SANTA MONICA BAY SHORELINE MONITORING
MUNICIPAL SEPARATE STORM SEWER SYSTEM (MS4) REPORT
(June 1, 2011 – May 30, 2012)
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. Furthermore, 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 and 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-permitee 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 bacterial 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. Waste load allocations are expressed as the number of sample days at a shoreline sampling site that may exceed a single-sample target. Waste load allocations are expressed as allowable exceedance days because the bacterial density and frequency of single-sample exceedances are the most relevant to public health protection (CRWQCB 2004).

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 bacterial 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 1). EMD evaluates and reports data relative to REC-1 bathing water quality standards for bacterial densities.

Table 1. 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/*E.coli* bacteria/100 ml; or	200 fecal coliform/*E.coli* bacteria/100 ml; or
104 *Enterococcus* bacteria/100 ml; or	35 *Enterococcus* 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 MS4 NPDES Permit, CLA had been submitting a Santa Monica Bay Shoreline Monitoring Annual Report that included water quality 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 was 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 July1 through June 30 to **June 1 thru May 31**. . This report summarizes the City of Los Angeles EMD's Santa Monica Bay shoreline bacteriological data for the Reporting Year 2011-2012 (June 1, 2011 through May 31, 2012).

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 (1-2), southward to Dockweiler State Beach (stations BC-1 through 2-13). 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 the upgrading of observation stations with persistent runoff and either the removal or re-location of sampling locations that were consistently inaccessible to sampling and/or observations. In December 2009, the Regional Board approved CLA's proposed changes. Observation stations SMB-O-1 (Zumirez Dr, Point Dume) and SMB-O-2 (Puerco Canyon SD, Puerco Beach) were upgraded to bacterial monitoring stations based on persistent runoff and accessibility, and station SMB-O-3 (Pierda Gorda, 36" SD) was removed as an observation site due to its continued inaccessibility. Also, 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. 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.

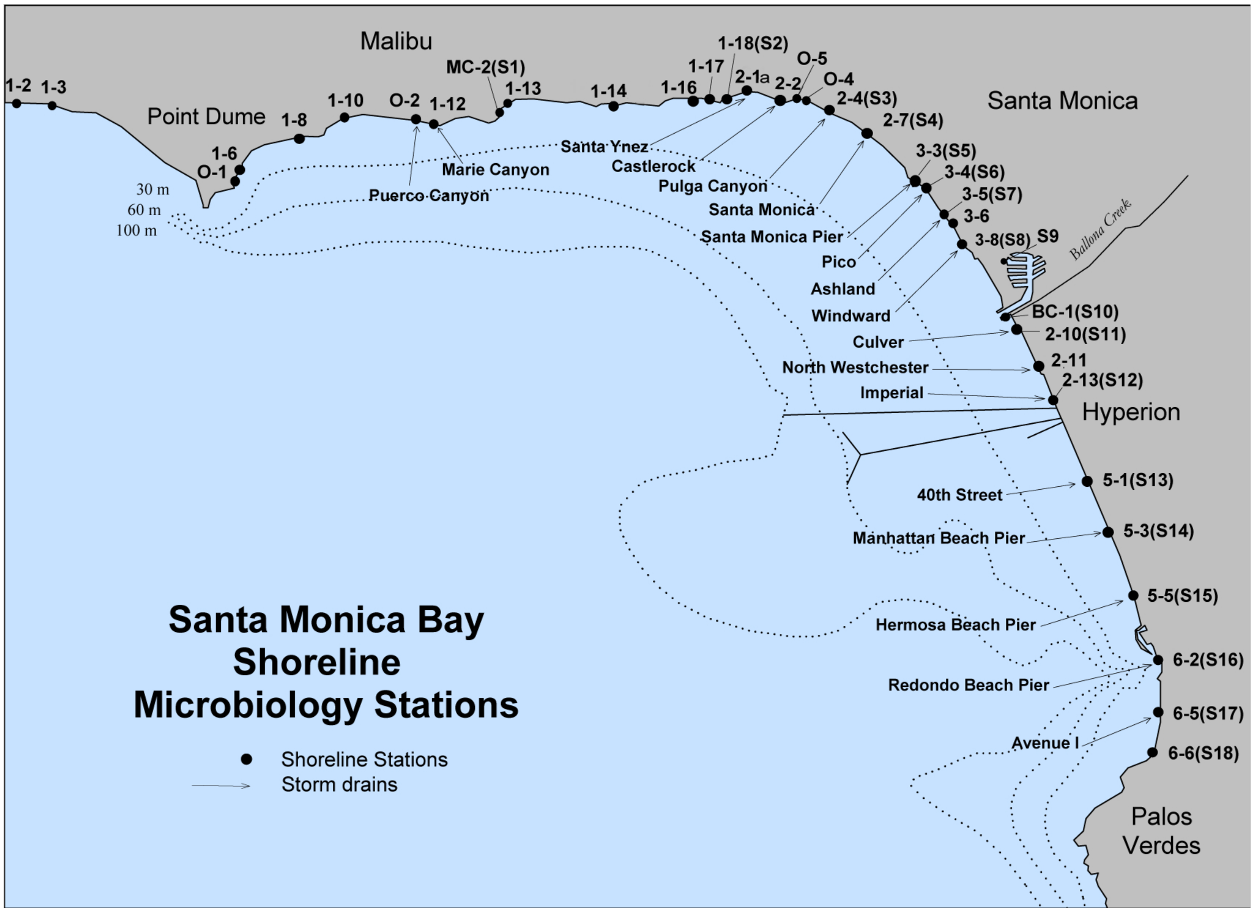

Figure 1: Geographic scale of EMD shoreline sampling locations of Santa Monica Bay, including storm drains and piers. Table 2 provides a complete list of station names and their corresponding MS4 and/or SMBBB TMDL station identification.

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, 16 compliance stations solely as SMBBB TMDL stations, and 11 compliance stations as both MS4 and SMBBB TMDL sites, e.g., Malibu Creek at Surfrider Beach is both S1 and SMB-MC-2 for MS4 and SMBBB TMDL compliance monitoring, respectively (Table 2). MS4 and SMBBB TMDL stations are monitored either daily or weekly. In addition to adopting some MS4 stations as TMDL stations, some TMDL monitoring requirements were incorporated into the MS4 permit. Accelerated monitoring of weekly monitored TMDL stations is conducted 48 hours after the initial sample exceeds bacterial standards and 96 hours for sites that again exceed bacterial limits.

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); there is no point zero. Station SMB-2-1 (Castlerock SD), which was relocated from point zero to just north of the storm drain in January 2010, also, is not sampled at point zero. 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.

