1	1	3	1	6	95
1-6	28	0	0	0	0	0	0	0	0
1-8	28	8	29	1	5	7	5	18	67
1-10	28	4	14	1	0	4	0	5	88
1-12	28	6	21	1	3	6	1	11	95
O-2	28	1	4	0	0	1	0	1	0
S1	139	41	29	10	31	18	20	79	80
1-13	28	2	7	0	0	2	0	2	33
1-14	27	0	0	0	0	0	0	0	0
1-16	27	1	4	0	0	1	0	1	0
1-17	10	0	0	0	0	0	0	0	38
S2	139	41	29	3	24	35	25	87	108
2-1	28	0	0	0	0	0	0	0	0
2-2	15	2	13	1	0	2	0	3	51
S3	28	1	4	0	0	1	0	1	2
S4	139	11	8	2	9	11	9	31	36
S5	139	19	14	1	12	11	6	30	2
S6	137	10	7	1	3	9	3	16	23
S7	139	3	2	0	2	3	2	7	6
3-6	28	1	4	0	1	1	0	2	6
S8	28	4	14	0	1	4	1	6	0
S9	139	9	0	0	3	8	2	13	0
S10	137	16	11	7	3	8	4	22	67
S11	28	1	4	0	0	1	0	1	20
2-11	28	0	0	0	0	0	0	0	0
S12	28	0	0	0	0	0	0	0	0
S13	28	1	4	0	1	1	1	3	-
S14	28	1	4	0	0	1	0	1	-
S15	28	0	0	0	0	0	0	0	-
S16	138	25	18	6	19	14	10	49	-
S17	28	2	7	0	2	2	2	6	-
S18	28	1	4	0	0	1	1	2	-

<sup>1</sup>Total coliform limit is 10,000 MPN/100mL

<sup>2</sup>E.coli limit is 400 MPN/100mL

<sup>3</sup>Enterococcus limit is 104 MPN/100mL

<sup>4</sup>Ratio of E.coli/Total coliform is greater than 0.1 when total coliform level is greater than 1,000 org./100mL

<sup>5</sup>The allowable exceedance days for the rolling 30-day geometric mean limit is zero (0) exceedance days

### Winter-Dry Weather

The diversion of year-round dry-weather urban run off began in November 1, 2009. In the five-month period of winter-dry weather from November 1, 2010 through March 31, 2011, stations MC-1 (S1), O-1, 1-18 (S2), 1-8, 2-2, 2-7 (S4), and S16 exceeded AB411 water quality standards more frequently than other stations. However, as some sites, such as station 2-2, Santa Ynez SD (33% exceedance rate), were collected so infrequently (inaccessible 79 % of the time, collected only 3 days, with 1 exceedance day), this can be a little misleading. The other side to this would be the low or zero percent exceedance rate seen at Station 1-17 (Tuna Cyn); no exceedances for four of the days it was collected.

High seasonal geometric means detected at the stations with the higher means were previously observed in the summer-dry period and are observed for this period. Total exceedances for the winter-dry monitoring period are summarized in Table 5. Station S1, a site associated with a lagoon, continued to have high exceedances into the winter months with 74% days exceeded, almost tripling the probability of exceeding compared to the summer-dry period. This site was highest for all measured exceedances parameters, excluding the number of total coliform exceedances; Station S4 was the site with the highest total coliform exceedances.

The indicator exceeded most at each station was, again, as in the summer-dry season, enterococcus. Sixty-two percent of all sites exceeded enterococcus, as compared to 41% for *E. coli*, 23% for total coliforms, and 38 % for the fecal/total ratio. Fifty-six percent of all sites passed waste load allocations for the winter-dry period (Table 2).

Sites with highest compliance percentages (excluding 1-17 and 2-1) were stations 1-2, 1-16, and S14, S3, S8, S11, 2-11, S13, S14, S17, and S18. There were no winter-dry exceedances for these sites, therefore, no failure of waste load allocations.

**Table 5. Fiscal Year 2010-2011 Winter-Dry Weather Exceedances**

Station	Total Sample Days	Single-Sample Exceedance Days	Percent Single-Sample Exceedance Days	Exceedances Per Indicator				Total Indicator Exceedances	Rolling 30-Day Geometric Mean Exceedance Days <sup>5</sup>
				Total <sup>1</sup>	E.coli <sup>2</sup>	Entero <sup>3</sup>	Ratio <sup>4</sup>		
1-2	9	0	0	0	0	0	0	0	13
1-3	9	1	11	0	1	0	0	1	25
O-1	8	4	50	0	0	4	0	4	41
1-6	10	1	10	0	0	1	0	1	0
1-8	10	4	40	0	2	4	3	9	94
1-10	9	1	11	0	1	1	1	3	120
1-12	9	1	11	0	0	1	0	1	82
O-2	9	2	22	0	0	1	0	1	23
S1	61	45	74	2	27	39	28	96	140
1-13	9	2	22	1	1	2	1	5	91
1-14	9	1	11	0	0	1	0	1	36
1-16	9	0	0	0	0	0	0	0	0
1-17	4	0	0	0	0	0	0	0	0
S2	62	27	44	0	13	25	15	53	116
2-1	9	0	0	0	0	0	0	0	21
2-2	3	1	33	1	1	1	1	4	92
S3	9	0	0	0	0	0	0	0	26
S4	62	19	31	5	16	19	15	55	90
S5	62	14	23	0	7	10	1	18	73
S6	62	13	21	3	8	13	7	31	50
S7	62	5	8	1	1	5	1	8	5
3-6	9	1	11	0	0	1	0	1	37
S8	9	0	0	0	0	0	0	0	0
S9	62	0	0	1	4	15	3	23	0
S10	62	7	11	1	3	7	2	13	68
S11	9	0	0	0	0	0	0	0	0
2-11	9	0	0	0	0	0	0	0	7
S12	9	2	22	0	0	2	0	2	0
S13	9	0	0	0	0	0	0	0	-
S14	9	2	22	0	0	0	0	0	-
S15	9	1	11	0	0	1	0	1	-
S16	62	19	31	0	11	13	8	32	-
S17	9	0	0	0	0	0	0	0	-
S18	9	0	0	0	0	0	0	0	-

