SAN PEDRO CREEK AND PACIFICA STATE BEACH FECAL INDICATOR BACTERIA TMDL STATUS AND MONITORING REPORT WATER YEAR 2017

IN COMPLIANCE WITH PROVISION C.14 OF THE MUNICIPAL REGIONAL STORMWATER PERMIT

Submitted in Accordance with State Water Resources Control Board Resolution No. 2013-0007
(Approving Basin Plan Amendment for TMDL)

March 15, 2018

Prepared by the County of San Mateo and City of Pacifica

1. Introduction

This report provides the status of the County of San Mateo and the City of Pacifica's implementation of the Total Maximum Daily Load (TMDL) for Fecal Indicator Bacteria in San Pedro Creek and at Pacifica State Beach, as required by Provision C.14 of the Municipal Stormwater Permit (Order No. R2-2015-0049).

The TMDL for Bacteria in San Pedro Creek and at Pacifica State Beach was adopted by the San Francisco Bay Regional Water Quality Board (RWQCB) on November 14, 2012. An amendment to the San Francisco Bay Basin Water Quality Control Plan establishing the TMDL was approved by the State Water Resources Control Board and the U.S. Environmental Protection Agency on June 24, 2013 and August 1, 2013 respectively. The Basin Plan Amendment became effective on October 1, 2013.

As part of the TMDL, the RWQCB required the County of San Mateo and the City of Pacifica to develop a Best Management Practices (BMP) implementation plan and water quality monitoring plan. The BMP Implementation Plan and Monitoring Plan were developed in 2014 and identify best management practices to address sources of impairment and to achieve water quality objectives. The plan also describes a fecal indicator bacteria monitoring plan to identify bacteria sources and to measure wasteload allocations.

This report was prepared by the County of San Mateo and City of Pacifica and provides an update on BMP implementation and water quality monitoring in San Pedro Creek and at Pacifica State Beach in Water Year 2017 (October 1, 2016-September 30, 2017).

2. Control Measures to Achieve Indicator Bacteria Wasteload Allocations

The following section details control measures implemented by the County of San Mateo (County) and by the City of Pacifica (City). The City and County may modify and/or refocus control measure implementation efforts as appropriate, at a frequency of no less than every two years.

2.1 Control Measures Implemented by the County of San Mateo

The County of San Mateo has implemented the following measures as required in Provision C.14.a.ii:

2.1.1. Sanitary Sewer System Activities

The County of San Mateo operates two restroom facilities at the San Pedro Valley County Park that discharge to the Pacifica collection system within the San Pedro Creek watershed. County Parks Ranger staff continues to conduct an annual visual inspection of the manhole near the San Pedro Valley County Park restroom for root issues that could compromise sewer line integrity. No issues were found in Water Year (WY) 2017.

The County will ensure that routine sewer line scoping is conducted every seven years. The most recent scoping was in 2015; the next scoping will occur in 2022. At that time, the County will take actions to correct any issues found, and will report on the findings of the scoping in the TMDL Status and Monitoring Report.

2.1.2. Bacteria Discharges from Horse and Dog Facilities

Shamrock Ranch Kennels and Stables is the only commercial horse facility and dog kennel facility in the unincorporated County areas of the San Pedro Creek Watershed. According to County records,

Shamrock Ranch has been a permitted horse facility since the early 1970's. Inspections for *horse* facilities in San Mateo County are normally conducted every three years as required by the San Mateo County Confined Animals Ordinance. However, in order to comply with Provision C.14.a.ii(2) of the MRP, Shamrock Ranch horse facility has been elevated to an annual inspection schedule. The San Mateo County Kennels/Catteries Ordinance requires inspections of *dog kennel* facilities annually.

The County Planning and Building Department and County Environmental Health have conducted joint annual site inspections and compliance reviews of Shamrock Ranch beginning in 2014. The TMDL Implementation Plan requires annual inspections and compliance reviews by June 30 but due to conflicting schedules between the County and Shamrock Ranch operators, the 2017 inspection and compliance review did not occur until July 13, 2017.

Horse Facility: On July 13, 2017, County staff found the Shamrock Ranch horse facility to be in compliance with all standards of the County's Confined Animal Ordinance and the facility's Confined Animal Permit, PLN1999-00406, including for manure management, drainage, and facility management practices.

Dog Kennel Facility: On July 13, 2017, County staff found the Shamrock Ranch dog kennel facility to be in compliance with all standards of the County's Kennels/Catteries Ordinance (San Mateo County Ordinance, Chapter 6.20.) and the facility's Kennel Permit, PLN1999-00633, including for waste management, drainage, and facility management practices.

2.2 Control Measures Implemented by the City of Pacifica

The City of Pacifica has implemented the following measures as required in C.14.a.ii:

2.2.1. Bacteria discharges from Horse Facilities

Two commercial horse facilities are located in the City of Pacifica, including Sweeney Ridge Equestrian and Millwood Ranch. As of March 2017, City staff found Sweeny Ridge Equestrian facilities to be in compliance with the City's standards for Keeping Animals including for waste management, drainage, and facility management practices. As of March 2017, City staff found Millwood Ranch facilities to be in compliance with the City's standards for Keeping Animals including waste management, but compliance with a number of the City's policies and codes including those related to drainages and ponds have not yet been achieved. The City is starting the process to renew permits for both facilities.

2.2.2 Dog Waste Installations

The City of Pacifica installed 10 new dog waste clean-up signs, waste bag dispensers and trash cans at high priority locations within the TMDL Project Area. The high priority sites were determined via visual inspections of popular dog walking areas and their potential to discharge improperly deposited pet waste to San Pedro Creek and Pacifica State Beach. The locations are listed on Table 1 and shown on Figure 1.

Table 1. San Pedro Creek and Pacifica State Beach Pet Waste Stations

#	Station ID	Station Location	Latitude	Longitude
1	Pet Waste Station 1	Pacifica State Beach Anza Pump Station	37°35'53.63"N	122°30'7.63"W
2	Pet Waste Station 2	Pacifica State Beach North of Taco Bell	37°35'50.28"N	122°30'11.40"W
3	Pet Waste Station 3	Pacifica State Beach South of Taco Bell	37°35'49.65"N	122°30'13.63"W
4	Pet Waste Station 4	Pacifica State Beach Linda Mar Pump Station	37°35'47.49"N	122°30'16.41"W
5	Pet Waste Station 5	Pacifica State Beach San Pedro Creek	37°35'45.00"N	122°30'20.22"W
6	Pet Waste Station 6	Highway 1 and San Pedro Creek Trail Head	37°35'35.73"N	122°30'19.43"W
7	Pet Waste Station 7	San Pedro Creek Trail Head and Linda Mar Covelescent Home	37°35'21.52"N	122°30'6.02"W
8	Pet Waste Station 8	Peralta Bridge	37°35'18.36"N	122°29'58.15"W
9	Pet Waste Station 9	Sanchez Arts Center Entrance	37°35'1.25"N	122°29'12.76"W
10	Pet Waste Station 10	Sanchez Arts Center Parking Lot	37°34'57.79"N	122°29'13.98"W

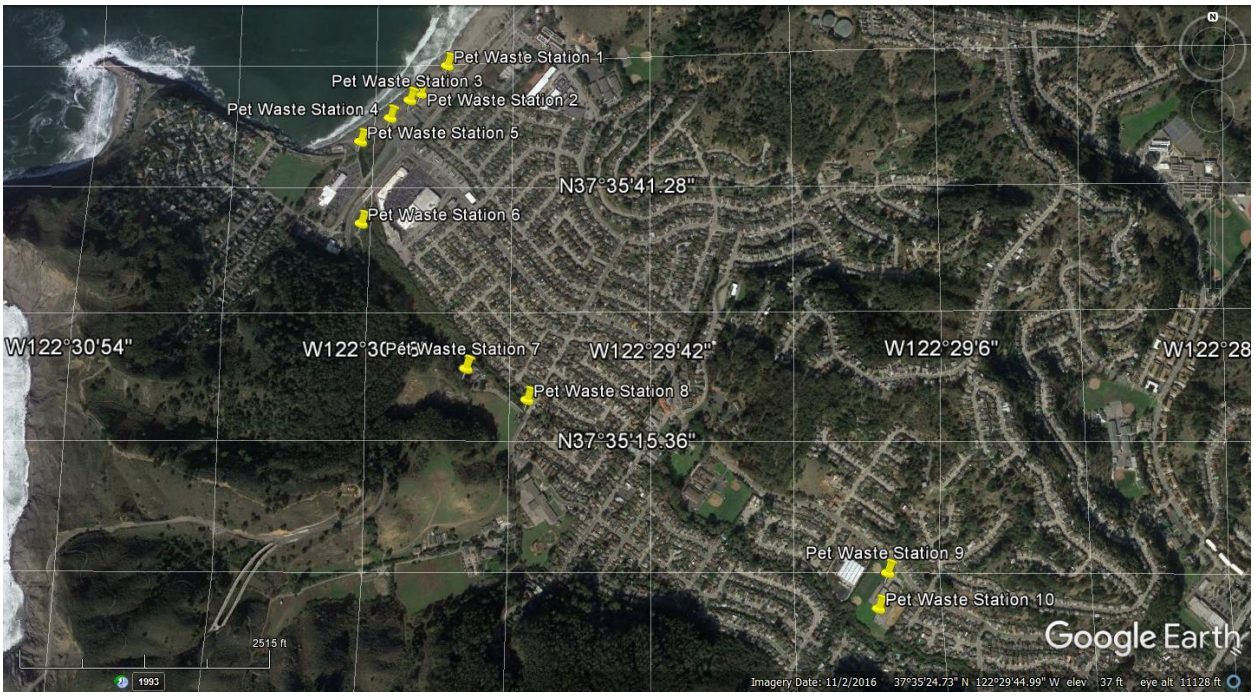

Figure 1. San Pedro Creek and Pacifica State Beach Pet Waste Stations

2.2.3. Visual Inspections

In February 2017, The City of Pacifica developed and implemented a visual inspection and cleanup plan for high dog waste accumulation areas along San Pedro Creek and its tributaries. The locations of visual inspection and cleanup areas are listed on Table 2 and shown on Figure 2. Visual inspection completed in March, April and November 2017 found no pet waste left in the walking pathways. Visual inspection completed in September 2017 found pet waste left in two (2) of the ten (10) the walking pathways. Visual inspection completed in January 2018 found pet waste left in three (3) of the ten (10) the walking pathways.

Visual inspection log is attached as Exhibit B.

Table 2. San Pedro Creek and Pacifica State Beach Visual Monitoring

#	Station ID	Station Location	Latitude	Longitude
1	Visual Monitoring 1	Pacifica State Beach Anza Pump Station	37°35'53.63"N	122°30'7.63"W
2	Visual Monitoring 2	Pacifica State Beach North of Taco Bell	37°35'50.28"N	122°30'11.40"W
3	Visual Monitoring 3	Pacifica State Beach South of Taco Bell	37°35'49.65"N	122°30'13.63"W
4	Visual Monitoring 4	Pacifica State Beach Linda Mar Pump Station	37°35'47.49"N	122°30'16.41"W
5	Visual Monitoring 5	Pacifica State Beach San Pedro Creek	37°35'45.00"N	122°30'20.22"W
6	Visual Monitoring 6	Highway 1 and San Pedro Creek Trail Head	37°35'35.73"N	122°30'19.43"W
7	Visual Monitoring 7	San Pedro Creek Trail Head and Linda Mar Covelescent Home	37°35'21.52"N	122°30'6.02"W
8	Visual Monitoring 8	Peralta Bridge	37°35'18.36"N	122°29'58.15"W
9	Visual Monitoring 9	Sanchez Arts Center Entrance	37°35'1.25"N	122°29'12.76"W
10	Visual Monitoring 10	Sanchez Arts Center Parking Lot	37°34'57.79"N	122°29'13.98"W

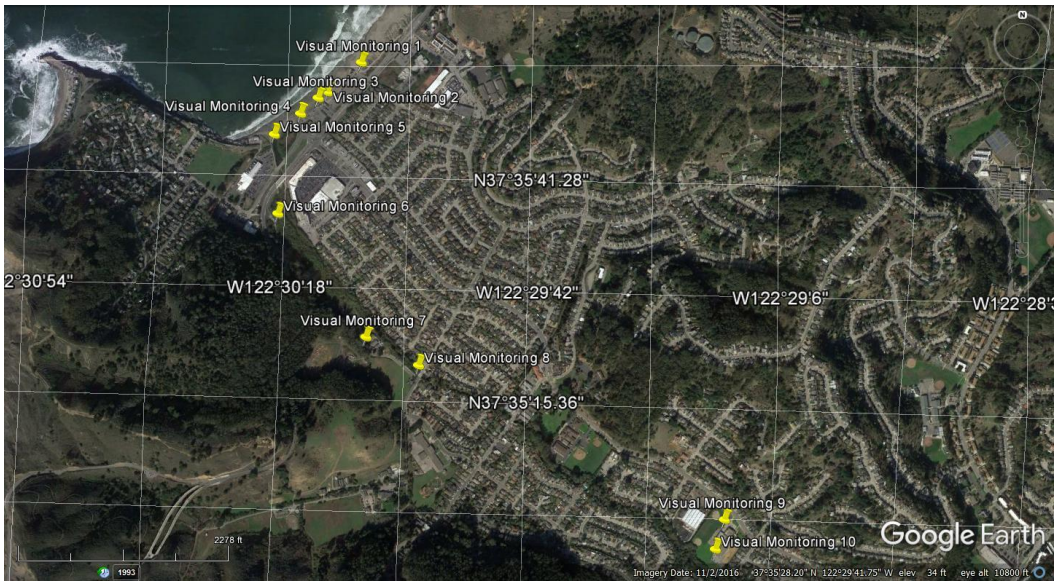

Figure 2. San Pedro Creek and Pacifica State Beach Visual Monitoring

2.2.4. Pet Waste Outreach

The City has implemented an enhanced pet waste public outreach and education campaign that includes all of the following:

Stakeholder Group

The City continued to search for animal clubs, organizations and groups in the City with no success. Due to limited resources, the City did not explore the possibility of establishing a new public pet waste management stakeholder group for this water year. The pet waste informational brochures were distributed to various City Departments for community distribution.

