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

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

![Figure 1. San Pedro Creek and Pacifica State Beach Pet Waste Stations](image-url)
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>
<thead>
<tr>
<th>#</th>
<th>Station ID</th>
<th>Station Location</th>
<th>Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Visual Monitoring 1</td>
<td>Pacifica State Beach Anza Pump Station</td>
<td>37°35'53.63&quot;N</td>
<td>122°30'07.63&quot;W</td>
</tr>
<tr>
<td>2</td>
<td>Visual Monitoring 2</td>
<td>Pacifica State Beach North of Taco Bell</td>
<td>37°35'50.28&quot;N</td>
<td>122°30'11.40&quot;W</td>
</tr>
<tr>
<td>3</td>
<td>Visual Monitoring 3</td>
<td>Pacifica State Beach South of Taco Bell</td>
<td>37°35'49.65&quot;N</td>
<td>122°30'13.63&quot;W</td>
</tr>
<tr>
<td>4</td>
<td>Visual Monitoring 4</td>
<td>Pacifica State Beach Linda Mar Pump Station</td>
<td>37°35'47.49&quot;N</td>
<td>122°30'16.41&quot;W</td>
</tr>
<tr>
<td>5</td>
<td>Visual Monitoring 5</td>
<td>Pacifica State Beach San Pedro Creek</td>
<td>37°35'54.00&quot;N</td>
<td>122°30'20.22&quot;W</td>
</tr>
<tr>
<td>6</td>
<td>Visual Monitoring 6</td>
<td>Highway 1 and San Pedro Creek Trail Head</td>
<td>37°35'35.73&quot;N</td>
<td>122°30'19.43&quot;W</td>
</tr>
<tr>
<td>7</td>
<td>Visual Monitoring 7</td>
<td>San Pedro Creek Trail Head and Linda Mar Covelescent Home</td>
<td>37°35'21.52&quot;N</td>
<td>122°30'06.02&quot;W</td>
</tr>
<tr>
<td>8</td>
<td>Visual Monitoring 8</td>
<td>Peralta Bridge</td>
<td>37°35'18.36&quot;N</td>
<td>122°29'58.15&quot;W</td>
</tr>
<tr>
<td>9</td>
<td>Visual Monitoring 9</td>
<td>Sanchez Arts Center Entrance</td>
<td>37°35'1.25&quot;N</td>
<td>122°29'12.76&quot;W</td>
</tr>
<tr>
<td>10</td>
<td>Visual Monitoring 10</td>
<td>Sanchez Arts Center Parking Lot</td>
<td>37°34'57.79&quot;N</td>
<td>122°29'13.98&quot;W</td>
</tr>
</tbody>
</table>
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.
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.
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.

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


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 \textit{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 \textit{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 \textit{E. coli} (in place of fecal coliform). Creek mouth samples were analyzed for \textit{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.
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)

<table>
<thead>
<tr>
<th>E. coli (Pacifica State Beach)</th>
<th>E. coli (San Pedro Creek)</th>
<th>Total coliform</th>
<th>Enterococci</th>
</tr>
</thead>
<tbody>
<tr>
<td>400 MPN/100 mL</td>
<td>235 MPN/100 mL</td>
<td>10,000 MPN/100 mL</td>
<td>104 MPN/100 mL</td>
</tr>
</tbody>
</table>

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)

<table>
<thead>
<tr>
<th></th>
<th>San Pedro Creek</th>
<th>Pacifica State Beach</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dry Weather</td>
<td>Wet Weather</td>
</tr>
<tr>
<td></td>
<td>Summer Dry</td>
<td>Winter Dry</td>
</tr>
<tr>
<td></td>
<td>Weather</td>
<td>Weather</td>
</tr>
<tr>
<td>Allowable Exceedances</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

### 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

<table>
<thead>
<tr>
<th></th>
<th>Summer Dry Weather</th>
<th>Winter Dry Weather</th>
<th>Wet Weather</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allowed</td>
<td>0</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Actual</td>
<td>6</td>
<td>8</td>
<td>7</td>
</tr>
</tbody>
</table>
Table 6: Pacifica State Beach percent exceedances, WY 2016

<table>
<thead>
<tr>
<th></th>
<th>Summer Dry Weather</th>
<th>Winter Dry Weather</th>
<th>Wet Weather</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Samples Exceeded</strong></td>
<td>6</td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td><strong>Total Samples</strong></td>
<td>28</td>
<td>14</td>
<td>10</td>
</tr>
<tr>
<td><strong>% of Samples Exceeded</strong></td>
<td>21%</td>
<td>57%</td>
<td>70%</td>
</tr>
</tbody>
</table>