<sup>1</sup>Total coliform limit is 10,000 MPN/100mL

<sup>2</sup>E.coli limit is 400 MPN/100mL

<sup>3</sup>Enterococcus limit is 104 MPN/100mL

<sup>4</sup>Ratio of E.coli/Total coliform is greater than 0.1 when total coliform level is greater than 1,000 org./100mL

<sup>5</sup>The allowable exceedance days for the rolling 30-day geometric mean limit is zero (0) exceedance days

## Wet-Weather

Increased rainfall for this fiscal year as compared to the previous fiscal cycle resulted in a higher number of rain-event days. As predicted and supported by previous reporting cycles, wet-weather data revealed much higher bacterial densities compared to dry-weather data, which translated to a higher occurrence of bacterial exceedances. Only stations 1-8, S1, S2, and S16 had more or an equivalent number of summer- or winter-dry weather exceedance days compared to wet-weather exceedance days. Total exceedance rates for the wet-weather monitoring period are summarized in Table 6.

**Table 6. Fiscal Year 2010-2011 Wet-Weather Exceedances**

Station	Total Sample Days	Single-Sample Exceedance Days	Percent Single-Sample Exceedance Days	Exceedances Per Indicator				Total Indicator Exceedances
				Total <sup>1</sup>	E.coli <sup>2</sup>	Entero <sup>3</sup>	Ratio <sup>4</sup>	
1-2	16	2	13	0	0	2	0	2
1-3	16	1	6	0	0	1	0	1
O-1	14	6	43	1	1	6	0	5
1-6	15	1	7	0	1	1	0	1
1-8	13	4	31	1	1	4	0	3
1-10	16	6	38	1	1	6	1	5
1-12	15	8	53	4	2	7	1	7
O-2	12	3	25	1	1	3	0	2
S1	57	42	74	14	25	35	18	38
1-13	16	5	31	2	2	5	0	5
1-14	16	2	13	1	1	2	0	1
1-16	16	2	13	0	0	2	0	2
1-17	1	0	0	0	0	0	0	0
S2	58	36	62	14	19	34	9	31
2-1	16	3	19	0	0	3	1	2
2-2	13	5	38	4	2	5	2	5
S3	16	3	19	1	3	3	1	2
S4	58	38	66	17	19	37	14	34
S5	58	25	43	9	16	19	7	24
S6	57	33	58	21	24	32	13	30
S7	57	20	35	15	13	20	6	18
3-6	16	8	50	3	2	8	3	8
S8	16	6	38	2	1	5	2	5
S9	58	25	43	9	9	19	6	-
S10	58	25	43	23	16	30	7	30
S11	16	4	25	1	1	3	0	3
2-11	16	4	25	0	1	4	0	4
S12	16	4	25	1	2	4	1	3
S13	16	1	6	0	0	1	1	2
S14	16	1	6	1	1	3	1	6
S15	16	1	6	0	0	1	1	2
S16	58	19	33	2	10	17	7	36
S17	16	5	31	2	3	5	2	12
S18	16	2	13	1	0	2	0	3

<sup>1</sup>Total coliform limit is 10,000 MPN/100mL

<sup>2</sup>E.coli limit is 400 MPN/100mL

<sup>3</sup>Enterococcus limit is 104 MPN/100mL

<sup>4</sup>Ratio of E.coli/Total coliform is greater than 0.1 when total coliform level is greater than 1,000 org./100mL

<sup>5</sup>The allowable exceedance days for the rolling 30-day geometric mean limit is zero (0) exceedance days

Stations S1, S2, S4, S5, S6, S9, and S10 showed a significantly higher number of wet-weather exceedance days than other sites; all, excluding S9 (open beach) are associated with a storm drain. Stations S1, S4, and S2 had the highest percent exceedance days with 74%, 66% and 62%, respectively. Stations 1-2, 2-1, and 2-11 had no dry-weather exceedance days, neither for

summer nor winter, but exceedances for wet weather increased from 200 % to 400%, comparatively. Generally, wet-weather data shows increasing bacterial indicator exceedances throughout the Bay; however, all stations had enterococcus exceedances occurring more frequently than any other indicator. Station 1-17 was the only site with no exceedances; but, it was accessible to collection only one day during the entire period.