Station Name	SMB TMDL	MS4	Station Name	SMB TMDL	MS4
El Pescador State Beach	1-2		Santa Monica Pier SD, Santa Monica SB	3-3	S5
El Matador State Beach	1-3		Pico-Kenter SD, Santa Monica SB	3-4	S6
Zumirez Dr, Point Dume	O-1		Ashland SD, Santa Monica SB	3-5	S7
Walnut Creek, Paradise Cove	1-6		Rose Ave SD, Venice Bch	3-6	
Escondido Crk, Escondido SB	1-8		Windward Ave SD, Venice Bch	3-8	S8
Solstice Crk, Dan Blocker County Bch	1-10		Marina del Rey Beach, MDR		S9
Marie Cyn SD, Puerco Bch	1-12		Ballona Creek, Dockweiler SB	BC-1	S10
Puerco Canyon SD, Puerco Beach	O-2		Culver SD, Dockweiler SB	2-10	S11
Malibu Crk, Malibu Lagoon County Bch	MC-2	S1	North Westchester SD, Dockweiler SB	2-11	
Sweetwater Cyn SD, Carbon Bch	1-13		Imperial Hwy SD, Dockweiler SB	2-13	S12
Las Flores Crk, Las Flores SB	1-14		40th Street, Manhattan Bch		S13
Pena Crk, Las Tunas County Bch	1-16		Manhattan Beach Pier		S14
Tuna Cyn, Las Tunas County Bch	1-17		Hermosa Beach Pier		S15
Topanga Cyn, Topanga County Bch	1-18	S2	Redondo Beach Pier		S16
Castlerock SD, Topanga County Bch	2-1		Avenue I SD, Redondo Beach		S17
Santa Ynez SD, Will Rogers SB	2-2		Malaga Cove, Palos Verdes Estates		S18
Pulga Cyn SD, Will Rogers SB	2-4	S3	24" corrugated metal pipe near O-5	O-4	
Santa Monica Cyn SD, Santa Monica SB	2-7	S4	Marquez SD, Santa Ynez subwatershed	O-5	

Table 2. Summary of bacterial compliance monitoring stations in Santa Monica Bay with corresponding MS4 and/or SMBBB TMDL station identification (sampling by EMD). Stations SMB-O-4 and O-5 are monitored only as dry-weather flow observations sites.

All samples were collected at ankle-depth 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, but a point zero (mixed) sample can be collected only at high tide. In September 2011, sampling at El Pescador State Beach (1-2) ceased due to safety concerns to field personnel; sampling will resume when safety issues, such as eroding and unstable terrain, are resolved.

Because of spatial, logistical, and time constraints, simultaneous sample collection (within a 3 – 4 hour period) of SMB TMDL and MS4 stations is 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 FY2011-2012, 3,580 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 10,740 were performed during the 2011 – 2012 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 and creeks. 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. Geometric means are the best estimate of central tendency for log-normalized data and were calculated for each bacterial indicator group. 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^{th} root of the product of n numbers." Geometric mean values 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 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 2011-2012, totaling 8.68 inches with 25 measurable rainfall incidents, was 11.51 inches less than FY 2010-2011 (20.19 inches), and 6.36 inches below the seasonal average (15.14 inches) for the Los Angeles area. This also was the third lowest rainfall year for the last ten years. Total rainfall was measured from October 2011 to April 2012; rainfall totals per month for this period were between 1 to 2 inches, with the exception of February 2012 which recorded 0.16 inches, in contrast to the maximum monthly average precipitation of 3.29 inches, which occurs in February in the Los Angeles area. March and April had the highest and second highest rainfall amounts, 1.75 and 1.71 inches, respectively. The difference between the highest and third highest monthly rainfall, November, was only 0.17 inches. No rain was recorded from June through September 2011 and in May 2012 (Figure 2).

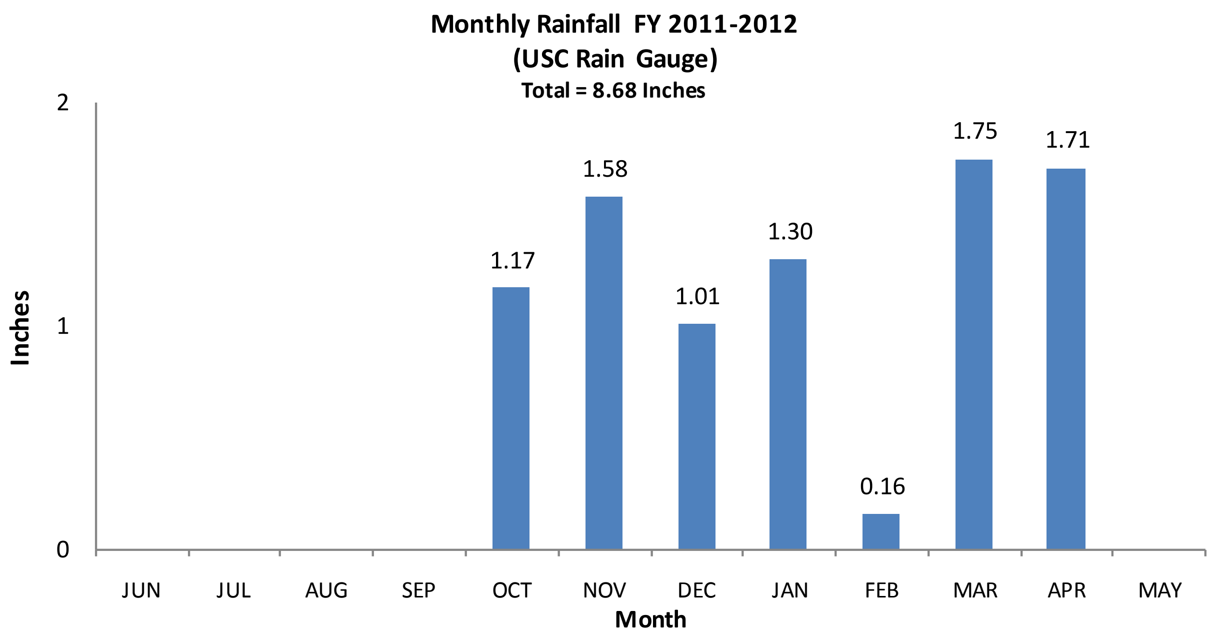

Figure 2. Monthly rainfall at Downtown Los Angeles, USC, June 2011 – May 2012.

Shoreline Monitoring Stations

Sample collection from Santa Monica Bay compliance monitoring stations is conducted year round to assess water quality. Bacterial densities obtained from fiscal year 2011-2012 were computed and graphed for geometric mean values for summer-dry, winter-dry, and wet-weather. Graphical representations of geometric mean values per monitoring site for each time period are illustrated in Figures 3, 4, and 5. With the incorporation of sixteen SMBBB TMDL stations, in addition to the 18 historical SMB MS4 sites, variations and significant geometric mean observations are presented below.