Figure 3. Pet Waste Poster at the Pacifica Community Center

Public Service Announcements

The City continues to request Pacifica Coast TV to broadcast public service announcements regarding pet waste management and associated impacts to the Creek and Beach and requested print ads to run in the Pacifica Tribune. The print ads ran weekly throughout the winter of 2017-18 and monthly starting March 2018.

A video copy of the TV PSA is available in the enclosed CD. Print ads are attached as Exhibit C.

Mailer

The City developed an informational brochure describing proper pet waste management, the linkage of the watershed to the Creek and Beach and the adverse impact on those water bodies and those recreating in them from improper pet waste management. In June 2017, the City mailed to approximately 5,363 addresses in the San Pedro Creek and Pacifica State Beach neighborhoods. The next round of mailers is scheduled for Fall of 2018.

Informational brochure is attached as Exhibit D.

Web Page

The City added a website with information on the TMDL and the water quality monitoring and BMP implementation activities, as well as information about proper pet waste management and the impact of improperly deposited waste on water quality of the Creek and Beach and public health. The web site has been active since December 2015.

Email Alert

The City implemented a pre-rain pet waste cleanup social media alert on Nextdoor, reminding residents to cleanup accumulated pet waste in their yards that could otherwise get washed into the Creek and Beach. Nextdoor is a social networking service for neighborhoods and allows users to connect with people who live in their own and nearby neighborhoods. Alerts were posted on March 17, 2017, April 6, 2017, September 12, 2017, October 30, 2017, January 3, 2018 and January 18, 2018. As of March 7, 2018 there were 5,879 subscribers in the San Pedro Creek and Pacifica State Beach Nextdoor groups. Discussions related to this topic have occurred in these groups and over 50 residents have thanked the City for the alerts.

Nextdoor can send urgent alerts and can target individual neighborhoods. Nextdoor members in those neighborhoods receive alerts via text messages, app notifications or email. Nextdoor has thousands of readily available members in the affected neighborhood(s). Screenshot of the Nextdoor post is attached as Exhibit E.

Events and Festivals

The City has participated in several annual local events and festivals such as Pacifica Eco Fest and Fog Fest since 2015 and distributed pet waste management materials such as educational fliers, dog waste bags, etc.

Eco Fest/Earth Day was held on Saturday April 22, 2017 and as always was well attended and includes a Citywide cleanup prior to the celebration. Many locations throughout the City are cleaned. The City of Pacifica distributed Pet Waste materials as well as doggy bags and dispensers.

Figure 4. City of Pacifica Booth at the 2017 Eco Fest

The Fog Fest was held on Saturday and Sunday September 23 and 24, 2017 and again was very well attended by people from all over the Bay Area. Many people want various brochures and information and this triggers interesting discussions about how to better protect the creek, ocean and our environment. Over the weekend hundreds upon hundreds of people participate in the City's interactive storm drainage booth. The City of Pacifica distributed Pet Waste materials as well as doggy bags and dispensers.

Figure 5. City of Pacifica Table at the 2017 Fog Fest

The City of Pacifica 60th Anniversary was held on Saturday November 18, 2017 and was well attended by local residents. City of Pacifica distributed Pet Waste materials as well as doggy bags and dispensers.

Figure 6. City of Pacifica Table at the 60th Anniversary Commemoration

3. Water Quality Monitoring

3.1 Requirements

Provision C.14.b of the MRP requires water quality monitoring to assess attainment of wasteload allocations. Provision C.14.c of the MRP requires water quality monitoring to characterize sources of bacteria and assess BMP effectiveness.

Compliance Monitoring

Wasteload allocation assessment monitoring (i.e., "compliance monitoring") must be conducted by the City and County at two stations (Pacifica State Beach and the mouth of San Pedro Creek) year-round on a weekly basis for fecal indicator bacteria. Samples collected at the beach (Linda Mar #5) must be monitored for enterococci, fecal coliform, and total coliform. Samples collected at the creek mouth must be analyzed for *E. coli* and total coliform. Annual reporting requirements include comparison of monitoring results from Linda Mar #5 and the creek mouth to the TMDL wasteload allocations, including a trends analysis and consideration of local rainfall data. See Section 3.2 for monitoring results and analysis.

Characterization Monitoring

Characterization/BMP effectiveness monitoring must be conducted by the City and County every other year on a water year basis (i.e., October 1 through September 30) beginning in WY 2016. The first year of monitoring must include sample collection from a minimum of twelve sampling stations. Ten samples are collected on a monthly basis from November through March (wet season) and May through September (dry season). All samples must be analyzed for *E. coli* and a subset of samples must be analyzed for human-, horse-, and dog-specific genetic markers. After WY 2016, the overall monitoring effort must remain the same but specific sampling locations and frequencies can be modified. Annual reports must evaluate characterization monitoring results focusing on geographic and genetic sources of bacteria in the San Pedro Creek Watershed. Characterization Monitoring Report for Water Year 2017 is attached as Appendix A.

3.2 Compliance Monitoring

This report includes an analysis of compliance monitoring conducted in WY 2016 and WY 2017, as WY 2016 data was not analyzed in last year's status and monitoring report. In WY 2016 and WY 2017, County Environmental Health performed weekly compliance monitoring on behalf of the City and the County at Pacifica State Beach (Linda Mar Station #5) and the mouth of San Pedro Creek (Creek Mouth). See Figure 7 for a map of sampling locations. Ocean water samples from Linda Mar beach were analyzed for total coliform, enterococci, and *E. coli* (in place of fecal coliform). Creek mouth samples were analyzed for *E. coli* and total coliform. Monitoring data from Linda Mar and the Creek Mouth is entered by County Environmental Health into the State Water Board's Beach Watch database on a weekly basis.

Figure 7: Compliance monitoring sampling sites

52 total samples at each location were collected and analyzed in WY 2016. 50 total samples at each location were collected and analyzed in WY 2017. Samples were not taken on December 26, 2016 during the Christmas holiday and also not taken on January 23, 2017 due to safety reasons.

For the purposes of data analysis, we assumed any samples under the lower detection limit of 10 MPN/100mL for *E. coli*, total coliform, and enterococci were 10 MPN/100mL. We assumed any samples above the upper detection limit of 24196 MPN/100mL for *E. coli* and total coliform were 24196 MPN/100mL. Samples never hit the upper detection limit for enterococci.

To determine whether the weekly attainment monitoring sampling events occurred during dry weather or wet weather, rainfall data was gathered from the Half Moon Bay airport station (KHAF) from wunderground.com. KHAF is 11 miles south of Pacifica State Beach and the closest active station to the sampling locations. This rainfall data may not fully represent precipitation received at the attainment monitoring sampling sites in Pacifica. The station received 8.88 inches of rainfall in WY 2016 and 22.48 inches of rainfall in WY 2017.

Measured constituents were compared to water quality objectives, or thresholds, set in the TMDL Staff Report, as shown in Table 3. The water quality objective for fecal coliform was used for *E. coli* at Pacifica State Beach, since *E. coli* is sampled in place of fecal coliform.

Table 3: Water quality objectives for single samples (Table 6.1 of TMDL Staff Report)

***E. coli* (Pacifica State Beach)**	***E. coli* (San Pedro Creek)**	**Total coliform**	**Enterococci**
400 MPN/100 mL	235 MPN/100 mL	10,000 MPN/100 mL	104 MPN/100 mL

The number of actual exceedances were compared to the number of allowable exceedances for weekly sampling, set in the TMDL Staff Report, as shown in Table 4.

Table 4: Allowable exceedances of single-sample objectives for weekly sampling (Table 6.2 of TMDL Staff Report)

	San Pedro Creek		Pacifica State Beach		
	Dry Weather	Wet Weather	Summer Dry Weather	Winter Dry Weather	Wet Weather
Allowable Exceedances	1	4	0	1	5

3.2.1 Pacifica State Beach

As explained in the footnote of Table 6.2 from the TMDL Staff Report, wet weather is defined as any day with 0.1 inches of rain or more and the following 3 days. As defined in Table 6.2 from the TMDL Staff Report, summer is April 1 through October 31, and winter is November 1 through March 31.

The sampling location at Pacifica State Beach, Linda Mar #5, is conservatively collected at shin depth in the ocean water at point zero (coincident with San Pedro Creek outfall), which is the mixing zone of ocean water and San Pedro Creek. Thus, the sample has a higher percentage of creek water than if samples were collected further north or south on the beach. This configuration is recognized by the State Water Resources Control Board (SWRCB) Ocean Unit as being more protective of public health for beach water monitoring programs.

WY 2016 Analysis

Overall, out of 52 samples taken in WY 2016, 21 samples exceeded water quality objectives. 33% of exceedances occurred during wet weather (seven out of 21 total exceedances). See Table 5, Table 6, and Figure 8 for more information.

Table 5: Pacifica State Beach allowable exceedances vs actual exceedances for weekly sampling, WY 2016

Summer Dry Weather		**Winter Dry Weather**		**Wet Weather**	
Allowed	**Actual**	**Allowed**	**Actual**	**Allowed**	**Actual**
0	6	1	8	5	7

Table 6: Pacifica State Beach percent exceedances, WY 2016

	Summer Dry Weather	Winter Dry Weather	Wet Weather
Samples Exceeded	6	8	7
Total Samples	28	14	10
% of Samples Exceeded	21%	57%	70%

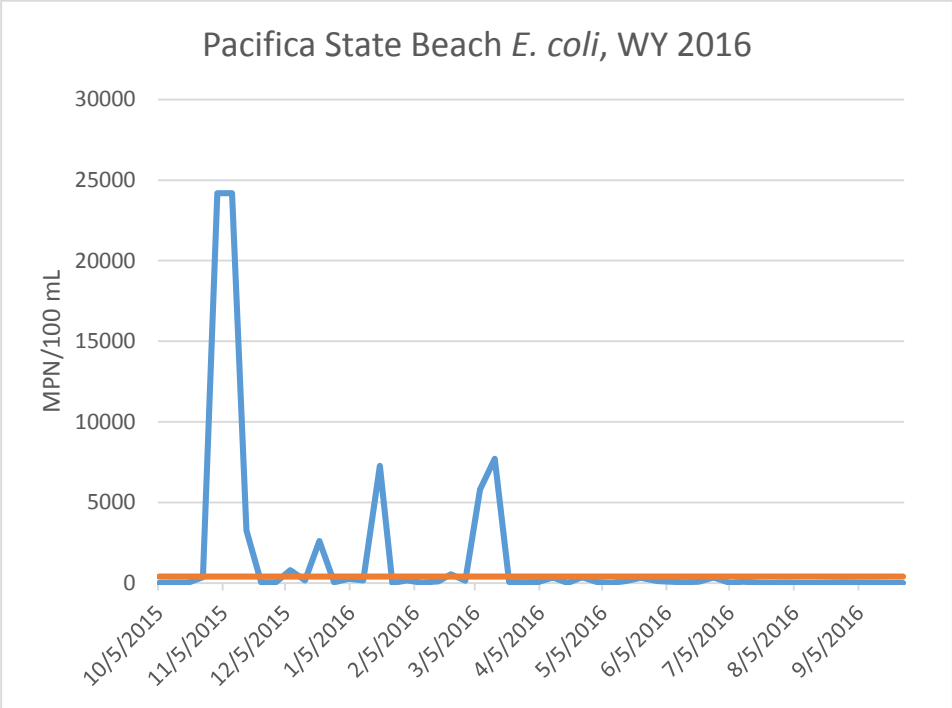

Figure 8: Pacifica State Beach E. coli, WY 2016
Note: the orange line shows the water quality threshold of 400 MPN/100 mL

All of the five highest *E. coli* concentrations occurred during winter wet weather. The lowest *E. coli* concentrations all occurred during summer dry weather.