Eight sites were below or equivalent to their waste load allocations: Stations 1-2, 1-3, 1-6, O-2, 1-14, 1-16, 2-1, and S3.

**Table 7. Percent compliance per Station, FY 2010-2011.**

Stations	Summer -Dry Weather				Winter-Dry Weather				Wet Weather			
	Total <sup>1</sup>	E.coli <sup>2</sup>	Entero <sup>3</sup>	Ratio <sup>4</sup>	Total <sup>1</sup>	E.coli <sup>2</sup>	Entero <sup>3</sup>	Ratio <sup>4</sup>	Total <sup>1</sup>	E.coli <sup>2</sup>	Entero <sup>3</sup>	Ratio <sup>4</sup>
1-2	100	100	100	100	100	100	100	100	100	100	88	100
1-3	100	100	100	100	100	89	100	100	100	100	94	100
O-1	96	96	89	96	100	100	50	100	93	93	57	100
1-6	100	100	100	100	100	100	89	100	100	93	93	100
1-8	96	82	75	82	100	80	60	70	92	92	69	100
1-10	96	100	86	100	100	89	89	89	94	94	63	94
1-12	96	89	79	96	100	100	89	100	73	87	53	93
O-2	100	100	96	100	100	100	89	100	92	92	75	100
S01	93	78	87	86	97	56	36	54	75	56	39	68
1-13	100	100	93	100	89	89	78	89	88	88	69	100
1-14	100	100	100	100	100	100	89	100	94	94	88	100
1-16	100	100	96	100	100	100	100	100	100	100	88	100
1-17	100	100	100	100	100	100	100	100	100	100	100	100
S02	98	83	75	82	100	79	60	76	76	67	41	84
2-1	100	100	100	100	100	100	100	100	100	100	81	94
2-2	93	100	87	100	67	67	67	67	69	85	62	85
S03	100	100	96	100	100	100	100	100	94	81	81	94
S04	99	94	92	94	92	74	69	76	71	67	36	76
S05	99	91	92	96	100	89	84	98	84	72	67	88
S06	99	98	93	98	95	87	79	89	63	58	45	77
S07	100	99	98	99	98	98	92	98	74	77	66	89
3-6	100	96	96	96	100	100	89	100	81	87	50	81
S08	100	96	86	96	100	100	100	100	88	94	69	88
S09	100	98	94	99	98	94	76	95	84	84	67	90
S10	95	98	94	97	98	95	89	97	60	72	48	88
S11	100	100	96	100	100	100	100	100	94	94	81	100
2-11	100	100	100	100	100	100	100	100	100	94	75	100
S12	100	100	100	100	100	100	78	100	94	88	75	94
S13	100	96	96	96	100	100	100	100	100	100	94	94
S14	100	100	96	100	100	100	100	100	94	94	81	94
S15	100	100	100	100	100	100	89	100	100	100	94	94
S16	96	86	90	93	100	82	79	87	97	83	71	88
S17	100	93	93	93	100	100	100	100	88	81	69	88
S18	100	100	96	96	100	100	100	100	94	100	88	88

<sup>1</sup>Total coliform limit is 10,000 MPN/mL

<sup>2</sup>E.coli limit is 400 MPN/mL

<sup>3</sup>Enterococcus limit is 104 MPN/mL

<sup>4</sup>Ratio of E.coli/Total coliform is greater than 0.1 when total coliform level is greater than 1,000 org./100mL

## **Field Observations**

Field observations were recorded for each sampling location and normally are rated using an EMD historical standard rating system, 1=low, 2=moderate, and 3=high. Observations include the materials of sewage origin (MOSOs) or non-sewage origin, any unusual odors of sewage or non-sewage origin, and flow and flow rate (visual rating only) from storm drains, debris, seaweed, tar, and plankton, among others.

### *Materials of Sewage Origin*

Observations of materials of sewage origin (MOSOs), such as plastic goods (tampon inserts), rubber goods (prophylactic rings), and grease particles were recorded during Fiscal Year 2010-2011. There were no incidences of observed MOSOs in Santa Monica Bay for the entire fiscal year.

### *Storm Drain Flows*

Non-point source pollution has been estimated to be the leading cause of water quality deterioration (EPA 2010). Originating from inland, these pollutants are washed into creeks, streams, rivers, and storm drains, which eventually reach the ocean during heavy rains. Storm drains are designed to receive urban and storm water runoff from paved streets, parking lots, sidewalks, and roofs. Urban and storm water runoff, carried to the Bay through the region's massive storm drain systems and few remaining streams, is a serious, year-round concern (Santa Monica Bay Restoration Commission 2008). Out of the 34 sampling stations at the Santa Monica Bay shoreline, 18 stations are associated with storm drain outfalls, 4 are located at a pier, 6 stations are associated with creeks, 4 are open beach sites, and 2 sites are associated with a lagoon.

A Summary of storm drain flow data obtained from CLA EMD Santa Monica Bay monitoring sites during FY 2010-2011 is presented in Table 8.