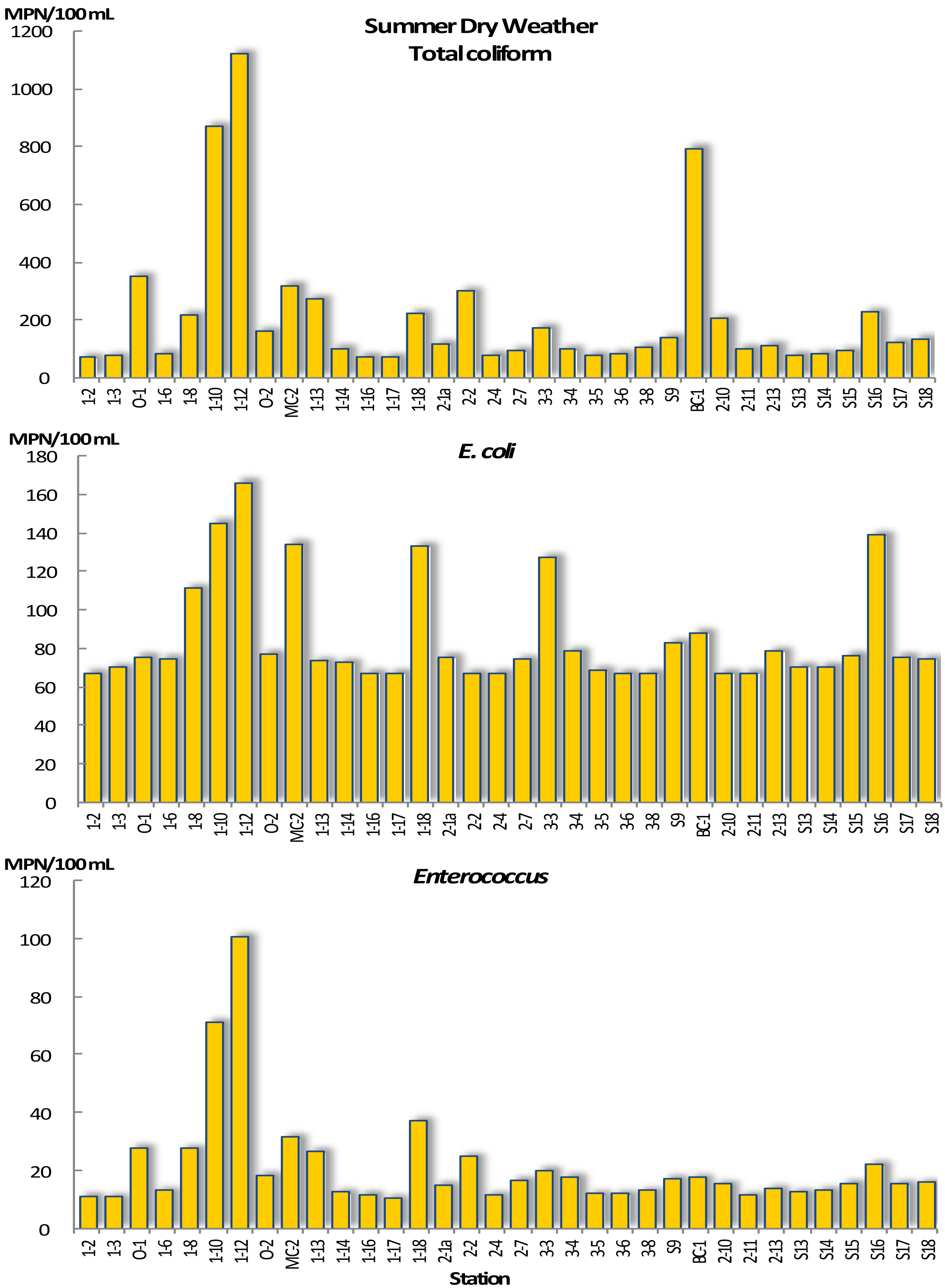

Figure 3. Summer-dry weather geometric means for indicator bacteria at compliance monitoring stations in Santa Monica Bay, FY 2011-2012.

Summer-Dry Weather (Jun 2011 – Oct 2011; Apr 2012 – May 2012)

The highest geometric means, overall, for indicator bacteria during summer-dry periods were recorded at stations SMB-1-12 (Marie Canyon), SMB-1-10 (Solstice Creek), SMB-MC-2 (S1, Surfrider Beach, Malibu), SMB-BC-1 (S10, Ballona Creek) and S16 (Redondo Beach Pier) (Figure 3). Stations 1-12 and 1-10 had the highest and second highest densities, respectively, for all three fecal indicator bacteria (FIB).

In addition to having the highest FIB densities at 1-12 and 1-10, in general, northerly located Santa Monica Bay monitoring stations from SMB-1-2 (El Pescador State Beach) to SMB-1-16 (Pena Creek) recorded higher FIB densities than central and southern SMB stations (Figure 1). Station 3-03 (S5, Santa Monica Pier) had the highest *E. coli* densities amongst centrally located SMB stations from Castlerock SD (2-01) to Mother's Beach (S9, Marina Del Rey); station 2-02 (Santa Ynez SD) had the highest total coliform and enterococcus geometric means in the central bay. In the southern bay, stations S16 and BC-1(S10) registered the highest FIB densities.

Winter-Dry Weather (November 1 to March 30)

Station MC-2(S1) had by far the highest geometric means for total coliform, *E. coli*, and enterococcus during winter-dry weather (Figure 4). The total coliform geometric mean for MC-2(S1) is greater than five times than the second highest total coliform geometric means at stations 1-10 and O-1; the MC-2(S1) *E. coli* geometric mean is greater than twice the geometric means of stations S16 and 3-3; and, the enterococcus geometric mean for MC-2(S1) is also more than twice the second highest geometric means at station 1-10.

Station 1-10 was a site that also registered a relatively high geometric mean in the northern bay and, in general, as in the summer-dry period, higher FIB densities were recorded at northern bay monitoring stations compared to central and southern bay sites. Stations 1-18(S2) and 3-3(S5) had the highest FIB densities amongst the central bay monitoring stations. In the southern bay, stations S16 and BC-1(S10) registered the highest FIB densities. Bacterial densities during the winter-dry weather period were in general lower than densities in the summer-dry and wet-weather periods

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

As expected, wet-weather periods registered higher geometric mean concentrations compared to dry-weather periods. Geometric means computed for compliance stations during wet-weather are graphically illustrated in Figure 5. Stations BC-1(S10), MC-2(S1), 3-04(S6), and 2-02 were among the sites with the highest geometric means for all three indicators during wet weather. Station BC-1(S10) registered the highest geometric means for total coliform and enterococcus; MC-2(S1) had second highest geometric means for the same FIB. Conversely, MC-2(S1) registered the highest geometric mean for *E. coli*, followed by BC-1 (S10) with the second highest *E. coli* densities. Although Figure 5 indicates that weekly monitored station 2-2 had the third highest densities for all FIB during wet-weather, station 2-2 was collected only four days during this period compared to 37 days for MC-2(S1) and 3-04(S6) and 27 days for BC-2(S10), which are sampled daily. This site is one of the locations that is frequently inaccessible to sampling. Changing tides and the safety of field personnel limited the collection of more samples, which would have produced a better representation of the FIB water quality of station 2-2 during wet-weather. In the absence of additional samples it is difficult to predict how the geometric mean would have been affected.