Overall, trends throughout WY 2016 show that the beach has exceeded water quality thresholds in both summer and winter and dry and wet weather. The data shows that the bacteria levels drop off quickly after rain events. Samples collected on 11/23/15, 1/25/16, 3/21/16, and 5/2/16 did not exceed water quality objectives, and were all collected one week after samples collected during wet weather exceeded water quality objectives. The data also shows that background *E. coli* concentrations at the beach throughout the dry, summer period remain well below water quality objectives.

81% of the beach exceedances occurred when the creek also had exceedances (17 creek exceedances occurred simultaneously during 21 total beach exceedances).

There were three reported Sanitary Sewer Overflows (SSOs) during this period that flowed to the ocean entry point to the north of Linda Mar #5 (at the sewer pump station). After each SSO, Pacifica posts the

beach as closed and collects samples at point of entry, 300 feet south of entry point, and 300 feet north of entry point. The 300 feet south sample is very near the Linda Mar #5 location. The beach is not reopened until County Environmental Health determines the water is no longer "sewage dominated". Two out of three SSOs in WY 2016 were storm related (stormwater overwhelming the sanitary sewer system). In those cases, the residual impact to the ocean was likely a combination of stormwater and storm/sewage mixture. The SSO that was not related to a storm did not cause any exceedances. The other two reported SSOs likely contributed to water quality exceedances. An overflow was reported on 1/19/16, and sampling was conducted that day which exceeded thresholds for *E.coli*, total coliform, and enterococci. An overflow was also reported on 3/5/16, and sampling was conducted two days later on 3/7/16 which exceeded thresholds for *E.coli*, total coliform, and enterococci, as did the sample collected on 3/14/16.

Overall, TMDL wasteload allocations were not attained at Pacifica State Beach in WY 2016. The attainment date to achieve the wasteload allocations at the beach is August 1, 2021.

WY 2017 Analysis

Overall, out of 50 samples, 20 samples exceeded water quality objectives. One of the summer dry weather exceedances, on 5/15/17, was for total coliform only, which is likely a false positive. 55% of exceedances occurred during wet weather (11 out of 20 total exceedances). See Table 7, Table 8 and Figure 9 for more information.

Table 7: Pacifica State Beach allowable vs actual exceedances for weekly sampling, WY 2017

Summer Dry Weather		Winter Dry Weather		Wet Weather	
Allowed	**Actual**	**Allowed**	**Actual**	**Allowed**	**Actual**
0	9	1	0	5	11

Table 8: Pacifica State Beach percent exceedances, WY 2017

	Summer Dry Weather	Winter Dry Weather	Wet Weather
Samples Exceeded	9	0	11
Total Samples	27	9	14
% of Samples Exceeded	33%	0%	79%

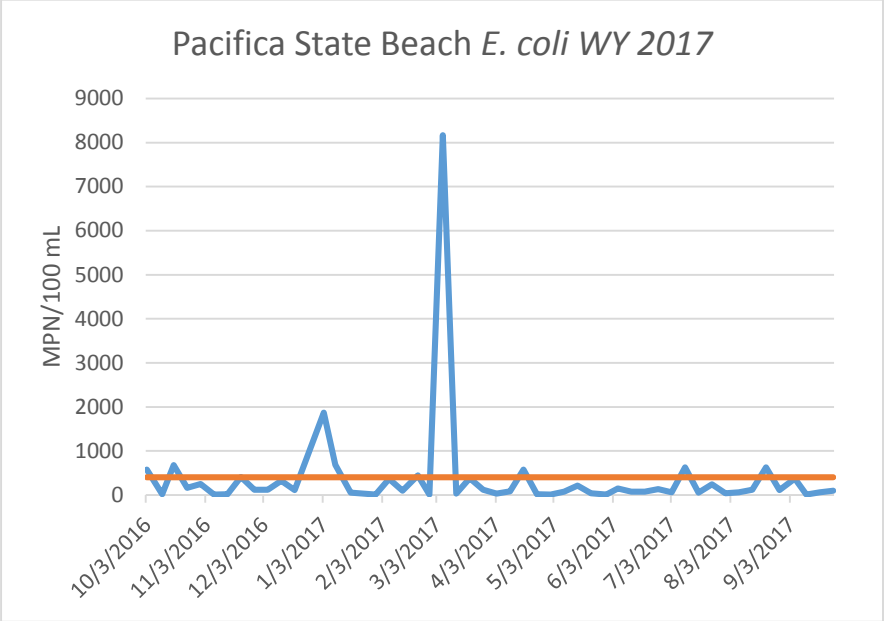

Figure 9: Pacifica State Beach E. coli, WY 2017
Note: the orange line shows the water quality threshold of 400 MPN/100 mL

Four of the five highest *E. coli* concentrations occurred during wet weather. The lowest *E. coli* concentrations all occurred during dry weather.

Overall, trends throughout WY 2017 show that the beach has exceeded water quality thresholds in both summer and winter wet weather, but only in summer dry weather (not winter dry weather). The data shows that the bacteria levels drop off quickly after rain events. Samples collected on 10/24/16, 11/7/16, 11/28/16, 2/27/17, 3/13/17, and 4/24/17 did not exceed water quality objectives, and were all collected one week after samples collected during wet weather exceeded water quality objectives.

85% of the beach exceedances occurred when the creek also had exceedances (17 creek exceedances occurred simultaneously during 20 total beach exceedances).

There were five reported SSOs during this period that flowed to the ocean entry point to the north of Linda Mar #5 (at the sewer pump station). All of these SSOs were storm related (stormwater overwhelming the sanitary sewer system). Therefore, the residual impact to the ocean was likely a combination of stormwater and storm/sewage mixture. Out of the County's reported exceedances at Pacifica State Beach, one exceedance may have been related to an SSO. An overflow was reported on 1/8/17, and sampling was conducted the next day on 1/9/17 which exceeded thresholds for *E.coli*, total coliform, and enterococci.

Overall, TMDL wasteload allocations were not attained at Pacifica State Beach in WY 2017. The attainment date to achieve the wasteload allocations at the beach is August 1, 2021.

3.2.2 San Pedro Creek

As explained in the footnote of Table 6.2 from the TMDL Staff Report, wet weather is defined as any day with 0.1 inches of rain or more and the following 3 days.

WY 2016 Analysis

Overall, out of 52 samples collected in WY 2016, 41 exceeded water quality objectives. 22% of exceedances occurred during wet weather (9 out of 41 total exceedances). See Table 9, Table 10 and Figure 10 for more information.

Table 9: San Pedro Creek allowable vs actual exceedances for weekly sampling, WY 2016

Dry Weather		Wet Weather	
Allowed	**Actual**	**Allowed**	**Actual**
1	32	4	9

Table 10: San Pedro Creek percent exceedances, WY 2016

	Dry Weather	Wet Weather
Samples Exceeded	32	9
Total Samples	42	10
% of Samples Exceeded	76%	90%

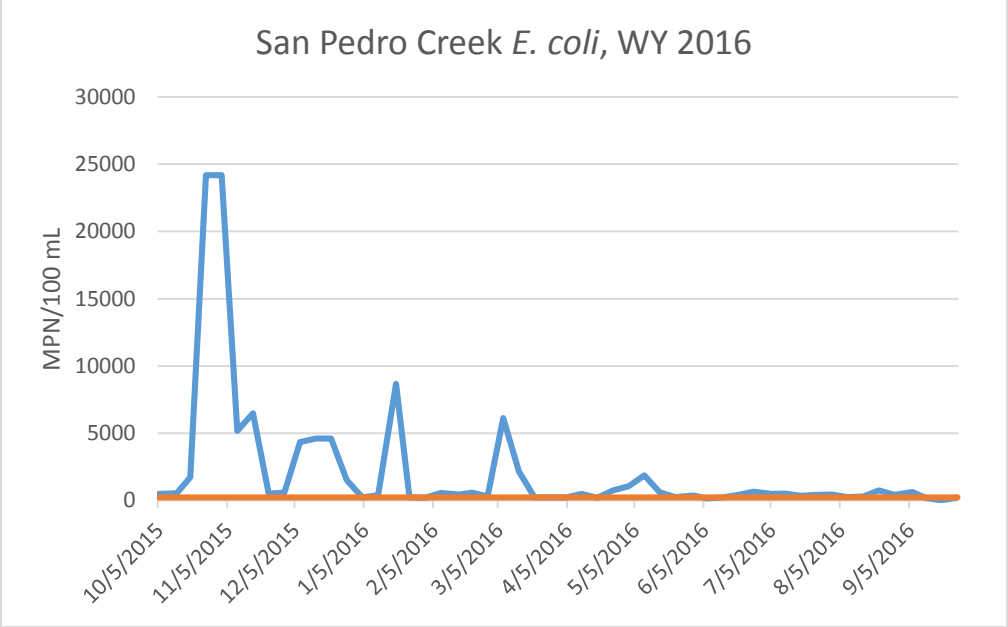

Figure 10: San Pedro Creek E. coli, WY 2016
Note: the orange line shows the water quality threshold of 235 MPN/100 mL

E. coli concentrations exceeded water quality objectives throughout the year. The dry weather, summer data shows that the average background *E. coli* concentration is about 300 to 500 MPN/100mL.

The lowest *E. coli* concentrations occurred during summer dry weather: four of the lowest five *E. coli* concentrations were during summer dry weather. The highest concentrations of *E. coli* occurred during winter wet weather sampling: four of the top five highest *E. coli* concentrations were during winter wet weather.

Overall, TMDL wasteload allocations were not attained in San Pedro Creek in WY 2016. The attainment date to achieve the wasteload allocations in the creek is August 1, 2028.

WY 2017 Analysis

Overall, out of 50 samples collected in WY 2017, 38 exceeded water quality objectives. 32% of exceedances occurred during wet weather (12 out of 38 total exceedances). See Table 11, Table 12 and Figure 11 for more information.

Table 11: San Pedro Creek allowable vs actual exceedances for weekly sampling, WY 2017

Dry Weather		**Wet Weather**	
Allowed	**Actual**	**Allowed**	**Actual**
1	26	4	12

Table12: San Pedro Creek percent exceedances, WY 2017

	Dry Weather	**Wet Weather**
Samples Exceeded	26	12
Total Samples	36	14
% of Samples Exceeded	72%	86%

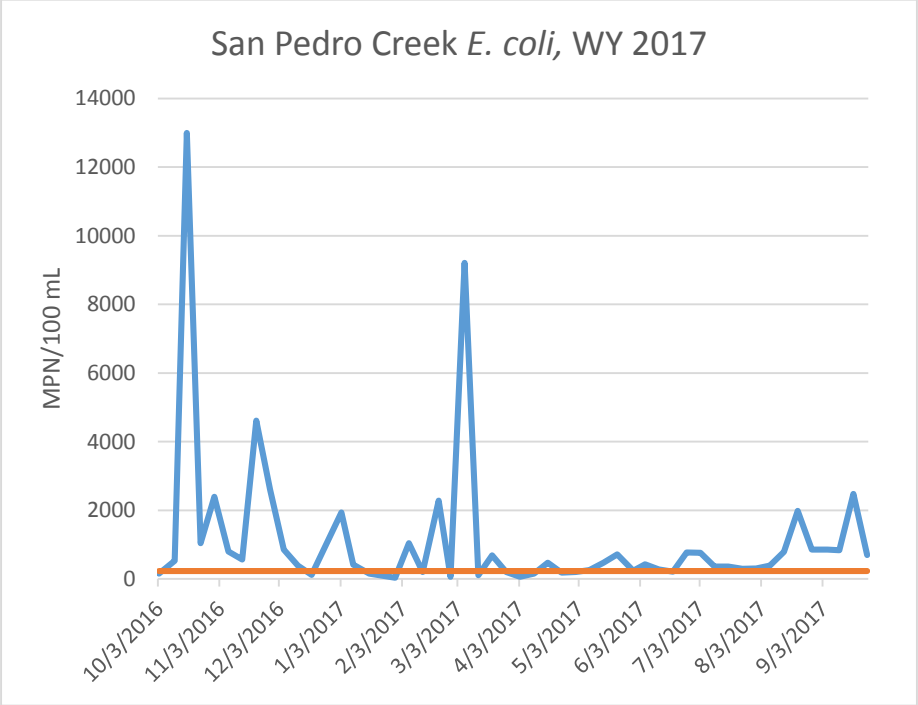

Figure 11: San Pedro Creek E. coli, WY 2017
Note: the orange line shows the water quality threshold of 400 MPN/100 mL

E. coli concentrations exceeded water quality objectives throughout the dry weather, summer period. The dry weather, summer data shows that the average background *E. coli* concentration is about 300 to 500 MPN/100mL. There were a couple major increases in *E. coli* concentrations in the summer, during dry weather: 1989 MPN/100 mL on 8/21/17 and 2481 MPN/100 mL on 9/18/17.