### *Low-Flow Diversion Devices (LFDs):*

Thirteen SMB compliance stations and one observation site, O-5 monitored by CLA EMD are associated with low-flow diversion devices (LFDs). The cities of Los Angeles and Santa Monica and the County of Los Angeles operate a total of 23 LFDs along the Santa Monica Bay shoreline from Castle Rock to Dockweiler State Beach, which as of November 1, 2009 operate during year-round dry weather. These devices are installed at the major storm drain outfalls to prevent storm water runoff from reaching the Santa Monica Bay beach surf zones by diverting the flows to the sanitary sewer collection system for treatment at the Hyperion Wastewater Treatment Plant (Table 8).

**Table 8. Fiscal Year 2010-2011 Storm Drain Flows MS4, SMB TMDL stations and observation sites.**

Station	Location	LFD In Place	Summer-Dry		Winter-Dry		Wet Weather	
			% Flow Days	Ave. Flow <sup>1</sup>	% Flow Days	Ave. Flow <sup>1</sup>	% Flow Days	Ave. Flow <sup>1</sup>
1-2	Open Beach	-	-	-	-	-	-	-
1-3	Open Beach	-	-	-	-	-	-	-
O-1	Creek	No	100	2	100	2	100	2
1-6	Creek	No	4	2	33	2	47	1
1-8	Creek	No	50	2	100	2	69	2
1-10	Creek	No	89	2	100	2	88	2
1-12	Storm Drain	No	97	2	100	2	93	2
O-2	Storm Drain	No	73	1	82	1	75	1
S01	Lagoon	No	37	3	100	3	81	3
1-13	Storm Drain	No	93	1	100	1	88	2
1-14	Creek	No	33	2	67	2	44	2
1-16	Creek	No	36	1	56	1	56	1
1-17	Storm Drain	No	100	1	100	1	100	2
S02	Lagoon	No	31	3	53	2	55	3
2-1	Storm Drain	Yes	4	1	11	2	19	2
2-2	Storm Drain	Yes	100	2	100	2	100	2
S03	Storm Drain	Yes	28	1	22	1	31	2
S04	Storm Drain <sup>2</sup>	Yes	6	2	26	2	50	3
S05	Pier	Yes	0	0	0	0	19	2
S06	Storm Drain	Yes	3	2	16	3	61	2
S07	Storm Drain	Yes	0	0	2	3	25	2
3-6	Storm Drain	Yes	3	2	0	0	25	3
S08	Storm Drain <sup>2</sup>	Yes	0	0	0	0	0	0
S09	Open Beach	-	-	-	-	-	-	-
S10	Storm Drain	No	100	3	100	3	91	3
S11	Storm Drain	Yes	0	0	0	0	0	0
2-11	Storm Drain	Yes	0	0	0	0	0	0
S12	Storm Drain <sup>2</sup>	Yes	14	2	0	0	0	0
S13	Storm Drain	No	0	0	0	0	0	0
S14	Pier	No	4	2	0	0	19	2
S15	Pier	No	0	0	0	0	6	3
S16	Pier	No	-	-	-	-	-	-
S17	Storm Drain	Yes	0	0	0	0	0	0
S18	Open Beach	-	-	-	-	-	-	-
O-4 <sup>3</sup>	Storm Drain	No	0	0	0	1	0	0
O-5 <sup>3</sup>	Storm Drain	Yes	9	1	0	1	63	1

<sup>1</sup> Average Flow Rate: (0)= no flow (1)=low (2)=moderate (3)=heavy

<sup>2</sup> Low Flow Diversion (LFD) owned and operated by the City of Los Angeles

<sup>3</sup> Per CSMP, only dry-weather storm drain flow data for observation sites.

#### IV. DISCUSSION

Data presented herein, indicates Stations S1 (Surfrider Beach, Malibu), S2 (Topanga Canyon SD), 1-8 (Escondido Creek), and 1-12 (Marie Canyon) as the sites, overall, that are the most impacted by pollution and consequently, the most problematic. All are located at storm drains or a creek with consistent runoff (with visibly observed flow rates of 2 to 3).

The geographic locations of stations at the mouths of storm drains and creeks predispose these locations to greater non-point source bacterial loading. Station S1, by far the site with the poorest water quality, is located at Surfrider Beach at the outlet of the Malibu Creek watershed and is mainly affected by flows from Malibu Lagoon. The watershed where this site is located covers a large area, approximately 105 square miles. There is considerable local activity at this beach, and the lagoon serves as a habitat for numerous bird species, an added source of bacterial pollutants. Surfrider Beach previously has been identified as one of the most polluted beaches in Santa Monica Bay (CLA, EMD 2003). Excluding wet weather, seasonal exceedance rates increased from twelve to twenty-five percent compared to the previous year. This site received a Grade F in the Heal the Bay Beach Report Card for 2010-2011 year as did station S2 at Topanga State Beach.