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**

<table>
<thead>
<tr>
<th></th>
<th>Summer Dry Weather</th>
<th>Winter Dry Weather</th>
<th>Wet Weather</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Allowed</strong></td>
<td>0</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td><strong>Actual</strong></td>
<td>9</td>
<td>0</td>
<td>11</td>
</tr>
</tbody>
</table>

**Table 8: Pacifica State Beach percent exceedances, WY 2017**

<table>
<thead>
<tr>
<th></th>
<th>Summer Dry Weather</th>
<th>Winter Dry Weather</th>
<th>Wet Weather</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Samples Exceeded</strong></td>
<td>9</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td><strong>Total Samples</strong></td>
<td>27</td>
<td>9</td>
<td>14</td>
</tr>
<tr>
<td><strong>% of Samples Exceeded</strong></td>
<td>33%</td>
<td>0%</td>
<td>79%</td>
</tr>
</tbody>
</table>
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*

<table>
<thead>
<tr>
<th>Dry Weather</th>
<th>Wet Weather</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allowed</td>
<td>Actual</td>
</tr>
<tr>
<td>1</td>
<td>32</td>
</tr>
</tbody>
</table>

*Table 10: San Pedro Creek percent exceedances, WY 2016*

<table>
<thead>
<tr>
<th></th>
<th>Dry Weather</th>
<th>Wet Weather</th>
</tr>
</thead>
<tbody>
<tr>
<td>Samples Exceeded</td>
<td>32</td>
<td>9</td>
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<tr>
<td>Total Samples</td>
<td>42</td>
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</tr>
<tr>
<td>% of Samples Exceeded</td>
<td>76%</td>
<td>90%</td>
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</table>

*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*

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<tr>
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<td>Allowed</td>
<td>Actual</td>
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*Table 12: San Pedro Creek percent exceedances, WY 2017*

<table>
<thead>
<tr>
<th></th>
<th>Dry Weather</th>
<th>Wet Weather</th>
</tr>
</thead>
<tbody>
<tr>
<td>Samples Exceeded</td>
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<td>12</td>
</tr>
<tr>
<td>Total Samples</td>
<td>36</td>
<td>14</td>
</tr>
<tr>
<td>% of Samples Exceeded</td>
<td>72%</td>
<td>86%</td>
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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/100 mL. 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/100 mL 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>
<thead>
<tr>
<th>Table 13: Pacifica State Beach # of exceedances, WY 2016 vs WY 2017</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Summer Dry Weather</strong></td>
</tr>
<tr>
<td>WY 2016 Exceedances</td>
</tr>
<tr>
<td>WY 2017 Exceedances</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 14: Pacifica State Beach % exceedances, WY 2016 vs WY 2017</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Summer Dry Weather</strong></td>
</tr>
<tr>
<td>WY 2016 Exceedances</td>
</tr>
<tr>
<td>WY 2017 Exceedances</td>
</tr>
</tbody>
</table>

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>
<thead>
<tr>
<th>Table 15: San Pedro Creek # of exceedances, WY 2016 vs WY 2017</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dry Weather</strong></td>
</tr>
<tr>
<td>WY 2016 Exceedances</td>
</tr>
<tr>
<td>WY 2017 Exceedances</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 16: San Pedro Creek % exceedances, WY 2016 vs WY 2017</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dry Weather</strong></td>
</tr>
<tr>
<td>WY 2016 Exceedances</td>
</tr>
<tr>
<td>WY 2017 Exceedances</td>
</tr>
</tbody>
</table>
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:
City of Pacifica
155 Milagra Drive
Pacifica, CA 94044

County of San Mateo
455 County Center
Redwood City, CA 94063

Prepared by:
San Mateo Resource Conservation District
625 Miramontes Street Suite 103
Half Moon Bay, California 94019

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)
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   a. Sample Site Map
   b. Locations and Parameters Table
   c. Results Table