The *E. coli* concentrations are actually lowest after a rain event has cleared out the creek, in the week following a wet weather sample (121 MPN/100 mL on 12/19/16, 158 MPN/100 mL on 1/17/17, 201 MPN/100 mL on 2/13/17, 63 MPN/100mL on 2/27/17, 110 MPN/100 mL on 3/13/17, 63 MPN/100 mL on 4/3/17, 189 MPN/100 mL on 4/24/17). Furthermore, four out of the five lowest measured *E. coli* concentrations were during winter dry weather.

The highest concentrations of *E. coli* occurred during wet weather sampling: eight of the top ten highest *E. coli* concentrations were during wet weather.

Overall, TMDL wasteload allocations were not attained in San Pedro Creek in WY 2017. The attainment date to achieve the wasteload allocations in the creek is August 1, 2028.

3.2.3 Comparison Between WY 2016 and WY 2017

The weather station used to gather rainfall data, KHAF, received 8.88 inches of rainfall in WY 2016, as compared to 22.48 inches of rainfall in WY 2017. This drastic difference in rainfall may have an influence on water quality monitoring results.

Pacifica State Beach

Overall, the total number of exceedances did not vary significantly between WY 2016 and WY 2017 at Pacifica State Beach, nor did the number of summer dry weather or wet weather exceedances. The major difference was that in WY 2016, there were several winter dry weather exceedances, whereas in WY 2017, none of the samples taken during winter dry weather exceeded water quality objectives. See Table 13 and Table 14 for more information.

Table 13: Pacifica State Beach # of exceedances, WY 2016 vs WY 2017

	Summer Dry Weather	Winter Dry Weather	Wet Weather	TOTAL
WY 2016 Exceedances	6	8	7	21
WY 2017 Exceedances	9	0	11	20

Table 14: Pacifica State Beach % exceedances, WY 2016 vs WY 2017
Note: 21% means 21% of all summer dry weather samples exceeded water quality objectives.

	Summer Dry Weather	Winter Dry Weather	Wet Weather
WY 2016 Exceedances	21%	57%	70%
WY 2017 Exceedances	33%	0%	79%

San Pedro Creek

Overall, the total number of exceedances did not vary greatly between WY 2016 and WY 2017. In WY 2017, there was a slight decrease in the percentage of dry weather samples that exceeded water quality objectives as compared to WY 2016. Similarly, in WY 2017, there was a slight decrease in the percentage of *wet* weather samples that exceeded water quality objectives as compared to WY 2016. See Table 15 and Table 16 for more information.

Table 15: San Pedro Creek # of exceedances, WY 2016 vs WY 2017

	Dry Weather	Wet Weather	TOTAL
WY 2016 Exceedances	32	9	41
WY 2017 Exceedances	26	12	38

Table 16: San Pedro Creek % exceedances, WY 2016 vs WY 2017
Note: 76% means 76% of all dry weather samples exceeded water quality objectives.

	Dry Weather	Wet Weather
WY 2016 Exceedances	76%	90%
WY 2017 Exceedances	72%	86%

Appendix A

Characterization Monitoring Report Water Year 2017

San Pedro Creek and Pacifica State Beach Bacteria TMDL

Characterization Monitoring Report Water Year 2017

Prepared for:

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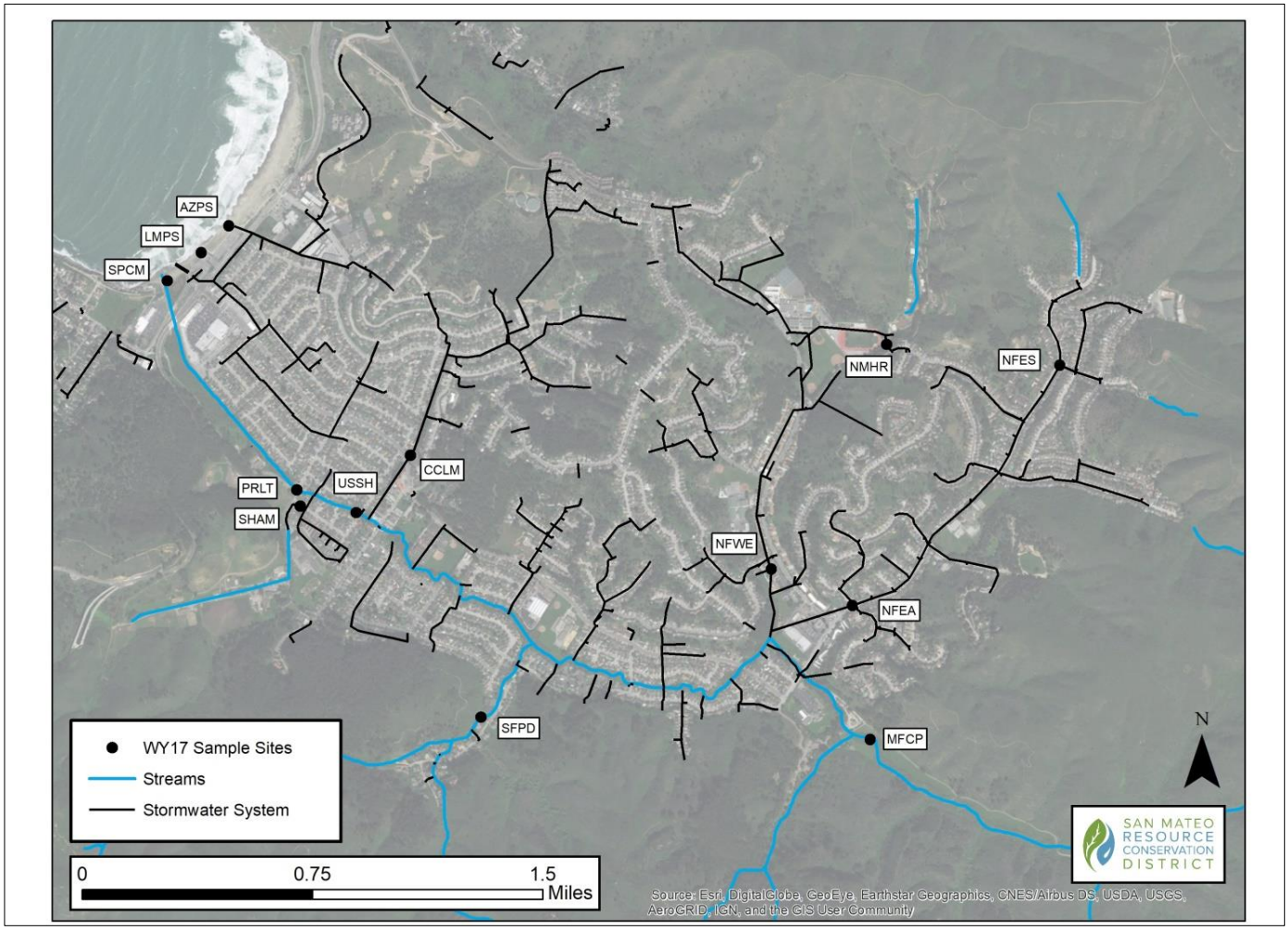
March 15th 2018

IN COMPLIANCE WITH PROVISION C.14 OF THE SAN FRANCISCO BAY REGION MUNICIPAL REGIONAL STORMWATER NPDES PERMIT (Order No. R2-2015-0049)

Table of Contents

Data Tables



Site ID	Sample Site Name	Latitude and Longitude	Parameters Assessed
NFES	North Fork East Sweeney	37.59306, – 122.46333	*E. Coli*
NFEA	North Fork East	37.58417, – 122.47306	*E. Coli* , *Bacteroides* (horse, human, dog)
NMHR	North Millwood Horse Ranch	37.59389, – 122.47167	*E. Coli*
NFWE	North Fork West	37.58556, – 122.47694	*E. Coli* , *Bacteroides* (horse, human, dog)
MFCP	Middle Fork at County Park	37.57944, – 122.47361	*E. Coli*
SFPD	Sanchez Fork at Perez Drive	37.57944, – 122.49111	*E. Coli* , *Bacteroides* (horse, human, dog)
CCLM	Crespi Canal	37.59000, – 122.49389	*E. Coli*
USSH	Upstream of Shamrock	37.58750, – 122.49639	*E. Coli*
SHAM	Shamrock Tributary	37.58778, – 122.49917	*E. Coli*
PRLT	Peralta Bridge	37.58861, – 122.49944	*E. Coli*
SPCM	San Pedro Creek Mouth	37.59611, – 122.50556	*E. Coli* , *Bacteroides* (horse, human, dog)
AZPS	Anza Pump Station	37.59825, – 122.50232	None- not able to sample
LMPS	Linda Mar Pump Station	37.59640, – 122.50425	None- not able to sample

Sample Date	Site ID	Water Year 2017 Characterization Monitoring results with exceedances of *E. Coli* WQO (235 MPN/100 mL) and all detections of *Bacteroides* markers highlighted.				
		E. Coli (MPN/100 mL)	Universal *Bacteroides* (gc/mL)	Dog *Bacteroides* (gc/mL)	Human *Bacteroides* (gc/mL)	Horse *Bacteroides* (gc/mL)
1/10/2017	NFES	2489				
	NFEA	2187	234675	632	23	2409
	NMHR	2723				
	NFWE	2755	197918	32	8	659
	MFCP	10				
	SFPD	122	36727	19	0	1038
	CCLM	4611				
	USSH	1050				
	PRLT	1374				
	SHAM	3076				
	SPCM	2603	160552	163	42	133
1/23/2017	NFES	471				
	NFEA	272				
	NMHR	51				
	NFWE	5794				
	MFCP	<10				
	SFPD	638				
	CCLM	318				
	USSH	208				
	PRLT	206				
	SHAM	110				
	SPCM	NA				
2/7/2017	NFES	379				
	NFEA	480				
	NMHR	169				
	NFWE	1112				
	MFCP	41				
	SFPD	288				
	CCLM	1153				
	USSH	988				
	PRLT	1455				
	SHAM	657				
	SPCM	NA				
2/21/2017	NFES	231				
	NFEA	620	44781	0	21	0
	NMHR	6488				
	NFWE	10462	49243	26	26	10
	MFCP	10				
	SFPD	41	12101	0	0	0
	CCLM	631				
	USSH	1119				

	PRLT	2282				
	SHAM	1421				
	SPCM	399	48916	2	73	420
3/23/2017	**NFES**	1309				
	NFEA	1291				
	NMHR	789				
	NFWE	1401				
	MFCP	10				
	SFPD	170				
	CCLM	9208				
	USSH	1694				
	PRLT	9208				
	SHAM	2402				
	SPCM	NA				
6/28/2017	**NFES**	10				
	NFEA	41	37881	0	3	40
	NMHR	NW				
	NFWE	52	54242	0	31	61
	MFCP	41				
	SFPD	75	37349	0	0	25
	CCLM	110				
	USSH	148				
	PRLT	203				
	SHAM	801				
	SPCM	187	568395	16	9	3
7/12/2017	**NFES**	20				
	NFEA	63				
	NMHR	NW				
	NFWE	63				
	MFCP	171				
	SFPD	368				
	CCLM	63				
	USSH	331				
	PRLT	146				
	SHAM	441				
	SPCM	NA				
8/2/2017	**NFES**	10				
	NFEA	52	17581	0	0	339
	NMHR	NW				
	NFWE	31	19886	0	7	352
	MFCP	10				
	SFPD	20	52830	0	3	0
	CCLM	20				
	USSH	20				

	PRLT	228				
	SHAM	6131				
	SPCM	341	147018	57	121	65
8/23/2017	**NFES**	586				
	NFEA	15531				
	NMHR	NW				
	NFWE	238				
	MFCP	1119				
	SFPD	1722				
	CCLM	285				
	USSH	1187				
	PRLT	563				
	SHAM	>24196				
	SPCM	NA				
9/11/2017	**NFES**	<10				
	NFEA	20				
	NMHR	NW				
	NFWE	10				
	MFCP	31				
	SFPD	884				
	CCLM	20				
	USSH	959				
	PRLT	1296				
	SHAM	NW				
	SPCM	NA				

Background

San Pedro Creek and Pacifica State Beach are located in San Mateo County, California and are on the Clean Water Act's 303(d) list for impairment of fecal indicator bacteria (ex: Total Coliform, *E. Coli, Bacteroides*). This suggests fecal contamination from warm-blooded animals such as human, horses, dogs and wildlife. Fecal bacteria from these sources can indicate the presence of pathogens which can pose health risks to humans through water contact or ingestion.