Station S2 is located at the wave wash of Topanga Lagoon, which is created and fed by drainage from the Topanga Canyon Creek Watershed, the second largest watershed in the Santa Monica Mountains (CCA 2006). The large numbers of birds that have been observed to congregate at the beach likely is a source of bacterial loading. Four of the ten most polluted California beaches are in Los Angeles County and Topanga State Beach is listed fourth. A Source Identification Pilot Pro-gram (SIPP) is currently underway at this location, with researchers from Stanford University, UCSB, UCLA, U.S. EPA Office of Research and Development, and the Southern California Coastal Water Resource Project (SCCWRP). They are developing and implementing sanitary survey/source tracking protocols at 12 to 16 of California's most polluted beaches, including Topanga (Heal the Bay, 2011).

Escondido Creek, station 1-8, is located at the wave wash of Escondido Creek, just east of Escondido State Beach and west of Malibu Cove Colony. It is one of many creeks that run from the hills above Malibu into Santa Monica Bay. Water quality issues have been a recurring problem at this location as Escondido State Beach has shown high levels of indicator bacteria. In 2007, a microbial source tracking study was initiated at Escondido Creek in an effort to identify the source(s) of bacterial loading, assess the Creek's contribution to bacterial contamination to the beach, and develop a bacteria source identification protocol for future bacteria source tracking projects. The study was completed in 2010. Study found that enterococcus exceedances at Escondido Beach (adjacent to the Creek) appeared to have been resolved, as there were fewer beach postings during the project time period. Improvement in beach water quality may have been related to a decrease in rainfall and urban runoff flows, and public notification of ongoing efforts to reduce bacterial pollution. Work to track bacteria sources will resume pending any re-occurrence of beach postings (SCCWRP 2010). Peak bacterial indicator exceedances for three seasons indicate this site primarily exceeds in the winter season (an increase of 25 % from the

last reporting period); also observed in FY 2008-2009 (not reported) and FY2009-2010. The summer-dry and wet seasons, in comparison, had lower exceedance rates compared to winter-dry, however summer-dry exceedances rates also increased compared to the 2009-2010 period. At present, for July 2011, this location has an A grade on the Heal the Bay report card, but had numerous violations from March to July of this year.

Station 1-12, Marie Canyon, is located in front of Marie Canyon storm drain on Puerco Beach, just downstream of a treatment facility. The County of Los Angeles has operated a UV filtration treatment facility near this site since October 2007, designed to filter and treat as much as 100 gallons per minute of dry-weather runoff (LADPW 2007b). Los Angeles County's LFD at Marie Canyon has no sewer line at this location. Instead the LFD works as a type of stormwater treatment through filtration, with the cleansed flow returned to the storm drain. L.A. County is currently working to fix issues with the filtration system, including sediment diversions to limit inefficient filtration, as well as increasing dry-weather pumping capacity. Routine maintenance plans, including removing material at the discharge location and ponding prevention in the larger outfall pipes (not the treated runoff pipe), might be the answer to improved water quality at this location (Heal the Bay 2011).

Station S16 appears to be the site most impacted by pollutants in the southern Bay area. It is adjacent to a heavily used pier, which is likely the most significant contributor to the high bacterial counts measured at this station. Redondo Beach Pier is populated with large restaurants, food concessions, restrooms, parking facilities and large local and tourist populace. This site is subject to bacterial contamination by way of the Pier and flows from an associated storm drain located under the Pier. Historically a problematic site with a high exceedance rate of the water quality objectives for fecal indicators, station S16 was included in a supplemental environmental project for the Los Angeles County Sanitation District's resolution agreement Order (R4-2006-040; Model Program for Bacterial Source Identification and Abatement Plan - Redondo Beach Pier Pilot Project). Results from the microbial source tracking project conducted from June 24 to August 8, 2008 to ascertain the source(s) of dry-weather bacterial exceedances at S16, indicate a human source was not likely the cause of bacterial exceedances. Results also suggest that the storm drain and pond that forms under the pier are not contributors of bacterial loading and contamination at S16 during dry-weather periods. Sources of dry-weather exceedances at Redondo Beach Pier could be persistence of FIB in the sand; physical parameters such as wind, wave, tide height, and kelp on the sand; and association with the pier (LACSD 2010). This site stands out due to the very low bacterial densities and exceedances found at surrounding sites.

One station that previously demonstrated notable water quality improvement was the Santa Monica Canyon storm drain site, station S4, located in Santa Monica State Beach. Station S4 for the past 5 years was amongst the most highly polluted monitoring sites along the Santa Monica Bay shoreline. This location is often ponded during the dry-weather period. The stagnated pond water often becomes a habitat for birds and other beach wildlife, which ultimately becomes a potential source of bacteria. However, the City of Los Angeles and the County of Los Angeles Flood Control District have worked together to coordinate frequent draining of the pond before it could become a major source of pollution. For the 2010-2011 year, although there is a reduction in the number of indicator exceedances, station S4 is still showing some indication of pollutant impact, especially during dry-weather periods where likelihood of exceedances increased two-fold from the previous year's monitoring; it was the third highest site with the number of exceedances and sixth in rate of exceedances.