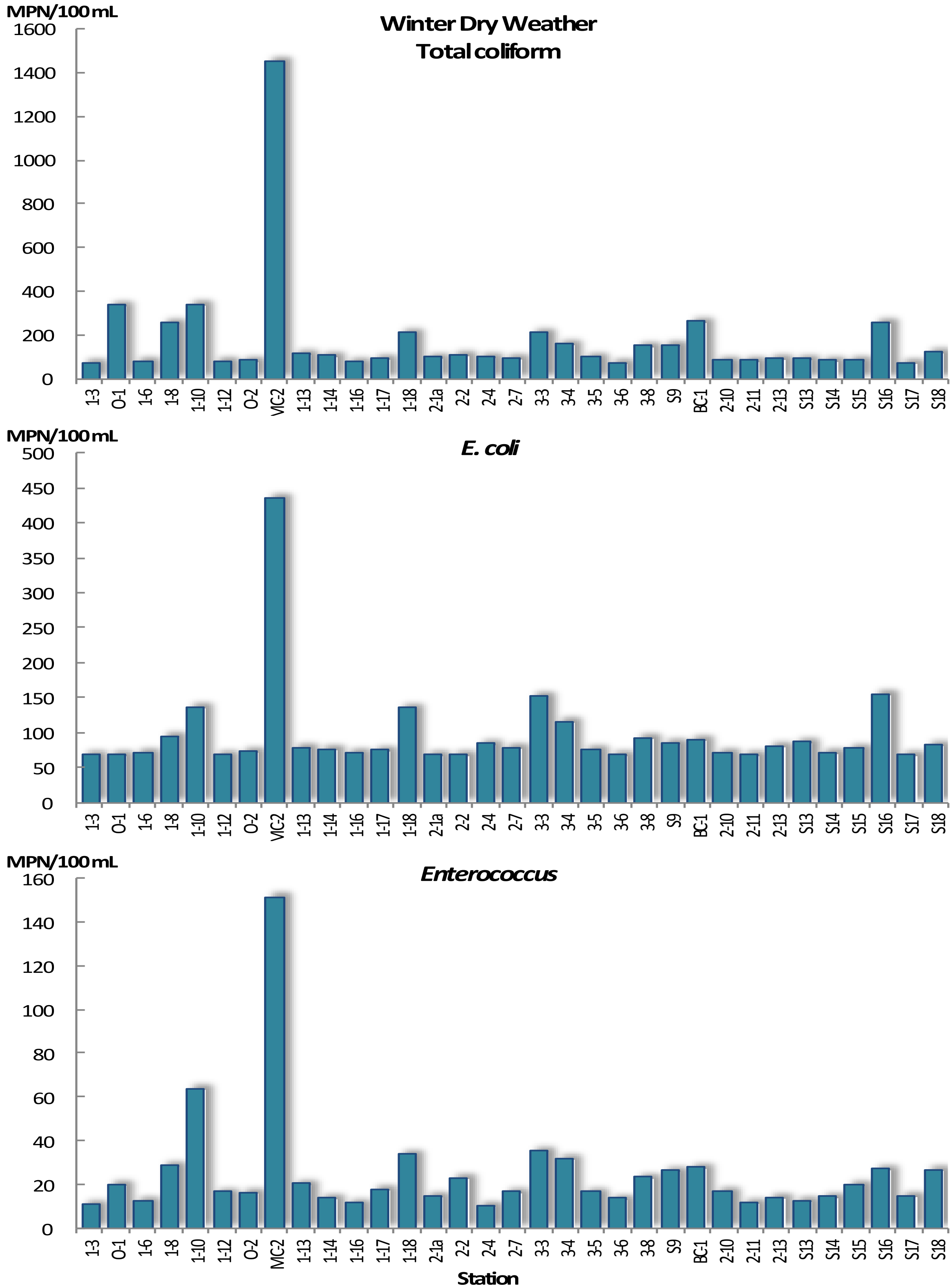

Figure 4. Winter-dry weather geometric means for indicator bacteria at compliance monitoring stations in Santa Monica Bay, FY 2011-2012.

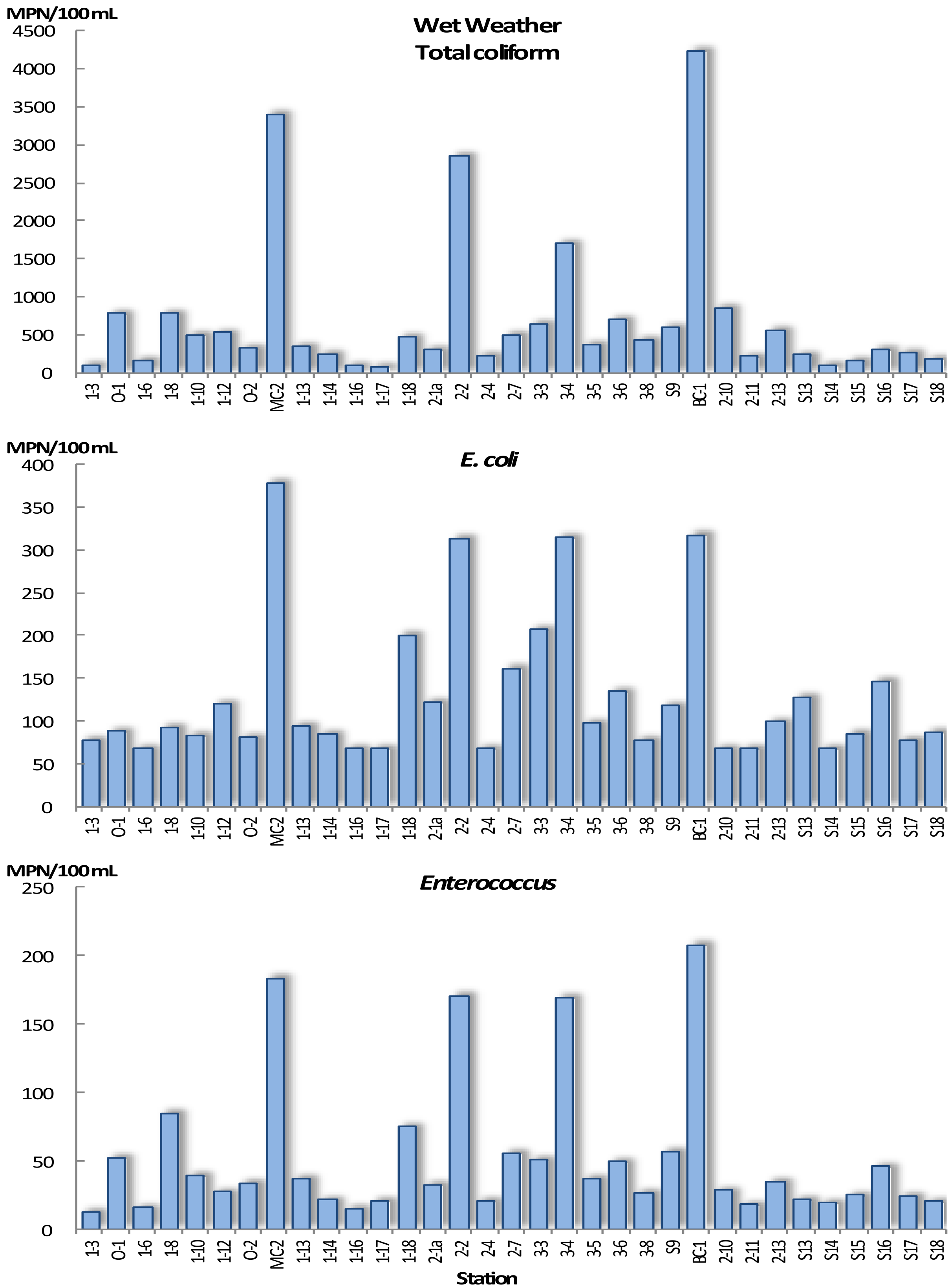

Figure 5. Wet-weather geometric means for indicator bacteria at compliance monitoring stations in Santa Monica Bay, FY 2011-2012.

Water Quality Standards Compliance

Per the Santa Monica Bay Beaches Bacteria TMDL, allowable exceedances days assigned to each station is adjusted on the basis of the monitoring frequency; fewer exceedances are allocated for sites monitored weekly, compared to those that are monitored daily. During dry weather period when a weekly monitored station exceeds one of the water quality objectives (Table 1), accelerated monitoring is triggered, in which an additional sample is collected after 48 hours of the initial sampling event, and if the 48-hour sample also exceeds, another sample is collected after another 48 hours (or 96 hours after the initial weekly collection). No additional exceedance allowances were allocated for accelerated samples, and they are not counted against the allowable exceedances. All exceedance days for daily monitored SMBBB TMDL sites are counted against the allowable exceedance days. SMBBB TMDL data assessment for stations S9 and S13 through S16 is not covered in this report as CLA only conducts MS4 monitoring for these sites (Table 2). Data for these sites is assessed only for the MS4 permit and is not subject to the SMBBB TMDL rolling 30-day geometric mean or waste load allocations for the three weather periods.

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. In addition, when an exceedance of bacterial water quality standards occurs, the LACDPH takes steps to notify beach goers, such as posting health hazard warning signs. Los Angeles Basin Plan bacteriological objectives for REC-1 designation for FY 2011-2012 Santa Monica Bay shoreline stations collected by CLA EMD were examined and evaluated (Tables 3 to 6).