The San Francisco Bay Regional Water Quality Control Board (RWQCB) adopted the San Pedro Creek and Pacifica State Beach Bacteria Total Maximum Daily Load (TMDL) to address these impairments. The TMDL establishes wasteload allocations, or an amount of permitted exceedances of water quality objectives (WQOs) that are designed to protect water contact recreation. Fecal indicator WQOs are established in the TMDL including a single sample maximum for *E. Coli* of 235 MPN/100mL in freshwater.

The TMDL requires a monitoring plan for the San Pedro Creek watershed to "1) better characterize bacteria contributions; and 2) assess compliance with wasteload allocations." The City of Pacifica (City), the County of San Mateo (County), and Eisenberg Olivieri and

Associates, Inc. developed the San Pedro Creek and Pacifica State Beach Bacteria Monitoring Plan (MP) to achieve the requirements set forth in the TMDL. The County and City partnered with the San Mateo Resource Conservation District (RCD) to implement the Characterization Monitoring component of this plan which aims to better characterize bacteria contributions by addressing the following questions:

1. Which land uses and/or sources contribute most to bacteria impairments in San Pedro Creek?
2. Are controllable sources of fecal contamination (e.g., human, horses, and dogs) present in the San Pedro Creek watershed?
3. What are the multi-year indicator bacteria density trends in San Pedro Creek (i.e., are BMPs showing any effect)?

Characterization Monitoring involves collecting grab samples at various locations for *E. Coli* and *Bacteroides* in both the wet and dry season. The City collected *E. Coli* samples in August of 2013 (geometric mean) and also collected samples for *E. Coli* at 11 locations in Water Year 2016 (WY16). The RCD work plan involves collecting samples in WY17, the dry season of WY18, the wet season of WY19, and in WY20.

In WY17, *E. Coli* samples were collected at 10 locations during five dry and five wet weather events. Samples were also collected for *Bacteroides* (horse, dog, human, universal markers) during two wet and two dry weather events at three of the sites, in addition to the mouth of the creek. *Bacteroides* markers were analyzed in terms of presence/absence, while the number of gene copies (gc/mL) was only generally considered and was not used to estimate loads from the various species. For additional information about the Characterization Monitoring program see Section 3.0 of the MP and the RCD's Bacteria TMDL Monitoring Services Work Plan.

Environmental Setting

San Pedro Creek is a perennial stream that flows from the Santa Cruz Mountains through San Pedro Valley and the City of Pacifica to its mouth at Pacifica State Beach. The creek drains about 5,114 acres (~8 square miles) of residential, commercial, and open space land uses. The main stem of the creek is about 2.5 miles long and about 36% of it is modified. About one third of the watershed is developed and 15% of the watershed consists of impervious surface.

The San Pedro Creek watershed is comprised of numerous catchments including five main tributaries with perennial flows fed by springs. These are the Northwest Fork, the Northeast Fork, the Middle Fork, the South Fork, and the Sanchez Fork (Fig 1). There is also a small unnamed intermittent tributary in the southwest portion of the watershed that runs through Shamrock Ranch, and is then culverted underground to join the main stem of the creek. The Middle Fork, the South Fork, and the Sanchez Fork are largely open channel streams with vegetated banks and drain open space, such as San Pedro Valley County Park. The Northeast and Northwest Forks consist of several streams in the headwaters that drain open space and horse facilities and are then conveyed into the stormwater system in the urban areas of Pacifica. The Northeast Fork and Northwest Fork eventually join together and discharge to the main stem of the creek upstream of the bridge on Linda Mar Blvd. In the northwest portion of the watershed,

there is also flow from about 300 acres of urban land that is conveyed to two pump stations (Linda Mar and Anza) and is then pumped to the Calera Creek Water Recycling Plant or to Pacifica State Beach.

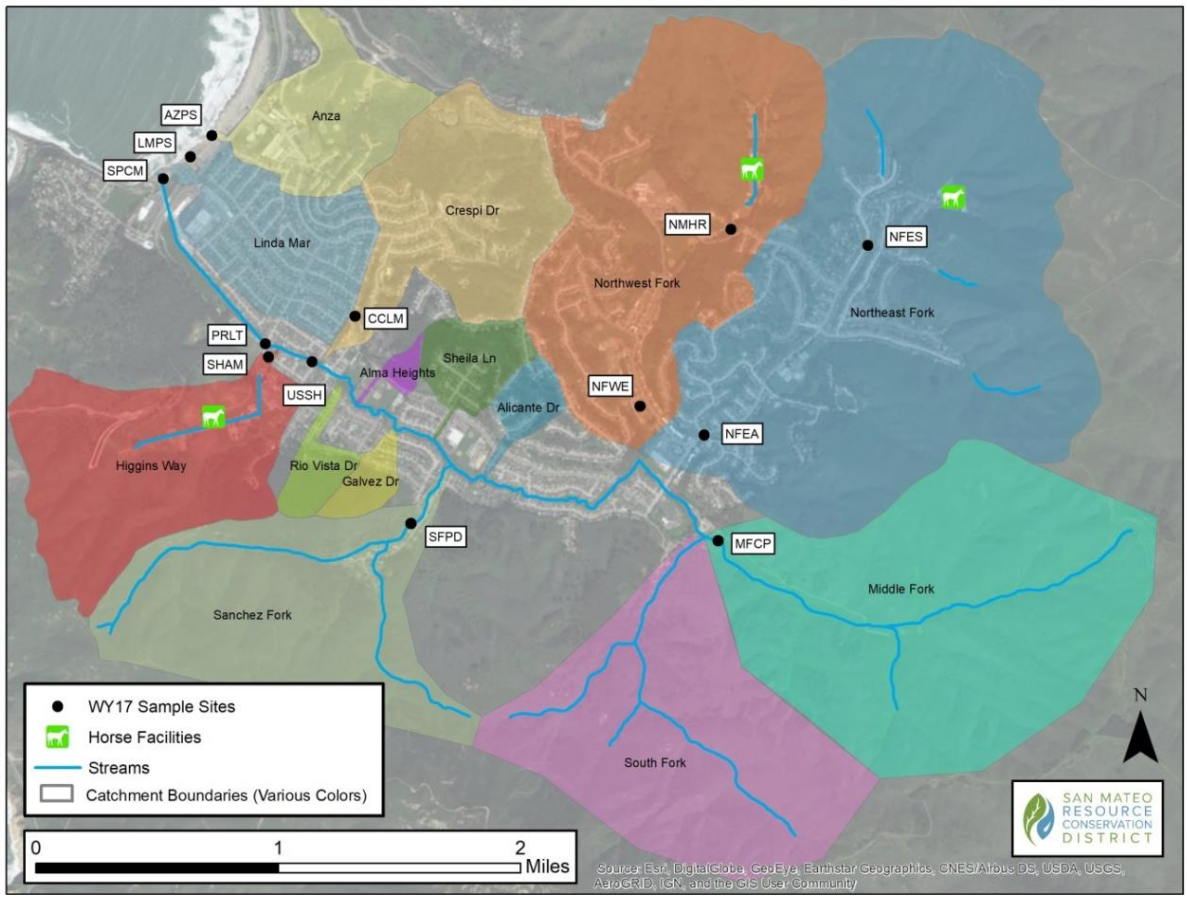


Figure 1. San Pedro Creek watershed catchments, tributaries, sample sites, and horse facilities.

Results

In WY17, a total of 98 *E. Coli* samples were collected at 10 sample sites during five dry and five wet weather events. Samples were also collected for *Bacteroides* (Universal, human, horse, and dog) during two of these wet events and two of these dry events at the Northeast Fork (NFEA), the Northwest Fork (NFWE), the Sanchez Fork (SFPD), and the mouth of the creek (SPCM). Samples were not collected at the pump stations as the RCD was unable to coordinate timing of sampling with releasing of wet weather flows by the City. It should also be noted that in WY17, sample site NMHR consisted of stormwater coming off of Everglades Drive (not drainage through Millwood Ranch), and therefore no samples were collected in the dry season.

All field and lab blanks for *E. Coli* and *Bacteroides* were non-detects except for one field blank with the horse marker detected at 3 gc/mL. *E. Coli* field duplicates were similar to the original samples except for during one wet season event at Crespi Canal (CCLM). Lab duplicates for *E. Coli* typically differed by around 300 MPN/mL. *Bacteroides* field and lab duplicates were

similar, except for one field duplicate at NFWE for the horse marker that differed by 112 gc/mL. However, all *Bacteroides* field and lab duplicates resulted in the same detection rates as the original samples. The *Bacteroides* matrix spike samples were within the acceptable range of values, signifying no inhibition or matrix effects.

Over half of the samples (57%) exceeded the *E. Coli* WQO of 235 MPN/100 mL. Most exceedances of the WQO occurred during the wet season (73%), while 39% of samples exceeded the WQO during the dry season (Fig 2). Few upstream/downstream trends were observed as the sample sites were along the main stem, various forks, and in different types of systems such as concrete channels, storm drains, and open stream channels. However, it is clear that *E. Coli* increased in the wet season between sites in the Northwest Fork (NMHR and NFWE), and between sites on the main stem (USSH and PRLT). On the other hand, *E. Coli* typically did not differ substantially between the Northeast Fork sample sites (NFES and NFEA).

In WY17, Crespi Canal (CCLM) and the downstream sites in the North Forks (NFWE and NFEA) exceeded the WQO during every wet season sampling event, and NFWE had some of the highest values (Fig 3). SHAM and the Sanchez Fork (SFPD) both exceeded the WQO more during the dry season than wet season, and SHAM exceeded the WQO during all dry season sampling events and had some of the highest values (Fig 4). There was also a sample event in the dry season (8/23/17) where all sample sites exceeded the WQO, including the Middle Fork (MFCP), and this was the only time this site exceeded the WQO.

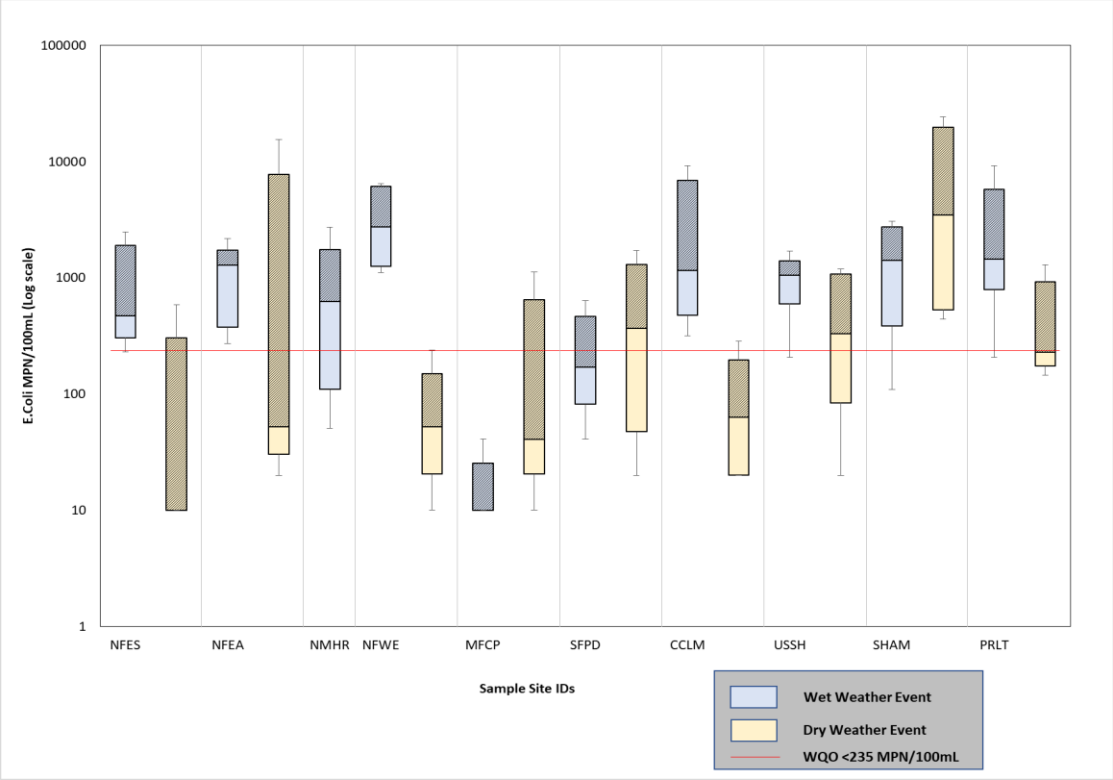


Figure 2. *E. Coli* by event type at WY17 sample sites.