Santa Monica Pier (S5) houses several food concession stands, restrooms, and parking facilities, as well as a small marine aquarium, and attracts thousands of local visitors and tourists. This location was listed as one of the ten most polluted beaches in the state, for two consecutive years according to Heal the Bay's 20<sup>th</sup> Annual Report Card (HTB 2010). Recent efforts by the City of Santa Monica to reduce elevated fecal bacterial levels near the pier included replacement of a faulty storm drain under the pier to reduce runoff flows onto the beach, upgrades to the pier storm drain runoff diversion system, and several measures to reduce excessive bird populations at the pier in an effort to mitigate bird feces as a contributing source of bacterial contamination (HTB 2010; CSM 2010a and 2010b). These improvements were completed under the Santa Monica Pier improvement project, funded under Measure V. Measure V projects, approved by Santa Monica voters in 2006, were intended to reduce storm water pollution and runoff from entering Santa Monica Bay. The project began in February 2009 and involved replacing the severely degraded storm drain underneath the Santa Monica Pier. The new storm drain was designed and constructed in a manner to reduce or eliminate ponding of runoff under the pier. Santa Monica also put in a new dry-weather runoff diversion to replace the previous faulty system using CBI funds. The city also installed netting under the pier to keep pigeons and other birds from nesting underneath the pier and adding their fecal bacteria to the already problematic water quality (HTB 2011). This netting was completed in February 2010. These improvements have resulted in a reduced number of exceedance days and rates of exceedance over all seasonal periods in comparison to the previous reporting year.

## V. CONCLUSION

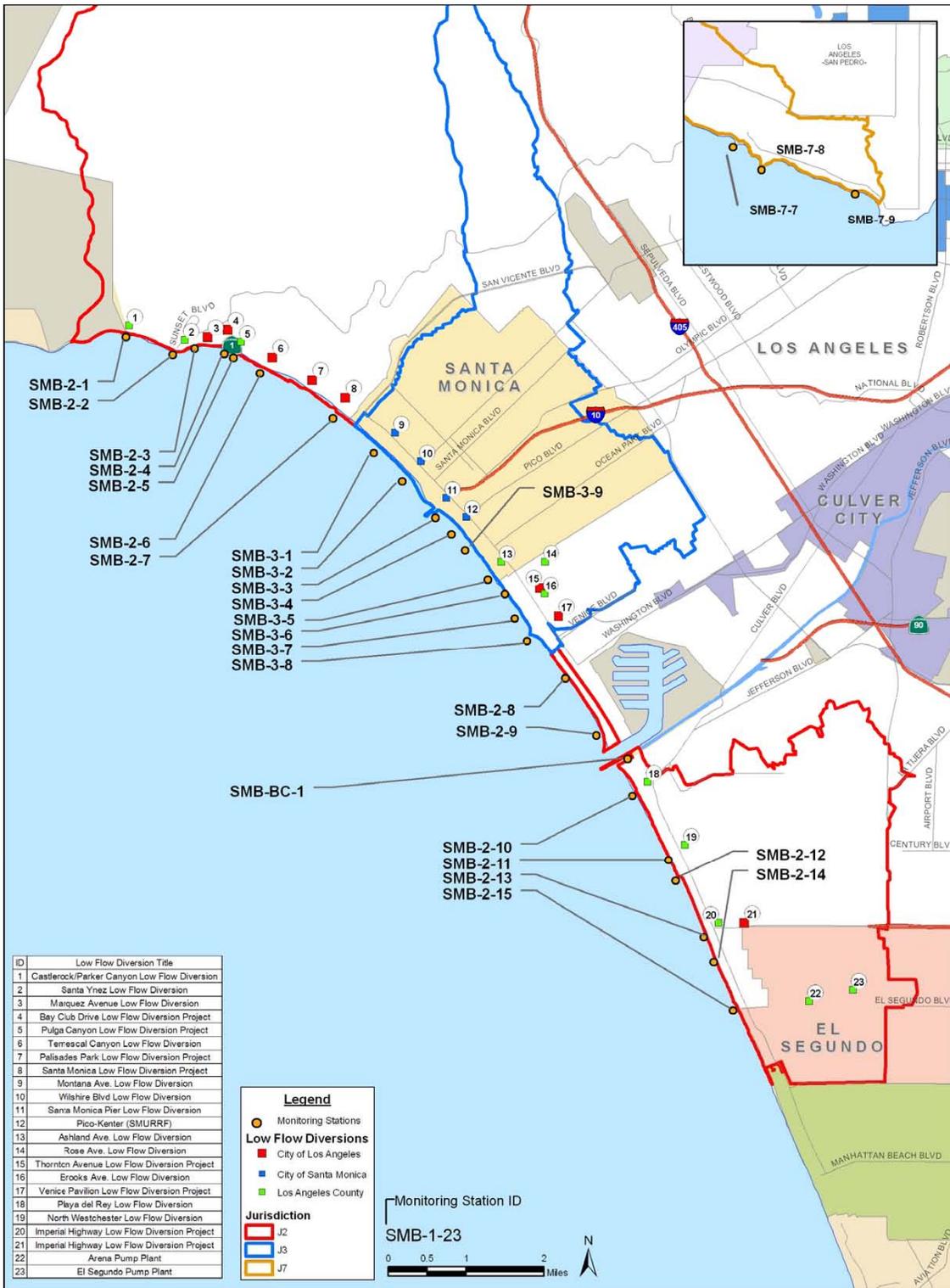
As assessment of SMB TMDL compliance-monitoring stations are incorporated in the CLA annual Santa Monica Bay Shoreline Monitoring MS4 Report, newly, identified problematic stations come to light. Sampled on a weekly basis, most of these stations had fewer AB411 water quality exceedances than stations collected daily (e.g., S1, S2 and S16); however, there were a few exceptions such as station 1-8 (Escondido Creek) for all seasonal periods, station O-1 (Point Dume) in winter-dry season, and station 1-12 (Marie Cyn) in summer-dry and wet seasons. Due to constant inaccessibility, one station in particular, station 1-17 (Tuna Canyon), should be re-assessed as to the feasibility of inclusion in the monitoring program. This site was proposed for replacement or deletion by EMD in a letter to the Regional Board in September 2009. Station 1-17 was inaccessible to sampling 72 percent of the time and for days the site was accessible, there were no exceedances. This site is inaccessible to CLAEMD sample collectors during high tide events, where bacterial densities may be higher than those days when it is accessible (low tide). Although Tuna Canyon does not discharge onto a public beach, it was included in the SMB TMDLs to fulfill the requirement of having at least one compliance location in every coastal watershed (CSMP 2004). Unfortunately, as it is accessible to private beach individuals during high tide and bacterial densities are unknown for these periods, health risks also remain unknown. As is, it is not possible to get a true or better picture of water quality in this area and sampling efforts are wasted. The removal or replacement of this site was not approved by the Board.