Summer-Dry Weather (Jun 2011 – Oct 2011; Apr 2012 – May 2012)

Of the 27 shoreline stations monitored for SMBBB TMDL compliance, 21 stations surpassed the single-sample waste load allocation (WLA) of zero allowable exceedances during summer-dry periods (Table 3); whereas only 11 stations surpassed the 30-day geometric mean limit of zero allowable exceedance days. Stations MC-2(S1), 1-18(S2), 3-3(S5), and BC-1(S10) had the highest single-sample TMDL exceedance days amongst the stations monitored daily; stations 1-12 and 1-10 had the highest single-sample TMDL exceedance days for weekly monitored stations. With the exception of station 3-3(S5), all aforementioned TMDL stations had the highest rolling 30-day geometric-mean exceedance days and some of the highest single-sample exceedance rates, ranging from 18% for station BC-1(S10) to 45% for stations 1-10 and 1-12.

The rolling 30-day geometric mean exceedance days for weekly monitored stations 1-10 and 1-12 were the highest and third highest, respectively, of all TMDL stations. Weekly sites can have a higher incidence of rolling 30-day geometric mean exceedance days as a result of the method by which the daily 30-day geometric mean is calculated. For weekly sampling, test results are assigned to the remaining days of the week. If more samples are tested within the same week, each test result supersedes the previous result and is assigned to the remaining days of the week until the next sample is collected. This approach gives weekly sites such as 1-10 and 1-12 less of an opportunity to lower their 30-day geometric mean values compared to daily sites.

Table 3. Summer-Dry Weather, FY 2011-2012 Exceedance Days

Station*	Sampling Frequency	Sample Days	Single-Sample Exceedance Days	Waste Load Allocation**	Rolling 30-Day Geometric Mean Exceedance Days	Percent Single-Sample Exceedance Rate
1-2	Weekly	10	0	0	0	0%
1-3	Weekly	29	0	0	0	0%
O-1	Weekly	29	4	0	42	14%
1-6	Weekly	29	2	0	0	7%
1-8	Weekly	29	7	0	43	24%
1-10	Weekly	29	13	0	138	45%
1-12	Weekly	29	13	0	113	45%
O-2	Weekly	29	3	0	0	10%
MC-2(S1)	Daily	138	48	0	126	35%
1-13	Weekly	29	3	0	33	10%
1-14	Weekly	29	1	0	0	3%
1-16	Weekly	29	0	0	0	0%
1-17	Weekly	7	0	0	30	0%
1-18(S2)	Daily	139	43	0	111	31%
2-1a	Weekly	29	2	0	0	7%
2-2	Weekly	17	2	0	38	12%
2-4(S3)	Weekly	29	1	0	0	3%
2-7(S4)	Daily	139	7	0	0	5%
3-3(S5)	Daily	139	20	0	39	14%
3-4(S6)	Daily	138	14	0	0	10%
3-5(S7)	Daily	139	2	0	0	1%
3-6	Weekly	29	1	0	0	3%
3-8(S8)	Weekly	29	0	0	0	0%
*S9**	Daily	139	*13*	13	-	9%
BC-1(S10)	Daily	104	19	0	66	18%
2-10(S11)	Weekly	29	1	0	0	3%
2-11	Weekly	29	0	0	0	0%
2-13(S12)	Weekly	29	3	0	0	10%
*S13**	Weekly	29	*1*	-	-	3%
*S14**	Weekly	29	*1*	-	-	3%
*S15**	Weekly	29	*3*	-	-	10%
*S16**	Daily	138	*26*	-	-	19%
*S17**	Weekly	29	*1*	-	-	3%
*S18**	Weekly	29	*3*	-	-	10%

* MS4 sites S9 and S13-S18 are assessed for the MS4 permit only and are not subject to SMBBB TMDL compliance.
** Waste Load Allocation is defined as allowable number of exceedance days.

Amongst the daily monitored MS4 only sites, station S16 had the highest single-sample exceedance days with an exceedance rate of 19%; weekly monitored MS4 stations S15 and S18 had the highest number of exceedance days with 10% exceedance rates. Overall, 24 stations had an exceedance rate equal to or less than 10 percent.

With the exception of 1-8 and BC-1(S10), *E. coli* and enterococcus were the indicators most frequently exceeding at sites registering higher exceedance days (Table 6). Stations MC-2(S1) and BC-1(S10) had the highest total coliform exceedances. MC-2(S1) and 1-18(S2) had the highest *E. coli*, enterococcus, and fecal coliform/*E. coli* exceedances.

Winter-Dry Weather (November 1 – March 31)

SMBBB TMDL compliance stations monitored during winter-dry weather are allocated higher allowable exceedances days compared to summer-dry periods (Table 4). Thus, fewer TMDL stations (eleven) exceeded their WLA during winter-dry periods. Stations MC-2(S1), 1-18(S2), and 3-3(S5) had the highest TMDL single-sample exceedance days and the highest rolling 30-day geometric mean exceedance days amongst daily sampled stations. Weekly monitored TMDL stations 1-8, 1-10, and 3-8 had the highest exceedance days. In addition, these stations had correspondingly high single-sample exceedance rates, ranging from 20% for 1-8 and 3-8 to a very high exceedance rate of 72% for MC-2(S1). The 25% and 14% exceedance rate of stations 2-2 and 1-17, respectively, can be misleading considering these sites are frequently inaccessible to sampling; they were collected 8 and 7 times, respectively, out of a minimum 15 possible sampling days. Stations O-1 and 1-12 are the only two stations to exceed their allowable rolling 30-day geometric mean exceedance days but not their WLA.

Daily monitored station S16 had the highest single-sample exceedance days amongst MS4 only sites and an exceedance rate of 27%; weekly MS4 stations S15 and S18 had the highest single-sample exceedance days, each with exceedance rates of 13%. *E. coli* and enterococcus were again the indicators that exceeded most frequently. Station MC-2(S1) had the highest number of exceedances for each indicator amongst all compliance stations (Table 6).

Table 4. Winter-Dry Weather, FY 2011-2012 Exceedance Days

Station*	Sampling Frequency	Sample Days	Single-Sample Exceedance Days	Waste Load Allocation**	Rolling 30-Day Geometric Mean Exceedance Days	Percent Single-Sample Exceedance Rate
1-3	Weekly	15	0	1	0	0%
O-1	Weekly	15	1	1	26	7%
1-6	Weekly	15	0	1	0	0%
1-8	Weekly	15	3	1	0	20%
1-10	Weekly	15	4	1	101	27%
1-12	Weekly	15	1	1	17	7%
O-2	Weekly	15	1	1	0	7%
MC-2(S1)	Daily	86	62	3	152	72%
1-13	Weekly	15	1	1	0	7%
1-14	Weekly	15	0	1	0	0%
1-16	Weekly	15	0	1	0	0%
1-17	Weekly	7	1	1	0	14%
1-18(S2)	Daily	86	21	3	86	24%
2-1a	Weekly	15	1	1	0	7%
2-2	Weekly	8	2	1	16	25%
2-4(S3)	Weekly	15	1	1	0	7%
2-7(S4)	Daily	86	6	3	27	7%
3-3(S5)	Daily	86	24	3	83	28%
3-4(S6)	Daily	86	18	3	47	21%
3-5(S7)	Daily	86	7	3	0	8%
3-6	Weekly	15	1	1	0	7%
3-8(S8)	Weekly	15	3	1	5	20%
*S9**	Daily	86	*13*	-	-	15%
BC-1(S10)	Daily	75	10	3	39	13%
2-10(S11)	Weekly	15	0	1	0	0%
2-11	Weekly	15	0	1	0	0%
2-13(S12)	Weekly	15	1	1	0	7%
*S13**	Weekly	15	*1*	-	-	7%
*S14**	Weekly	15	*1*	-	-	7%
*S15**	Weekly	15	*2*	-	-	13%
*S16**	Daily	86	*23*	-	-	27%
*S17**	Weekly	15	*1*	-	-	7%
*S18**	Weekly	15	*2*	-	-	13%

* MS4 sites S9 and S13-S18 are assessed for the MS4 permit only and are not subject to SMBBB TMDL compliance.
** Waste Load Allocation is defined as allowable number of exceedance days.