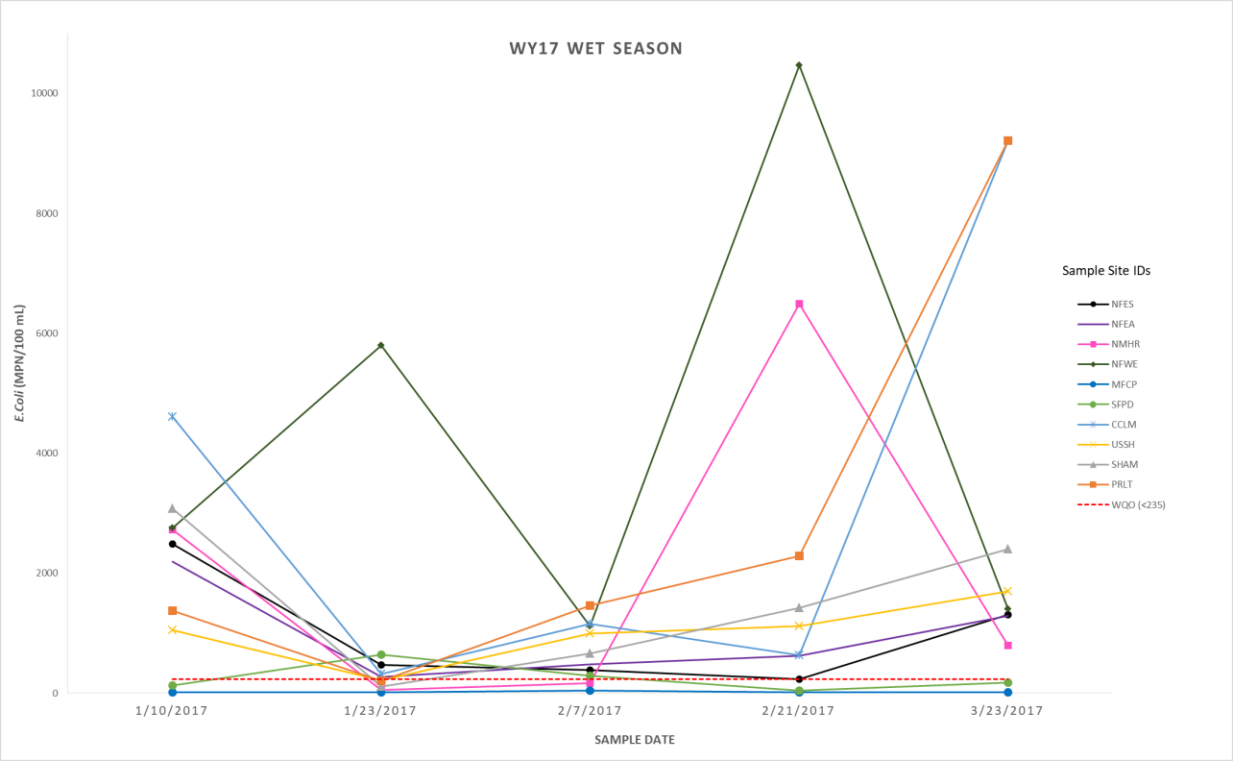


Figure 3. *E. Coli* by sample date in the wet season of WY17.

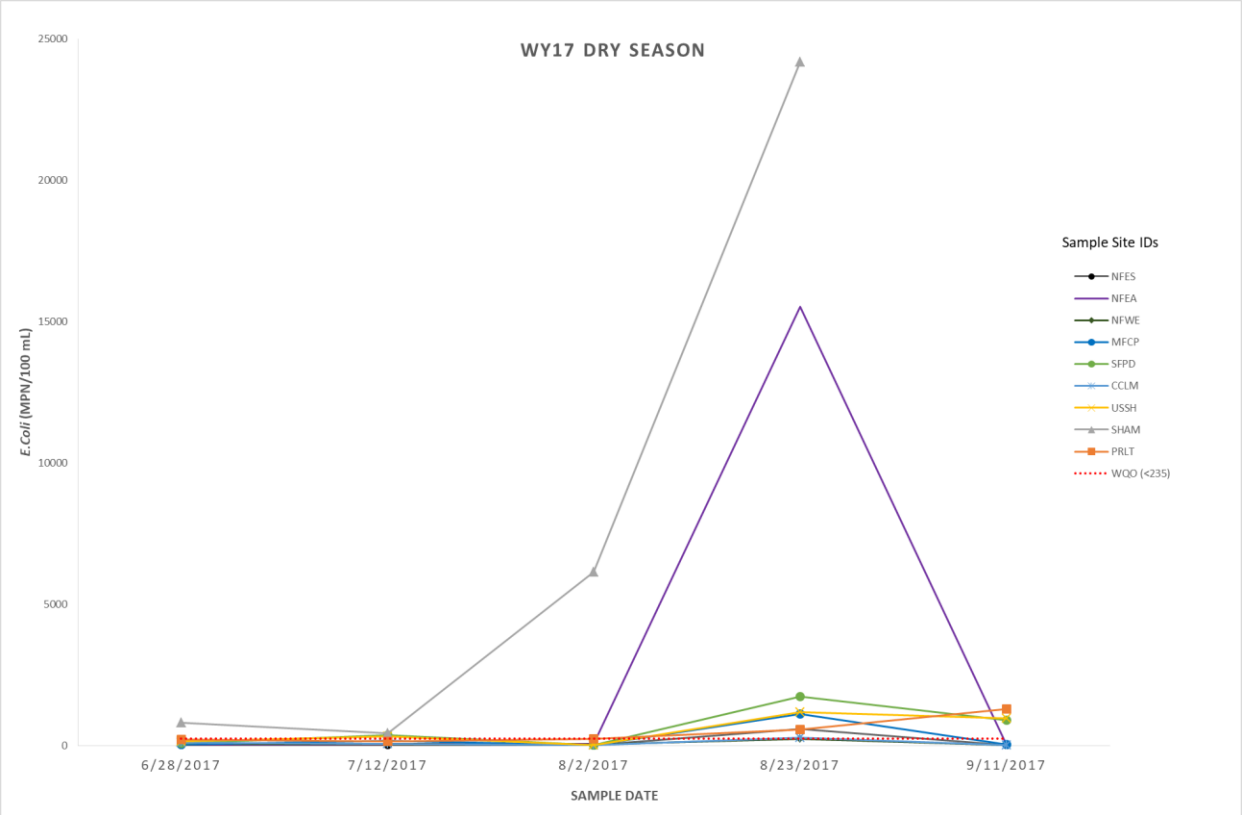


Figure 4. *E. Coli* by sample date in the dry season of WY17.

Bacteroides markers were analyzed for presence/absence with presence defined as any detection of the marker or all non-zero data. A total of 16 samples were collected at each sample site (NFWE, NFEA, SFPD, SPCM) for a total of 64 *Bacteroides* samples. The Universal marker was detected in all samples, while the horse marker was detected in 81% of samples, followed by the human marker with 75%, and the dog marker at 50%.

All three markers were detected at all four sites (Table 1). At the mouth of the creek (SPCM), all markers were detected during all sampling events. In the Northwest Fork (NFWE) all markers were detected during all sampling events, except for dog which was not detected at all during the dry season. In the Northeast Fork (NFEA), horse was detected during both dry season events and human was detected during both wet season events. The Sanchez Fork (SFPD) had the least detections, with dog and horse detected once in the wet season, and horse and human detected once in the dry season.

In general, the horse marker had some of the highest number of gene copies while the human and dog markers were typically closer to the Method Detection Limits (MDL) and the Reporting Limits. The highest value for the human marker was at the mouth of the creek (SPCM) in the dry season while the highest values for the horse and dog markers were at NFEA in the wet season.

Table 1. Number of detects/number of samples for *Bacteroides* markers in WY17.

Sample Site/*Bacteroides* Markers	**Dry Season**	**Wet Season**	**Total**
NFEA			
Human	1/2	2/2	3/4
Horse	2/2	1/2	3/4
Dog	0/2	1/2	1/4
NFWE			
Human	2/2	2/2	4/4
Horse	2/2	2/2	4/4
Dog	0/2	2/2	2/4
SFPD			
Human	1/2	0/2	1/4
Horse	1/2	1/2	2/4
Dog	0/2	1/2	1/4
SPCM			
Human	2/2	2/2	4/4
Horse	2/2	2/2	4/4
Dog	2/2	2/2	4/4

Discussion

Historic data, including characterization monitoring results for WY16, will be included in discussion of results. It should be noted that in WY16, a WQO of 406 MPN/100 mL (lightly used areas) was used instead of a WQO of 235 MPN/100 mL (designated beach). Therefore, the data were reanalyzed using the 235 WQO to be able to make comparisons with WY17 data. This resulted in 18 more exceedances of the WQO in WY16 and somewhat different trends (Appendix 1). The WQO currently proposed by the RWQCB (320 MPN/100 mL) was also considered when reviewing the data, and if applied to the WY17 data there would be five less WQO exceedances. It is also important to note that the QA/QC data for *E. Coli* could deviate by more than the current WQO of 235 MPN/100 mL. These cases demonstrate the potential variability and limitations of fecal indicator bacteria and the influence of different WQOs.

QA/QC data for *Bacteroides* markers indicate that the number of gene copies can vary considerably. For example, control samples and duplicates could differ by about 100 gc/mL for the human and dog markers, and by about 200 gc/mL for the horse marker. This lends credence to the current standard of analyzing *Bacteroides* data on a presence/absence basis rather than by concentration.

Overall, there were more exceedances of the WQO in WY17 than WY16 at sample sites tested in both years. However, WY16 was characterized by more frequent and more intense storms which could have diluted *E. Coli* levels. For WY17 in particular, there was a trend of higher *E. Coli* during the wet season; although dry season samples still exceeded the WQO about 50% of the time. This information, along with data from WY16, indicate that dry weather flows are also an important source and/or transport mechanism of bacteria within the watershed. Hydrology of the tributaries and drainages at different times of year and the interaction between various types of systems (stream, concrete channel, storm drain) will continue to be explored.

In WY17, the Middle Fork (MFCP) had the lowest *E. Coli* levels and rarely exceeded the WQO. This correlates with data at MFCP from WY16, and historic sampling data for the South Fork. Therefore, these sub-watersheds, characterized by open space, are not currently considered to be major contributors of bacteria to the watershed and will not be discussed further. Data collected by the City in WY16 at Linda Mar and Anza pump stations show high *E. Coli* levels at both pump stations during all sampling events. So it is recommended that the City continue to assess impacts of these sub-watersheds, pump stations, and discharges to Pacifica State Beach.

In WY16 and WY17, sample sites in the lower reaches of San Pedro Creek (USSH, SHAM, PRLT, SPCM) exceeded the WQO more than the other sample sites. The North Forks (NMHR, NFWE, NFES, NFEA), the Sanchez Fork (SFPD), and Crespi Canal (CCLM) located upstream also had high *E. Coli* levels. All sample sites except, SFPD and SHAM, are characterized by high density urban areas, which have historically been correlated to high bacteria levels in the watershed. These sample sites and potential sources of bacteria are discussed in further detail below.

The Northwest Fork includes perennial and intermittent streams, springs, and groundwater that are conveyed to the stormwater system and sustain dry season flows. High levels of *E. Coli* can

occur in both the wet and dry season, but in WY17 there were much higher levels in the wet season. Human and horse markers were detected during all sampling events, and the human marker was always above the MDL. The dog marker was detected during wet weather events only, suggesting that dog waste is being washed off of trails and/or sidewalks.

The Northwest Fork drains highly developed areas (residences, schools, library, churches etc) with an expansive stormwater and sewer network that are in close proximity and often cross over one another. Horse and dog waste were also observed on sidewalks in this area. In addition to urban land use, the Northwest Fork drains the Golden Gate National Recreation Area's (GGNRA) Sweeney Ridge in addition to Millwood Ranch. Sweeney Ridge includes multi-use trails that allow horses and dogs, and Millwood Ranch has horses and dogs on the property, in addition to residences/RVs on a septic system. Millwood Ranch is also listed specifically in the TMDL due to a Cleanup and Abatement Order that was issued by the RWQCB in 2009.

A substantial amount of water in the Northwest Fork appears to come from the Millwood Ranch area (~150 acres) where there are perennial springs running through different conveyance systems (ponds, pipes, open etc) before the water is routed off the property. At this point it combines with stormwater runoff from Everglades Drive (NMHR), then flows underneath Terra Nova High School and out to the main stormwater system on Terra Nova Blvd. In WY17, *E. Coli* exceeded the WQO during some wet weather events but not others at NMHR. Samples collected in WY16 by the City (referred to as NMHR- C in Appendix 1), were from water draining through Millwood Ranch after it joined with stormwater from NMHR. This data along with historic sampling data, indicate low *E. Coli* levels in the drainage coming off of Millwood Ranch in both the wet and dry season. At the downstream end of the Millwood Ranch, there appears to be a spring that adds substantial flow and could potentially be diluting water within the system.