Geometric mean densities during 2010-2011 dry-weather periods (summer and winter combined) were either equivalent to or greater than geometric mean densities of 2009-2010 dry-weather

periods, all three indicators compared. Higher geometric mean values coincide with the overall increase in the number of exceedance days. This is the second annual report to include assessment of CLAEMD MS4 and SMB TMDL monitored sites; therefore, comparison to past data is minimal except for those sites that are historically collected as MS4 only. Some of these sites (S3, S11-S15, S17, and S18) are collected weekly, rather than daily, because of the overall good water quality that has been seen consistently throughout the monitoring years. With improvements to the Santa Monica Pier, total bacterial exceedances at S5 have decreased substantially; 200 exceedances in 2006-2007, 199 in 2007-2008, 168 in 2008-2009, 101 in 2009-2010 to 48 exceedances in 2010-2011, representing a 76 % decrease. Station S4 (Santa Monica SD) has seen a reduction in overall total indicator bacterial exceedances in dry weather from 179 exceedances in 2006-2007, 38 in 2009-2010, to 86 for the current year. Dry-weather flows from drains at station S4 are diverted to the HTP for treatment by route of the City's Coastal Interceptor Sewer. These diversions are designed to divert water and to help reduce beach closures by eliminating bacterial load to the beach area from dry-weather runoff (e.g., irrigation returns, car washing, street cleaning, etc.).

The Santa Monica Bay Beaches Bacteria TMDL compliance deadline for the winter-dry period became effective on July 15, 2009. The allowable exceedance days during winter-dry period (November 1 – March 31) is one day for shoreline monitoring stations that are monitored on a weekly basis and three days for those with daily monitoring. The City of Los Angeles' compliance approach was to expand the operation of Low-Flow Diversions (LFDs) from the previously implemented summer-dry period (April 1 – October 31) to year-round diversion, excluding wet-weather events. Thus, as of November 1, 2009, the City, as well as the County of Los Angeles and the City of Santa Monica, began year-round operation of their LFDs. There are a total of 23 LFDs installed at major storm drain outfalls along the Santa Monica Bay shoreline within the Jurisdictional groups 2 and 3, from Parker Mesa at Castle Rock to Dockweiler subwatershed; eight of the LFDs are owned and operated by the City of Los Angeles (Figure 6). Water quality within Santa Monica Bay has shown improvement in recent years due to these Low-Flow Diversion Programs, the City of Santa Monica's Urban Runoff Recycling Facility (SMURRF), and the efforts of other municipalities within the watershed in implementing several best management practices (BMPs). The City is still in the process of upgrading its LFDs to increase reliability and capacity in order to improve management of year-round dry-weather flow diversion.

While effective for dry weather flow, low flow diversions are not necessarily a viable option for flows from storm water runoff. Most LFDs do not have the capacity to handle large volumes of runoff that contain greater amounts of pollutants during wet weather (Santa Monica Bay Restoration Commission 2010), and, unfortunately, the high pollutant load of wet-weather flow has the capacity to effect beaches that routinely have good water quality. Either the capacity of flow devices must be increased to handle year round flow, including wet-weather flows, or storm drain flows and run off to recreational waters must be reduced.



**Figure 6.** Low-Flow Diversions (LFDs) devices operated by City of Los Angeles, County of Los Angeles and the City of Santa Monica along the Santa Monica Bay shoreline from Parker Mesa at Castle Rock to Dockweiler subwatershed.

## VI. LITERATURE CITED

APHA. See American Public Health Association.

American Public Health Association. 1998. Standard methods for the examination of water and wastewater, 20<sup>th</sup> ed. American Public Health Association, Washington, DC, pp. 9-1 to 9-115.

CCA. See California's Critical Coastal Area.

CLA, EMD. See City of Los Angeles, Environmental Monitoring Division.