Table 5. Wet-Weather, FY 2011-2012 Exceedance Days

Station*	Sampling Frequency	Sample Days	Single-Sample Exceedance Days	Waste Load Allocation**	Percent Single-Sample Exceedance Rate
1-3	Weekly	8	0	3	0%
O-1	Weekly	8	2	3	25%
1-6	Weekly	8	0	3	0%
1-8	Weekly	8	4	3	50%
1-10	Weekly	8	2	3	25%
1-12	Weekly	8	1	3	13%
O-2	Weekly	8	2	3	25%
MC-2(S1)	Daily	37	30	17	81%
1-13	Weekly	8	2	3	25%
1-14	Weekly	8	1	3	13%
1-16	Weekly	8	0	3	0%
1-17	Weekly	1	0	3	0%
1-18(S2)	Daily	36	18	17	50%
2-1a	Weekly	8	2	3	25%
2-2	Weekly	4	2	3	50%
2-4(S3)	Weekly	8	0	3	0%
2-7(S4)	Daily	37	14	17	38%
3-3(S5)	Daily	37	13	17	35%
3-4(S6)	Daily	37	22	17	59%
3-5(S7)	Daily	37	7	17	19%
3-6	Weekly	8	3	3	38%
3-8(S8)	Weekly	8	1	2	13%
*S9**	Daily	37	*14*	-	38%
BC-1(S10)	Daily	27	19	17	70%
2-10(S11)	Weekly	8	0	3	0%
2-11	Weekly	8	0	3	0%
2-13(S12)	Weekly	8	3	3	38%
*S13**	Weekly	8	*2*	-	25%
*S14**	Weekly	8	*1*	-	13%
*S15**	Weekly	8	*2*	-	25%
*S16**	Daily	36	*13*	-	36%
*S17**	Weekly	8	*1*	-	13%
*S18**	Weekly	8	*1*	-	13%

* MS4 sites S9 and S13-S18 are assessed for the MS4 permit only and are not subject to SMBBB TMDL compliance.
** Waste Load Allocation is defined as allowable number of exceedance days.

Wet Weather

TMDL stations MC-2(S1), 3-4(S6), BC-1(S10), and 1-18(S2) had the highest single-sample exceedance days amongst daily sampled stations during the wet-weather period; weekly TMDL stations with the highest exceedance days consisted of stations 1-8, 3-6, and 2-13(S12) (Table 5). Seven stations had exceedance rates of 0%, meaning all samples for these stations passed water quality objectives; the remaining stations had exceedance rates of 13% or higher. Overall, single-sample exceedance rates are higher during wet-weather periods than dry-weather periods, which is consistent with the observed higher geometric mean densities for this period.

In recognition that urban runoff and stormwater runoff conveyed by storm drains and creeks is a primary source of elevated bacteria, the SMBBB TMDL allocates a greater number of single-sample exceedance days during wet-weather (Table 5) compared to dry-weather periods. Fewer TMDL stations, 5 compared to 11 and 21 for winter-dry and summer-dry periods, respectively, exceeded their WLA. Sampling sites collected during wet-weather are not subject to rolling 30-day geometric mean compliance requirements.

MS4 only stations monitored daily, S9 and S16, had more than 6 times the single-sample exceedance days that MS4 sites monitored weekly had. Enterococcus was the indicator that was exceeded the most during wet-weather periods. Stations 3-4 (S6) and BC-1 (S10) had the highest number of total coliform exceedances; stations MC-2 (S1) and 3-4 (S6) had the highest number of *E. coli*, enterococcus, and fecal coliform/*E. coli* ratio exceedances (Table 6).

Table 6. Exceedances Per Indicator, FY 2011-2012

	Summer-Dry					Winter-Dry					Wet-Weather				
	Exceedances Per Indicator				Total Indicator Exceedances	Exceedances Per Indicator				Total Indicator Exceedances	Exceedances Per Indicator				Total Indicator Exceedances
Station	Total[1]	E.coli[2]	Entero[3]	Ratio[4]		Total[1]	E.coli[2]	Entero[3]	Ratio[4]		Total[1]	E.coli[2]	Entero[3]	Ratio[4]	
1-2	0	0	0	0	0	-	-	-	-	-	-	-	-	-	-
1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O-1	1	1	4	0	6	0	0	1	0	1	0	0	2	0	2
1-6	0	1	2	0	3	0	0	0	0	0	0	0	0	0	0
1-8	0	5	8	9	22	0	2	3	3	8	1	1	4	0	6
1-10	2	9	20	7	38	0	4	9	5	18	0	0	2	0	2
1-12	8	12	24	6	50	0	0	1	0	1	1	1	1	1	4
O-2	0	2	4	1	7	0	0	1	0	1	1	0	2	0	3
MC-2(S1)	14	25	32	22	93	6	46	59	45	156	10	19	29	13	71
1-13	0	0	3	0	3	0	1	1	0	2	0	1	2	1	4
1-14	0	1	0	1	2	0	0	0	0	0	0	0	1	0	1
1-16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1-17	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
1-18(S2)	6	30	40	24	100	1	15	20	10	46	3	10	16	9	38
2-1a	1	1	2	1	5	0	0	1	0	1	0	2	2	1	5
2-2	0	0	2	0	2	0	0	2	0	2	1	2	2	2	7
2-4(S3)	0	0	1	0	1	0	1	0	1	2	0	0	0	0	0
2-7(S4)	0	2	6	4	12	0	3	5	2	10	7	8	13	5	33
3-3(S5)	0	19	10	8	37	0	17	15	7	39	5	8	9	7	29
3-4(S6)	3	4	13	4	24	0	11	17	9	37	15	12	22	11	60
3-5(S7)	0	0	2	0	2	1	2	5	2	10	4	5	7	2	18
3-6	0	0	1	0	1	0	0	1	0	1	1	2	3	2	8
3-8(S8)	0	0	0	0	0	0	1	3	1	5	0	0	1	0	1
S9	0	6	10	5	21	0	4	10	3	17	4	5	13	3	25
BC-1(S10)	14	4	5	2	25	1	5	8	3	17	15	11	17	6	49
2-10(S11)	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0
2-11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2-13(S12)	0	2	2	1	5	0	0	1	0	1	1	1	2	0	4
S13	0	0	1	0	1	0	1	1	1	3	0	1	2	1	4
S14	0	0	1	1	2	0	0	1	0	1	0	0	1	0	1
S15	0	2	3	0	5	0	1	1	0	2	0	1	2	1	4
S16	0	18	15	9	42	0	16	8	6	30	0	3	11	1	15
S17	0	1	1	1	3	0	0	1	0	1	0	0	1	0	1
S18	0	0	3	1	4	0	0	2	0	2	0	1	1	0	2

[1] Total coliform limit is 10,000 MPN/mL
[2] E.coli limit is 400 MPN/mL
[3] Enterococcus limit is 104 MPN/mL
[4] 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 2011-2012. 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 2011-2012 is presented in Table 7.

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 began operating 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 shoreline by diverting the flows to the sanitary sewer collection system for treatment at the Hyperion Wastewater Treatment Plant (Table 7 and Figure 6).

Table 7. Storm Drain flow data for MS4, SMB TMDL stations and observation sites, FY 2011-2012.