Similar to the Northwest Fork, the Northeast Fork has sustained dry season flows from a variety of streams and springs, many of which appear to combine at the upstream sample site (NFES). The Northeast Fork drains dense residential areas, Sweeney Ridge Horse Facility, and trails at GGNRA's Sweeney Ridge that allow horses and dogs. The Northeast Fork also appears to capture runoff from a commercial shopping center before it joins the Northwest Fork and connects to the main stem of the creek. In general, *E. Coli* levels varied but in WY17 concentrations were higher in the wet season and there were few increases between NFES and the downstream sample site (NFEA). There was an exception to this during one dry season event where *E. Coli* levels were much higher at NFEA. This could indicate sewer related issues, accumulation/growth of bacteria, or activities such as dumping.

All *Bacteroides* markers were detected and the human marker was above the MDL during the wet season indicating potential mechanisms such as sewer exfiltration into the stormwater system. The dog marker was only detected during one large wet season event so it is likely being washed off of the landscape. Dog waste was also observed once during the wet season on a residential sidewalk above NFES. The horse marker was detected in both the wet and dry season indicating the importance of dry season flow from springs and streams in the upper watershed and the potential impact of the trails and horse facility at Sweeney Ridge.

The Sanchez Fork (SFPD) had both high and low levels of *E. Coli* in the wet and dry season. The Sanchez Fork drains about one square mile that includes both low density residential areas and open space (McNee Ranch State Park) that allows horses and dogs on the trails. The Sanchez Fork was tested for the *Bacteroides* markers in WY17, and human and dog markers were detected once but were close to or below the MDL. This could indicate false positives and/or cross-reactivity with other *Bacteroides* species. The horse marker on the other hand was detected in the wet and dry season and was sometimes above the MDL which suggests presence of horse waste in the sub-watershed, potentially from the multi-use trails above the residential area.

The Crespi Canal (CCLM) drains approximately 240 acres of residential land use and open space before it joins the main stem of the creek just upstream of the USSH sample site. Data from WY16 and WY17 indicate consistently high levels of *E. Coli* in the wet season. The Crespi Canal has numerous outfalls from residential areas that discharge to it along the length of the channel and bubbles/soap were often observed. Water can persist in the canal throughout the dry season due to the influence of springs but water in the dry season is often stagnant and *E. Coli* levels low.

The unnamed tributary that flows through Shamrock Ranch drains about half a square mile that includes parts of Shamrock Ranch (horse and dog boarding facility), the Linda Mar Education Center, and low density residential and open space. Data from WY16 and WY17 at SHAM indicate high *E. Coli* in both the wet and dry season. However, it should be noted that this small tributary has less water than the other sample sites in general and that samples were taken from a storm drain where water was often stagnant in the dry season.

The only sample sites on the main stem of the creek were within the lower reaches of the watershed at sample sites USSH, PRLT, and SPCM. USSH had the highest exceedance rate of all sample sites and is downstream of all previously discussed sites, except SHAM. USSH is also downstream of land uses along the main stem such as nurseries, a fire station, schools, churches, and parks. Historic *E. Coli* data from the main stem of the creek generally do not show increases in *E. Coli* between the middle reaches of the creek around Capistrano Drive and the Fire Station. This section of the creek is where the Sanchez Fork (SFPD) joins the main stem and is characterized by residential areas and the Sanchez Dog Park. On the other hand, previous data indicate some increases in *E. Coli* along the main stem from around the Alma Heights School to the Peralta Bridge (PRLT). This section of the creek includes a church, a historic park (no dogs), the Crespi Canal (CCLM) input, a few businesses, residences, and the SHAM input between USSH and PRLT.

In WY17, there appear to be some similarities between *E. Coli* levels at CCLM and PRLT in the wet season. However, these high *E. Coli* levels were not seen at the USSH sample site, just downstream of where the Crespi Canal enters the main stem of the creek. This could be because *E. Coli* levels are being diluted by the creek and are not actually having much impact at USSH and PRLT. Or because there is a mechanism such as lack of mixing that did not allow the Crespi Canal input to be picked up at USSH where samples typically must be collected near the bank rather than the middle of the channel.

In WY16 and WY17, *E. Coli* at USSH and PRLT were typically similar or increased between the two sites. It is likely that these sites exceed the WQO due to the upstream land uses, including Crespi Canal, but there also appear to be localized sources of bacteria. Activities such as dog walking, car washing and power washing were observed on numerous occasions in this area (Bower, Dell and Standish Roads). Further, the small tributary that runs through the SHAM sample site enters the main stem between these two sites. Due to the amount of water in this tributary at different times of year, it is likely that this tributary impacts the main stem of the creek in the wet season but not necessarily in the dry season. The potential impacts of the Crespi Canal, the unnamed tributary and other nearby sources on the main stem of the creek in this area will continue to be characterized and better understood.

There were no clear trends between PRLT and the mouth of the creek (SPCM) but *E. Coli* was not sampled at SPCM in WY16 and only sampled four times in WY17 during the *Bacteroides* events. All *Bacteroides* markers were detected at SPCM during all wet and dry weather sampling events. This was the only *Bacteroides* sample site where the dog marker was detected in the dry season. This indicates additional sources of dog waste coming from areas other than the North Forks and Sanchez Fork. Dog waste was seen on sidewalks near the intersections of Highway 1 and Linda Mar Blvd by the RCD, and by the City at Peralta Bridge, Highway 1 at San Pedro Trailhead, and at the mouth of the creek. Horse waste was also seen on the sidewalk in this area (Fig 5), and other potential sources in the lower reaches of the creek include the SHAM tributary.

Figure 5. Horse manure (left) and dog waste (right) on the walking path near Highway 1 and the mouth of the creek.

The human marker was detected above the MDL during all sampling events at the mouth of the creek. But unlike the other markers, the highest levels were not seen in the wet season. Human sources could originate from almost any of the urban areas in the watershed. Most of the sewer infrastructure in the watershed is over 50 years old and could be failing and leaking. See Appendix 2 for a map of the City's sewer system within the San Pedro Creek watershed. There is also the possibility of dumping by RVs and influence from homeless encampments near Highway 1 and the mouth of the creek.

San Pedro Creek also supports a variety of wildlife in both open space and urban areas (Fig 6). Historic microbial source tracking data indicate that domestic animals and wildlife, primarily birds, were the most prominent sources of bacteria in the watershed (~75% uncontrollable sources). In WY17, the Universal marker was detected in 100% of samples while the other markers were detected at a rate of 81% or lower. This suggests sources of fecal indicator bacteria other than humans, horses and dogs such as raccoons, rodents, deer, and birds.

Figure 6. Deer in the parking lot of the Sun Valley Shopping Center sifting through food/trash. This is close to where both North Forks combine and then join the main stem of the creek.

BMP Effectiveness

Best Management Practices (BMPs) in the San Pedro Creek watershed are implemented according to the San Francisco Bay Municipal Regional Stormwater NPDES Permit (MRP), the TMDL, and the San Pedro Creek and Pacifica State Beach Bacteria TMDL BMP Implementation Plan. These include measures for both general stormwater as well as specific controllable sources of bacterial pollution. These measures will be discussed generally below but Characterization Monitoring does not allow for direct assessment of BMP effectiveness.

Many of the efforts to address general stormwater are through the San Mateo Countywide Water Pollution Prevention Program (SMCWPPP). This is a collaborative and effective partnership that includes the City of Pacifica, the County, and other municipalities in the region to implement a wide variety of BMPs. In addition to, or in lieu of, some of the MRP efforts, the following activities should also be considered for the San Pedro Creek watershed:

- Mail SMCWPPP's stormwater tip card to residences to further address issues such as car washing, power washing, and pet waste
- Engage local schools through activities such as storm drain artwork/stenciling
- Consider opportunities for stormwater BMPs on private and public property (ie bioswales, media filters, retention features etc)
- Employ the MRP trash reduction efforts with the lens of mitigating urban wildlife (raccoons, rodents, deer, feral cats etc)

Since the TMDL was adopted in 2012, more specific measures have been taken to address controllable sources of bacteria (human, horse, dog). Measures to address human waste have largely been related to assessing and repairing sanitary sewer infrastructure. As of 2014, all sewer gravity and force main lines have been inspected. By 2015, the City had also made repairs to both the sewer and stormwater system in the lower San Pedro Creek watershed near sample sites CCLM, USSH, PRLT, and SPCM. Currently, the existing sewer main line from the Anza Pump Station to Linda Mar Pump Station is being repaired along with the parts of the sewer system at Pedro Point near the mouth of the creek.

For many years, the City has also implemented a Sewer Lateral Replacement Grant Program that provides free inspections of private laterals and reimbursement for repairs to residences. There is also a Sewer Lateral Compliance Certificate Program that is required for real estate transactions and major remodels. These programs raise awareness and address an important aspect of preventing and mitigating human sources of bacteria within a watershed at a community-wide level. Other measures to address human waste include a Sanitary Sewer Overflow Reduction Program and subsequent planning for a wet weather equalization basin. The City has also taken measures that require residential units on the Millwood Ranch property to decommission the septic system and set up refuse collection services.

Assessing the sanitary sewer system is one of the first steps in addressing human sources of bacteria in a watershed, so the recent watershed-wide inspections will help inform future work. However, despite these inspections and some repairs of the sewer system in the lower watershed, the human marker was still detected at the mouth of the creek during both the wet and dry season. Therefore, the potential impact of the sewer system on the stormwater system should be evaluated specifically, along with other potential sources of human waste, and starting with areas where the human marker was detected above the MDL. This effort should be prioritized by the RCD and the City as human fecal sources may be linked to higher health risks.

Measures to address bacteria from horse waste have been implemented steadily over the past few years at all three horse facilities. BMPs have included moving and lining manure stockpiles and keeping horses away from drainage features. As of 2015, Shamrock Ranch has been in compliance with the County's Confined Animal Facility Ordinance, and Sweeney Ridge attained compliance with the City through issuance of an Animal Permit in March 2017. Some BMPs have been implemented at Millwood Ranch but compliance with a number of the City's policies and codes including those related to drainages and ponds have not yet been achieved.

In addition to the local regulations, each of these horse facilities must comply with the RWQCB's Waste Discharge Requirement for Confined Animal Facilities Order No. R2-2016-0031 (WDR). The WDR requires development and implementation of a comprehensive Ranch Water Quality Plan (RWQP) by November of 2018. There appear to be barriers to completing the RWQP for numerous reasons, such as cost and timeframe.

Successful implementation of BMPs at these horse facilities so far appears to be due to a combination of regulatory measures as well as voluntary incentives. For example, Shamrock Ranch and Millwood Ranch both participated in the RCD's Livestock and Land Program funded by Propositions 50 & 84 which included development of water quality/stormwater plans at both

ranches, and installation of manure compost bunkers at Millwood Ranch. Assisting the horse facilities with the RWQP is imperative as implementation of associated BMPs could reduce waste from horses throughout the watershed. Although the horse marker has not been tested in the unnamed tributary running through Shamrock Ranch, it has been detected in the North Forks (Millwood Ranch, Sweeney Ridge, multi-use trails) and in the Sanchez Fork (multi-use trails). It is clear that the potential impact of multi-use trails should also be considered (horse manure, dog waste, erosion, compaction, runoff etc) in further characterization of the San Pedro Creek watershed.

To address potential bacterial contamination coming from dog waste, the City installed ten dog waste clean-up disposal stations with signs. Five of these are near Pacifica State Beach and the other five are along the lower reaches of the main stem of the creek between the Sanchez Fork and the mouth of the creek, near sample sites USSH, SHAM, PRLT and SPCM. All of the pet waste stations along the creek appear to be used and functioning properly. The stations at Peralta Bridge and further downstream could be serviced more often to make sure they are fully stocked and not overflowing (Fig 7). Informational signs, such as the sign on Capistrano Drive Bridge that says "Please pick up after your pet", would likely be beneficial in the North Forks. Overall, pet waste stations and signage appeared to be a very effective measure for addressing dog waste in the San Pedro Creek watershed.

Figure 7. High usage of the pet waste station at Peralta Bridge.

The City has also implemented other pet waste BMPs such as public service announcements, print ads, informational brochures, mailers to residences, and a pet waste page on the City's website that includes a link to the SMCWPPP pet waste page. This is a great way to reach a variety of audiences and leverage resources. The County's Office of Sustainability also has a stormwater page that includes a "Scoop the Poop" pledge. If possible, this interactive interface should be added to the City's and SMCWPPP's pet waste pages to expand viewership.

The City also participates in local events such as Fog Fest and the Pacifica Beach Coalition's EcoFest. These events draw locals and tourists alike and allow for a direct educational opportunity about the impacts of pet waste on watersheds. These events are often interactive such as the city-wide trash clean-up during EcoFest and a dog bag dispenser giveaway during Fog Fest. The World Dog Surfing Championships at Pacifica State Beach is another opportunity for pet waste outreach. This was demonstrated in 2017 by the RCD, with funding from the County, when over 200 informational dog waste brochures were passed out in under an hour.