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III. Environmental Setting

IV. Results

V. Discussion

VI. BMP Effectiveness

VII. Conclusion
### Data Tables

<table>
<thead>
<tr>
<th>Site ID</th>
<th>Sample Site Name</th>
<th>Latitude and Longitude</th>
<th>Parameters Assessed</th>
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<tr>
<td>NFES</td>
<td>North Fork East Sweeney</td>
<td>37.59306, – 122.4633</td>
<td>E. Coli</td>
</tr>
<tr>
<td>NFEA</td>
<td>North Fork East</td>
<td>37.58417, – 122.47306</td>
<td>E. Coli, Bacteroides (horse, human, dog)</td>
</tr>
<tr>
<td>NMHR</td>
<td>North Millwood Horse Ranch</td>
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<td>E. Coli</td>
</tr>
<tr>
<td>NFWE</td>
<td>North Fork West</td>
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<td>MFCP</td>
<td>Middle Fork at County Park</td>
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<td>E. Coli</td>
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<tr>
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<td>Sanchez Fork at Perez Drive</td>
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<td>Crespi Canal</td>
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<td>Peralta Bridge</td>
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<td>San Pedro Creek Mouth</td>
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<td>Site ID</td>
<td>Water Year 2017 Characterization Monitoring results with exceedances of <em>E. Coli</em> WQO (235 MPN/100 mL) and all detections of <em>Bacteroides</em> markers highlighted.</td>
<td></td>
</tr>
<tr>
<td>-------------</td>
<td>--------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
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<tr>
<td></td>
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<td><strong>E. Coli</strong> (MPN/100 mL)</td>
<td><strong>Universal Bacteroides</strong> (gc/mL)</td>
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<td>8/2/2017</td>
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<td>NW</td>
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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.

![Image](image_url)

**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.

<table>
<thead>
<tr>
<th>Sample Site/Bacteroides Markers</th>
<th>Dry Season</th>
<th>Wet Season</th>
<th>Total</th>
</tr>
</thead>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>Horse</td>
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</tr>
<tr>
<td>Dog</td>
<td>0/2</td>
<td>1/2</td>
<td>1/4</td>
</tr>
<tr>
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<td></td>
<td></td>
</tr>
<tr>
<td>Human</td>
<td>2/2</td>
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<td>0/2</td>
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<td>2/4</td>
</tr>
<tr>
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**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.

![Horse manure (left) and dog waste (right) on the walking path near Highway 1 and the mouth of the creek.](image)

**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.](image)

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

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Red indicates an exceedance of the WQO, NW indicates No Water, and NA indicates Not Applicable/No Sample Taken.
The City of Pacifica’s sewer system in the San Pedro Creek watershed.
## San Pedro Creek and Pacifica State Beach Visual Monitoring Log

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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 oceans. 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: rodent, canine, and feline wastes. Rodent wastes also contain typhus. Pet waste contains pathogens that can make the water unsafe to swim in or touch — for swimming, boating, or fishing.

Eutrophication may also occur if waste is left in place.

When pet waste is washed into streams and creeks, it is denser than water, changes the color of the water, and increases the growth of algae and other organisms. This also makes the water cloudy and green — conditions for swimming, boating, and fishing.

**What is 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 they are off of their property, and to put up waste from their property if it attracts flies and other pests. A large risk is not the waste itself, but the bacteria and disease it carries.

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 your own pet waste, and take it home with you. In rain, pet waste is washed into storm drains and creeks.
- Use the designated collection areas when allowed.
- Keep pet waste out of the storm drains, creeks, and streams.
- Be sure to clean up your pet waste in any designated pick-up areas.
- If you do find pet waste in any area, please put it in the appropriate collection areas.
- If you see pet waste in any area, report it to your local government.

**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.

**What is Eutrophication?**

Eutrophication is the process by which lakes and other bodies of water become enriched with nutrients, causing an increase in the growth of algae and other organisms. This can lead to a decrease in the oxygen levels in the water, making it difficult for aquatic life to survive.

**A Typical Watershed System**

A typical watershed system includes:

- **Source Water:** Water from snow, rain, or other sources.
- **Runoff:** Water that flows over land or through the soil.
- **Granular Material:** Materials such as sand, silt, and clay that are transported by water.
- **Discharge:** Water that flows into a body of water, such as a river or lake.

**What is Stormwater Runoff?**

Stormwater runoffs are water that flows from surfaces, such as paved streets, sidewalks, and parking lots, across lawns and surfaces, and through drains and storm drains. It then 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 of 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.
Appendix E

Nextdoor Post

City of Pacifica

Pacifica, California is located just 12 miles south of San Francisco along the scenic coast of the Pacific Ocean. Known for its natural beauty, Pacifica is filled with numerous hiking trails.

cityofpacific.org

Activity

San Pedro Creek and Pet Waste

Rain is forecasted in Pacifica and we need you help. Pet waste left on sidewalks, streets, yards and other open areas can be washed away by rains and irrigation systems, making its way into storm drains leading into local creeks and the ocean. Pollutants from the pet waste can harm the water quality and habitat. The pet waste contains harmful bacteria and parasites. Please help by cleaning up after your pet and keep the storm drains free of other harmful debris.

For additional information please see our web page at http://www.cityofpacifica.org/people/petwaste or at http://www.nextdoor.com/pt?page= Thank you.

12 Sep 10 - Subscriber of City of Pacifica in 10 neighborhoods in Creswell