CRWQCB. See California Regional Water Quality Control Board

CSM. See City of Santa Monica, Public Works.

CSMP. See City and County of Los Angeles, Technical Steering Committee.

California's Critical Coastal Area. 2006. State of the CCAs Report.  
[http://www.coastal.ca.gov/nps/Web/cca\\_pdf/socoastpdf/CCA61TopangaCanyon.pdf](http://www.coastal.ca.gov/nps/Web/cca_pdf/socoastpdf/CCA61TopangaCanyon.pdf)  
accessed June 09, 2010.

California Regional Water Quality Control Board, Los Angeles Region. 2001. Municipal Separate Storm Sewer System NPDES Permit. pp. 58-59.

California Regional Water Quality Control Board, Los Angeles Region. 2004. Santa Monica Bay Beaches Bacteria TMDLs, Attachment A to Resolution No. 02-400.

City and County of Los Angeles, Technical Steering Committee. 2004. Santa Monica Bay Beaches Bacterial TMDLs Coordinated Shoreline Monitoring Plan, pp. 1-3 to 4-10 + appendices.

City of Santa Monica, Public Works. 2010a. Pier Storm Drain Improvements.  
<http://www.smgov.net/Departments/PublicWorks/ContentCivEng.aspx?id=9630>.

City of Santa Monica, Public Works 2010b. Pier Water Quality Improvement.  
<http://www.smgov.net/Departments/PublicWorks/ContentCivEng.aspx?id=9640>.

Csuros, M and C. Csuros. 1999. Microbiological examination of water and wastewater. CRC Press, Boca Raton, Florida, 360 pp.

Dojiri, M., M. Yamaguchi, S.B. Weisberg, and H.J. Lee. 2003. Changing anthropogenic influence on the Santa Monica Bay watershed. Marine Environmental Research, 56(2003): 1-14.

EPA. See Environmental Protection Agency

Environmental Protection Agency. 2010. Polluted Runoff: Nonpoint Source Pollutions.  
<http://www.epa.gov/nps/whatis.html>

HTB. See Heal the Bay

Heal the Bay. 2010. 20<sup>th</sup> Annual Beach Report Card. <http://www.healthebay.org/brcv2/>

Heal the Bay. 2011. 21<sup>st</sup> Annual Beach Report Card. [http://brc.healthebay.org/assets/pdfdocs/brc/Annual/2011/HtB\\_BRC\\_Annual\\_2011\\_Report.pdf](http://brc.healthebay.org/assets/pdfdocs/brc/Annual/2011/HtB_BRC_Annual_2011_Report.pdf)

LACSD. See Los Angeles County Sanitation Districts.

LADPW. See Los Angeles County Department of Public Works.

Los Angeles County Department of Public Works. 2007a. Study plan for evaluating bacterial sources in the Ramirez Canyon and Escondido Canyon Creeks watersheds  
<http://www.ladpw.org/wmd/bsi/media/TheStudy.pdf>.

Los Angeles County Department of Public Works. 2007b. New Water Treatment System Targets Bacteria at One of the State's "Worst" Beaches for Water Quality.  
[http://ladpw.org/apps/news/pdf/2380\\_2627.pdf](http://ladpw.org/apps/news/pdf/2380_2627.pdf).

Los Angeles County Department of Public Works. 2008. Marie Canyon Water Quality Improvement Project Experiences Temporary Set-Back.  
[http://dpw.lacounty.gov/apps/news/pdf/2380\\_2705.pdf](http://dpw.lacounty.gov/apps/news/pdf/2380_2705.pdf)

Los Angeles County Sanitation Districts. 2010. Model Program for Bacterial Source Identification and Abatement Plan - Redondo Beach Pier Pilot Project, Final Report and Abatement.

Ohio State University. 2009. FactSheet. Non-point Source Water Pollution. AEX-44-00. Agricultural. Engineering. 590 Woody Hayes Dr., Columbus, Ohio, 43210.

SCCWRP. See Southern California Coastal Water Research Project.

Southern California Coastal Water Research Project. 2010. Upper Santa Monica Bay Microbial Source Tracking. <http://www.sccwrp.org/ResearchAreas/BeachWaterQuality/MicrobialSourceTracking/UpperSantaMonicaBayMicrobialSourceTracking.aspx>.

Santa Monica Bay Restoration Commission. 2008. [www.santamonica-bay.org/smbay/ProblemsSolutions/WaterQuality/tabid/67/Default.aspx](http://www.santamonica-bay.org/smbay/ProblemsSolutions/WaterQuality/tabid/67/Default.aspx)

Santa Monica Bay Restoration Commission. 2010. State of the Bay 2010 Report. Focus on Water Quality. <http://santamonica-bay.org/smbay/NewsEvents/StateoftheBay/StateoftheBayReport/tabid/176/Default.aspx>

Schiff, K. and P. Kinney. 2001. Tracking sources of bacterial contamination in stormwater discharges from Mission Bay, California. [http://www.sccwrp.org/pub/download/DOCUMENTS/AnnualReports/1999AnnualReport/07\\_ar06.pdf](http://www.sccwrp.org/pub/download/DOCUMENTS/AnnualReports/1999AnnualReport/07_ar06.pdf)