The City's pet waste program also includes sending out pre-rain pet waste clean-up alerts on Nextdoor reminding residents to pick up pet waste before storms. Nextdoor is a prominent social media platform on the coastside and posts such as these appear to be much appreciated by residents. The RCD also sends out similar alerts to an email distribution list which includes organizations such as Coastside DOG and Surfrider who are often also forwarding this message to their distribution lists. These partnerships and sharing of resources are crucial for effectiveness of the pet waste BMPs.

Conclusion

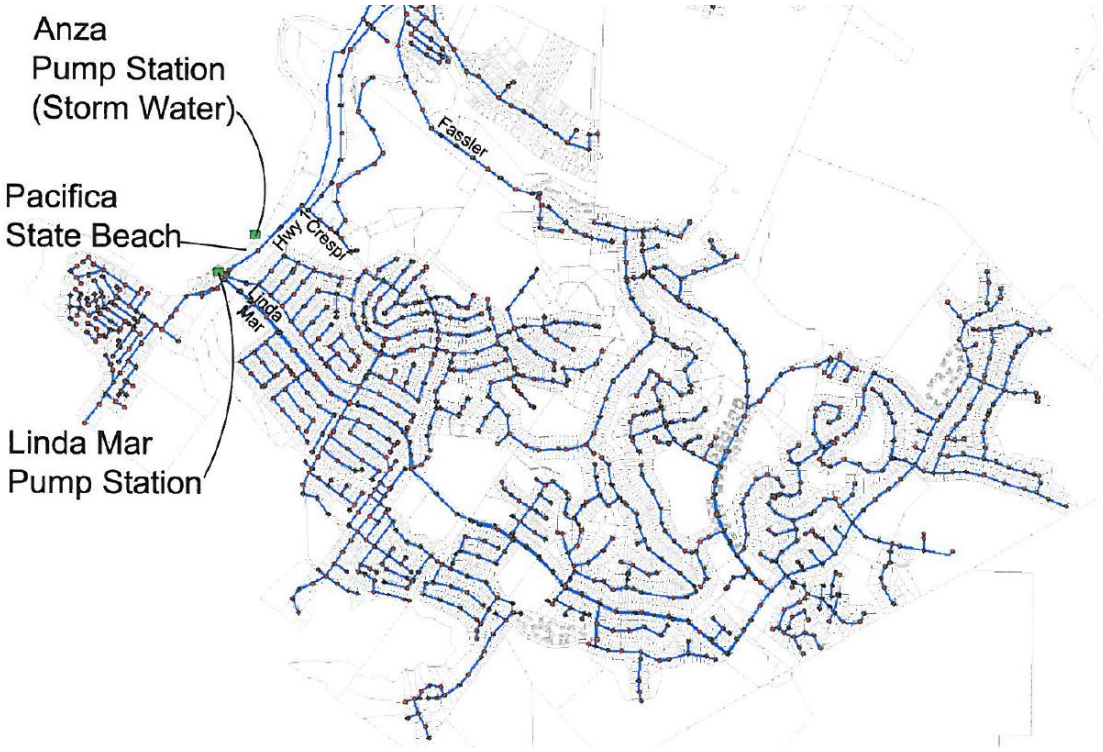
In summary, urban land use and wet weather both appear to be correlated to bacteria impairment of the San Pedro Creek watershed. Controllable sources of bacteria are considered to be human, horse, and dog waste and these were detected in the Northeast Fork, the Northwest Fork, the Sanchez Fork, and the mouth of the creek. The horse marker was detected the most often, followed closely by the human marker, then the dog marker. These sources are considered controllable through a variety of mechanisms such as sewer system repairs, BMPs at horse facilities, and education and outreach. Wildlife such as deer, raccoons, and birds are prevalent throughout the watershed and are generally considered to be uncontrollable sources of bacteria. BMPs that have been implemented so far appear to be effective control measures that with time, innovation, and collaboration are likely to reduce fecal bacteria in the San Pedro Creek watershed and at Pacifica State Beach.

Appendix 1

WQO *E.Coli* <235 MPN/100mL	Sample Date	Sample Site ID													
		LMPS	AZPS	SPCM	PRLT	SHAM	USSH	CCLM	SFPD	MFCP	NFEA	NFES	NFWE	NMHR-C	NMHR
WY16	11/25/2015	4884	4611	NA	15531	12997	14136	>24196	9804	>24196	12997	NA	4352	1076	NA
	12/29/2015	1725	749	NA	432	158	336	41	158	327	31	NA	10	20	NA
	1/28/2016	183	1989	NA	122	203	156	31	231	<10	206	NA	63	31	NA
	2/29/2016	N/A	N/A	NA	109	110	214	145	185	<10	185	NA	31	85	NA
	3/28/2016	414	384	NA	121	84	262	85	253	10	31	NA	20	<10	NA
	3/31/2016	N/A	N/A	NA	135	20	98	146	97	20	30	NA	NA	20	NA
	4/28/2016	4884	809	NA	275	259	279	10	NA	341	10	NA	31	31	NA
	7/28/2016	N/A	N/A	NA	426	20	279	<10	341	119	546	NA	1086	<10	NA
	8/30/2016	N/A	N/A	NA	959	NW	933	148	355	173	10	NA	10	<10	NA
	9/28/2016	414	384	NA	373	NW	3448	10	292	237	74	NA	5475	<10	NA
	10/26/2016	4884	809	NA	1515	794	1250	>24196	109	20	110	NA	209	20	NA
	11/30/2016	262	2247	NA	1450	14136	1178	512	359	20	609	NA	120	187	NA
WY17	1/10/2017	NA	NA	2603	1374	3076	1050	4611	122	10	2187	2489	2755	NA	2723
	1/23/2017	NA	NA	NA	206	110	208	318	638	<10	272	471	5794	NA	51
	2/7/2017	NA	NA	NA	1455	657	988	1153	288	41	480	379	1112	NA	169
	2/21/2017	NA	NA	399	2282	1421	1119	631	41	10	620	231	10462	NA	6488
	3/23/2017	NA	NA	NA	9208	2402	1694	9208	170	10	1291	1309	1401	NA	789
	6/28/2017	NA	NA	187	203	801	148	110	75	41	41	10	52	NA	NW
	7/12/2017	NA	NA	NA	146	441	331	63	368	171	63	20	63	NA	NW
	8/2/2017	NA	NA	341	228	6131	20	20	20	10	52	10	31	NA	NW
	8/23/2017	NA	NA	NA	563	>24196	1187	285	1722	1119	15531	586	238	NA	NW
	9/11/2017	NA	NA	NA	1296	NW	959	20	884	31	20	<10	10	NA	NW

Red indicates an exceedance of the WQO, NW indicates No Water, and NA indicates Not Applicable/No Sample Taken.

Appendix 2



The City of Pacifica's sewer system in the San Pedro Creek watershed.

Appendix B

San Pedro Creek and Pacifica State Beach Visual Monitoring Log

#	Station ID	Station Location	Latitude	Longitude	3/23/2017	4/5/2017	9/13/2017	11/2/2017	1/18/2018
1	Visual Monitoring 1	Pacifica State Beach Anza Pump Station	37°35'53.63"N	122°30'7.63"W	No visual evidence of Pet Waste. Photos taken.	No visual evidence of Pet Waste. Photos taken.	None	No visual evidence of Pet Waste. Photos taken.	None
2	Visual Monitoring 2	Pacifica State Beach North of Taco Bell	37°35'50.28"N	122°30'11.40"W			None		None
3	Visual Monitoring 3	Pacifica State Beach South of Taco Bell	37°35'49.65"N	122°30'13.63"W			None		None
4	Visual Monitoring 4	Pacifica State Beach Linda Mar Pump Station	37°35'47.49"N	122°30'16.41"W			Evidence of Pet Waste		Evidence of Pet Waste
5	Visual Monitoring 5	Pacifica State Beach San Pedro Creek	37°35'45.00"N	122°30'20.22"W			None		Evidence of Pet Waste
6	Visual Monitoring 6	Highway 1 and San Pedro Creek Trail Head	37°35'35.73"N	122°30'19.43"W			Evidence of Pet Waste		None
7	Visual Monitoring 7	San Pedro Creek Trail Head and Linda Mar Covelescent Home	37°35'21.52"N	122°30'6.02"W			None		None
8	Visual Monitoring 8	Peralta Bridge	37°35'18.36"N	122°29'58.15"W			None		Evidence of Pet Waste
9	Visual Monitoring 9	Sanchez Arts Center Entrance	37°35'1.25"N	122°29'12.76"W			None		None
10	Visual Monitoring 10	Sanchez Arts Center Parking Lot	37°34'57.79"N	122°29'13.98"W			None		None

Appendix C

Pacifica Tribune Pet Waste Public Service Advertisements

October 25, 2017

November 15, 2017

December 21, 2017

Appendix D

Pet Waste Mailers

Facts About Pet Waste

Every time it rains, the potential exists for thousands of pounds of pet waste to wash down storm drains and into streams, creeks and ocean. If not disposed of properly, pet waste flows directly into nearby streams and creeks without being treated at wastewater treatment facilities.

Pet waste can contain bacteria that threaten the health of animals and people, especially children. Pet waste also contains nutrients that encourage excess weed and algae growth. This water then becomes cloudy and green — unattractive for swimming, boating and fishing.

Excess nutrients are a major cause of water quality decline.

When pet waste is washed into streams and creeks, the waste decays, using up oxygen and sometimes releasing ammonia. Low oxygen levels and ammonia combined with warm temperatures can kill fish and other aquatic life.

When pet waste is disposed of improperly, water quality isn't the only thing that suffers — your health may be at risk, too.

Pets, children playing outside, and adults gardening are most at risk for infection from some of the bacteria and parasites found in pet waste. Diseases that can be transmitted from pet waste include the following:

Salmonellosis: the most common bacterial infection transmitted to humans by other animals. Symptoms include fever, muscle aches, headache, vomiting and diarrhea.

Toxocariasis: roundworms usually transmitted from dogs to humans, often without noticeable symptoms, but may cause vision loss, a rash, fever or cough.

Toxoplasmosis: a parasite carried by cats that can cause birth defects if a woman becomes infected during pregnancy, and can also be a problem for people with depressed immune systems.

What's the Problem? What Can You Do?

Pet waste should never enter storm drains and surface water. Many local communities require pet owners to pick up after pets when away from their property, and to pick up waste from their property if it attracts flies and can pose a health risk.

Fortunately, there are actions pet owners can take to help keep our water clean:

- ✓ Pick up pet waste from your yard. It is not a fertilizer.
- ✓ Carry disposable bags while walking your dog to pick up and dispose of waste properly. If you dispose of pet waste in the trash, wrap it carefully to avoid spillage during collection.
- ✓ Bury pet waste in your yard, at least 12 inches deep and cover with at least eight inches of soil to let it decompose slowly. Bury the waste in several different locations and keep it away from vegetable gardens.

The City of Pacifica provides pet waste disposal bags at selected local parks, trails and in public places where people frequently walk their dogs.

San Pedro Creek and Pacifica State Beach

San Pedro Creek and a portion of Pacifica State Beach do not meet state water quality bacteria standards for recreational use. Pet waste is one of the components of non-point source pollution that contributes to our water quality problems, and is one that each of us can help correct.

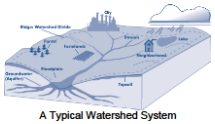
The Regional Water Board San Pedro Creek and Pacifica State Beach Total Maximum Daily Load showed that bacteria associated with pet waste were a source of the bacteria in samples collected from local waterways.

What is a Watershed?

A watershed is an area of land that drains to a common point, such as a nearby creek, stream, river or ocean. Every small watershed drains to a larger watershed that eventually flows to the ocean.

Watersheds support a wide variety of plants and wildlife and provide many outdoor recreation opportunities.

By protecting the health of our watersheds we can preserve and enhance the quality of life for Pacifica residents.



A Typical Watershed System

What is Stormwater Runoff?

Stormwater is water from rain. It flows from rooftops, over paved streets, sidewalks and parking lots, across bare soil, and through lawns and storm drains. As it flows, runoff collects and transports soil, pet waste, pesticides, fertilizer, oil and grease, litter and other pollutants. This water drains directly into nearby creeks, streams and rivers, without receiving treatment at sewage plants. Polluted stormwater contaminates streams, rivers and lakes. It can kill or damage plants, fish and wildlife, while degrading the quality of our water.

For more information, please visit our website:
http://www.cityofpacifica.org/depts/pw/pet_waste.asp

This information is provided by the City of Pacifica and is applicable to properties within the limits of the City. If you reside in a jurisdiction other than the City of Pacifica, contact your regulatory authority for information. If you believe you received this notice in error, or if you no longer own this property, please contact the City of Pacifica Department of Public Works at (650) 738-3760 or via U.S. Mail at the following address:

City of Pacifica
Department of Public Works
170 Santa Maria Avenue
Pacifica, CA 94044

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CITY OF PACIFICA

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Help Prevent Contamination of Creeks, Streams, Watersheds and the Ocean

Appendix E

Nextdoor Post