Station	Location	LFD In Place	Summer Dry		Winter Dry		Wet Weather	
			% Observed Flow Days	Ave. Flow[1]	% Observed Flow Days	Ave. Flow[1]	% Observed Flow Days	Ave. Flow[1]
1-2	Open Beach	-	0	0	-	-	-	-
1-3	Open Beach	-	0	0	0	0	0	0
O-1	Creek	No	86	2	100	2	80	2
1-6	Creek	No	19	1	7	2	50	1
1-8	Creek	No	36	2	45	2	63	1
1-10	Creek	No	100	2	100	2	100	1
1-12	Storm Drain	No	98	2	93	1	63	2
O-2	Storm Drain	No	33	1	63	1	100	1
MC-2	Lagoon	No	35	3	94	3	86	3
1-13	Storm Drain	No	75	1	63	1	73	1
1-14	Creek	No	13	2	7	1	38	2
1-16	Creek	No	0	0	0	0	11	1
1-17	Canyon	No	4	1	9	1	48	1
1-18	Lagoon	No	17	2	13	2	35	2
2-1	Storm Drain	Yes	13	2	0	0	25	2
2-2	Storm Drain	Yes	21	1	33	1	58	1
2-4	Storm Drain	Yes	31	1	13	1	25	3
2-7	Storm Drain[2]	Yes	1	1	3	2	27	3
3-3	Pier	Yes	0	0	0	0	8	2
3-4	Storm Drain	Yes	4	2	13	2	54	3
3-5	Storm Drain	Yes	0	0	1	2	16	2
3-6	Storm Drain	Yes	0	0	0	0	25	3
3-8	Storm Drain[2]	Yes	3	1	6	1	0	0
S9	Open Beach	-	0	0	0	0	0	0
BC-1	Storm Drain	No	100	3	100	3	100	3
2-10	Storm Drain	Yes	0	0	0	0	0	0
2-11	Storm Drain	Yes	0	0	0	0	0	0
2-13	Storm Drain[2]	Yes	13	2	0	0	25	2
S13	Storm Drain	No	0	0	0	0	0	0
S14	Pier	No	0	0	0	0	13	1
S15	Pier	No	0	0	0	0	0	0
S16	Pier	No	0	0	0	0	0	0
S17	Storm Drain	Yes	0	0	0	0	13	3
S18	Open Beach	-	0	0	0	0	0	0
O-4[3]	Storm Drain	No	0	0	0	0	-	-
O-5[3]	Storm Drain	Yes	0	0	6	1	-	-

[1] *Average Flow Rate: (0)= no flow (1)=low (2)=moderate (3)=heavy*

[2] *Low Flow Diversion (LFD) owned and operated by the City of Los Angeles*

[3] *Per CSMP, only dry-weather storm drain flow data for observation sites.*

IV. DISCUSSION

Data presented herein, indicates stations 1-10 (Solstice Creek), 1-12 (Marie Canyon), MC-2 (S1, Surfrider Beach, Malibu), 1-18 (S2, Topanga Canyon SD), 1-8 (Escondido Creek), and BC-1 (S10, Ballona Creek, Dockweiler SB) 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 1-10, at the wave wash of Solstice Creek at Dan Blocker County Beach, is a relatively newly identified problematic site in that the number of single-sample exceedance days for FY 2011-2012 spiked by more than 200% for summer-dry and 300% for winter-dry periods compared to FY 2010-2011. Although the precise source of bacterial loading is unknown, a flow from the creek was observed 100% of sampling days with an average observed flow rate of 2, moderate flow (Table7). From year to year on average, a moderate flow rate has been observed 75% to 100% of the time a sample has been collected during dry periods at station 1-10. One exception occurred in FY 2009-2010 in which flow was observed only 48% and 69% of sampling days during summer-dry and winter-dry weather, respectively. 2011- 2012 is the first time Solstice Creek has made Heal the Bay's Beach Bummer list (Heal the Bay 2012).

Station 1-12 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; it is designed to filter and treat as much as 100 gallons per minute of dry-weather runoff (LADPW 2007a). 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 working to fix issues with the filtration system, including sediment diversions to limit inefficient filtration, as well as increasing dry-weather pumping capacity. This site also appears on Heal the Bay's 2011-2012 Beach Bummer list.

Station MC-2(S1), one of the sites 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) and presently is considered to be the fourth most polluted beach in the state (Heal the Bay 2012). Surfrider Beach received a Grade F in the Heal the Bay Beach Report Card for 2011-2012 year as did station 1-18(S2) at Topanga State Beach (Heal the Bay, 2012).

Station 1-18(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. A Source Identification Pilot Program (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, 2012).

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. 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 (LADPW 2007b). The study, completed in 2010, 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).

Station BC-1 (S10) is at the mouth of Ballona Creek, across from the Marina Del Rey channel, and inside the breakwater that protects both channels. Ballona Creek is the largest freshwater flow to drain into the Bay. It is a channel with year-round flow and a drainage area equal to approximately 89 square miles. High bacterial concentrations from the Creek may contribute to bacteria detected at S10.

Station S16 (Redondo Beach Pier) appears to be the site most impacted by pollutants in the southern Bay area. It stands out due to the very low bacterial densities and exceedances found at surrounding sites. Adjacent to a heavily used pier, station S16 is subject to bacterial contamination by way of the pier and flows from an associated storm drain located under the pier. Redondo Beach Pier is populated with large restaurants, food concessions, restrooms, parking facilities, and large local and tourist populace. Historically a problematic site with a high exceedance rate of 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 indicate a human source was not likely the cause of bacterial exceedances and that the storm drain and pond that forms under the pier are not contributors of bacterial loading and contamination 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).

One station that previously exhibited poor water quality but has demonstrated notable water quality improvement in recent years is the Santa Monica Canyon storm drain site, station 2-7(S4), located in Santa Monica State Beach. Station 2-7(S4) 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.

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 20th 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's storm drain dry-weather 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 projects, funded by CBI and/or by Santa Monica voter-approved Measure V.

V. CONCLUSION

As assessment of SMBBB 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., MC-2(S1), 1-18(S2) and S16]; however, there were a few exceptions in which total single-sample exceedance days were either higher or equivalent to daily collected stations, such as 1-10 for summer and winter-dry periods and 1-8 and 1-12 for summer-dry periods.

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 approximately 71 percent of the time and for those days the site was accessible, there was only one exceedance. 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 Regional Board.

The Santa Monica Bay Beaches Bacteria TMDL compliance deadline for the winter-dry period became effective on July 15, 2009. The maximum 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). Heal the Bay reports that eight Santa Monica Bay beaches associated with an LFD received A or B grades this year during both summer- and winter-dry weather (Heal the Bay, 2012).

The City and the County Flood Control District negotiated and finalized a MOA addressing construction, operation, and maintenance of an inflatable rubber dam in the Santa Monica Canyon Channel as part of the new Low-Flow Diversion at this location. The construction of the rubber dam is anticipated to be completed by fall of 2012. The County has allocated $2,000,000 for design and construction of this project. Installation of the inflatable rubber dam will enhance the dry-flow diversion by providing ability to monitor and control the water level remotely via a computer or laptop providing faster response to storm events. The goal is to improve the operational efficiency and reliability, which in turn, should improve the dry-weather water quality compliance at Will Rogers State Beach. The City will continue 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 wet weather 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 affect 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 runoff to recreational waters must be reduced.

In March 2012, the Regional Board re-opened several bacteria TMDLs, including the SMBBB TMDLs, to reconsider certain provisions based on new data. A few of the proposed changes that will affect compliance monitoring and reporting include the calculation of a new rolling geometric mean, removal of BC-1 as a compliance site for SMBBB TMDL, and new WLA for winter-dry weather. The current rolling 30-day geometric means, which are calculated daily, shall be replaced by new rolling geometric means that will be calculated weekly using 5 or more samples for six-week periods, starting all calculation weeks on Sunday. As a consequence of the adoption of the Ballona Creek, Ballona Estuary, and Sepulveda Channel Bacteria TMDL (BCB TMDL), BC-1 shall be removed as a compliance monitoring station for the SMBBB TMDL and may be reassigned as a compliance site for the BCB TMDL. In addition, that specific sampling site, station S10 at the mouth of Ballona Creek at Dockweiler State Beach, will most likely continue to be sampled as an MS4 compliance monitoring site. A new winter-dry weather exceedance rate at the reference beach, Leo Carillo, calculated from point zero data collected from November 2004 to October 2010 will increase the final allowable exceedance days for the majority of SMBBB TMDLs compliance sites during winter-dry weather. Sites with no change in WLA or that were assigned fewer allowable exceedance days are subject to anti-degradation in which there is no degradation of existing water quality allowed if historical water quality at a particular site is better than the designated reference site.

It is anticipated that the next major milestones in water quality monitoring of recreational waters for the protection of public health will be the implementation a rapid molecular technique; quantitative polymerase chain reaction (qPCR) currently is the most promising candidate. From a public health perspective, an important facet of qPCR technology is the faster turn around time for results, usually 2-3 hours, compared to the current culture-based test methods requiring 18-96 hours. Quicker turn-around times will permit same-day notifications of the bacteriological condition of recreational waters, which will greatly enhance protection of public health, reducing health risk. The City of Los Angeles' Environmental Monitoring Division (EMD) led a multiagency qPCR Special Study at select Los Angeles County beaches for the detection of enterococci in the summer of 2011. This study was a cooperative effort among the microbiologists of EMD, the Southern California Coastal Water Research Project, the Los Angeles County Department of Public Works, and the Los Angeles County Department of Public Health. Six of the eight stations that were included in the study are located in Santa Monica Bay: Malibu Creek, Topanga Canyon, Santa Monica Canyon, Mothers' Beach, Ballona Creek, and Redondo Pier. The study indicated that the qPCR and culture-based bacteriological methods did not correlate well with each other. In addition, there were problems with the presence of inhibition, i.e., chemicals or compounds in the water that interfered with the test results, at a few of the beaches. QPCR is not ready for prime time (same-day notification) in Los Angeles County, and additional technical work needs to be done to further understand the reasons for the discrepancies observed between qPCR and current culture-based methods. EMD and collaborative agencies currently are conducting additional technical studies in the summer of 2012 to address the correlation and inhibition issues. Hopefully, this may be followed by a demonstration project in the summer of 2013 involving same-day notification to beach goers after these technical issues have been addressed.

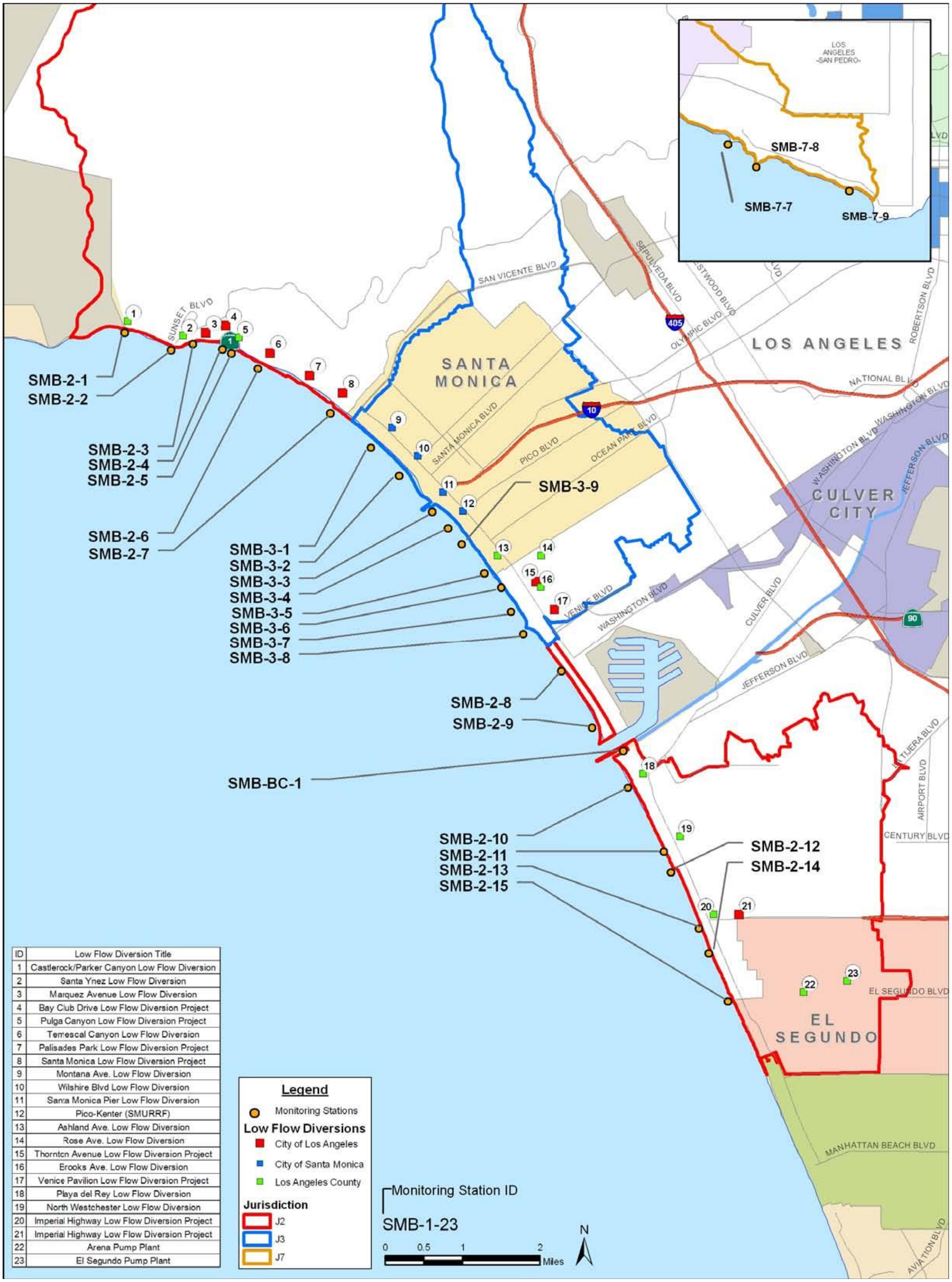

Figure 6. Low-Flow Diversions (LFDs) devices operated by City of Los Angeles, County of Los Angeles, and the City of Santa Monica along the Santa Monica Bay shoreline from Parker Mesa at Castle Rock to Dockweiler subwatershed.

VI. LITERATURE CITED

APHA. See American Public Health Association.

American Public Health Association. 1998. Standard methods for the examination of water and wastewater, 20th 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 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 of Los Angeles, Environmental Monitoring Division. 2003. Marine Monitoring in Santa Monica Bay: Biennial Assessment Report for the Period of January 2001 through December 2002. Report submitted to EPA and RWQCB (Los Angeles). Department of Public Works, Bureau of Sanitation, Hyperion Treatment Plant, Playa del Rey, California, pp. 1-1 to 8-37 + appendices.

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. 20th Annual Beach Report Card. http://www.healthebay.org/brcv2/

Heal the Bay. 2012. 21st Annual Beach Report Card. http://brc.healthebay.org/assets/pdfdocs/brc/annual/2012/HtB_BRC_Annual_2012_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. 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.

Los Angeles County Department of Public Works. 2007b. 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 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 SourceTracking.http://www.sccwrp.org/ResearchAreas/BeachWaterQuality/MicrobialSourceTracking/UpperSantaMonicaBayMicrobialSourceTracking.aspx.

Santa Monica Bay Restoration Commission. 2008. www.santamonicabay.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://santamonicabay.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.p