



**Monterey Bay Sanctuary Citizen Watershed Monitoring Network**  
99 Pacific Street BLDG 455A Monterey, CA 93940 (831) 647-4227

# 2016-2017 MRSWMP Monitoring Report

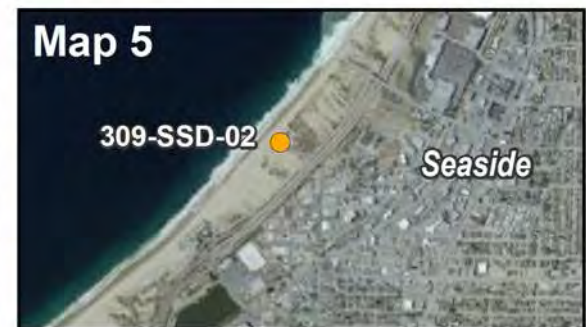
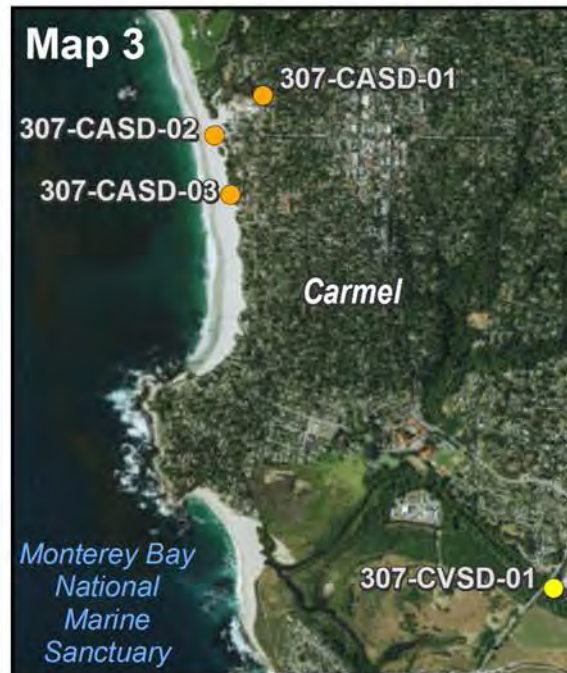
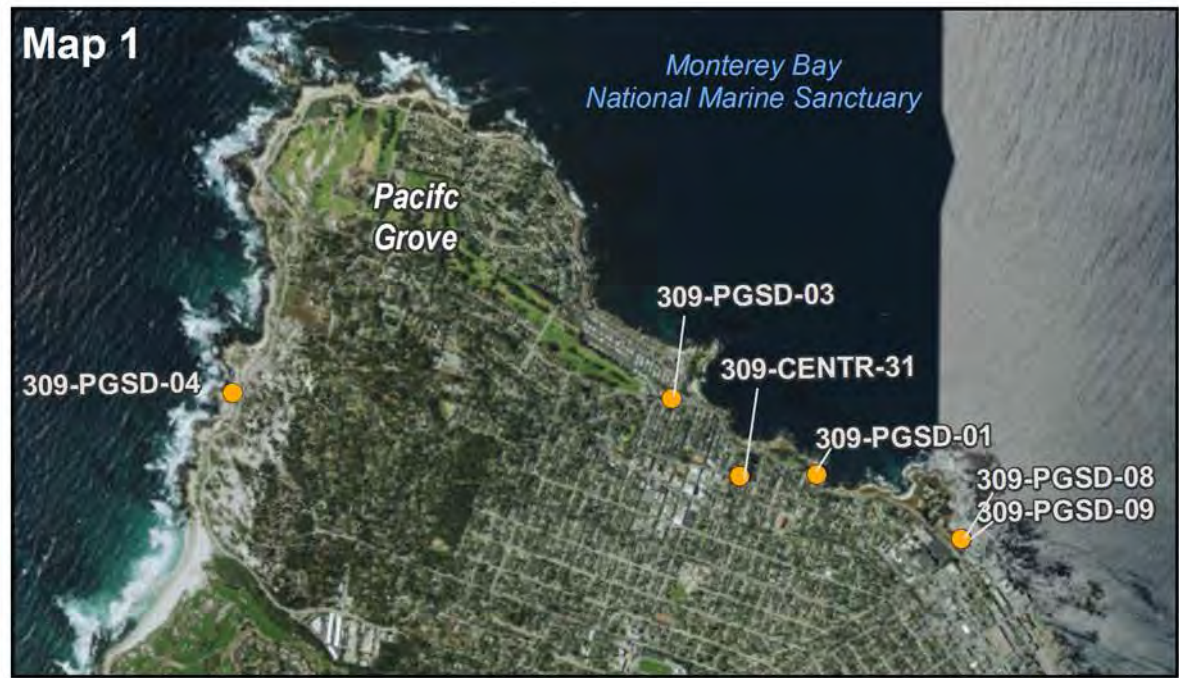
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Figure 1. Monterey Regional Stormwater Management Program (MRSWMP) sites monitored for the 2016 Dry Run and First Flush.

## **Introduction**

The Monterey Regional Storm Water Management Program's (MRSWMP) water quality monitoring program is modeled after the Monterey Bay National Marine Sanctuary's (MBNMS) Dry Run/First Flush monitoring program, for which volunteers collect water samples which are analyzed for common urban pollutants. This monitoring program design promotes volunteer participation, stewardship and environmental education while providing important data regarding the quality of water flowing into Monterey Bay National Marine Sanctuary.

The 2016-2017 MRSWMP monitoring program collected water samples prior to the first major rainstorm of the year (Dry Run) and during the first major rainstorm of the winter season (First Flush). Samples collected during dry weather, prior to the first major rainstorm, inform pollutants of concern and can give an indication of urban water uses (car washing, pressure washing, irrigation or illicit discharges), or groundwater base flow. In some cases, dry weather flows can be more concentrated than those of wet weather flows due to less dilution. Water samples collected during the first major storm of the winter season provide information on the concentration of contaminants in storm water after months of dry weather accumulation of pollutants on land in urban areas. All runoff from the Monterey region eventually flows into MBNMS except in Pacific Grove where some dry weather flows are diverted to the sanitary sewer. It is hoped that this data provided by the MRSWMP water quality monitoring program provides local cities with the information to implement best management practices to improve water quality.

This monitoring program is designed to meet E.8.ii requirements under the Phase II Stormwater Permit of the MRSWMP, satisfying public involvement and participation elements of the permit. This monitoring program does not fulfill the E.13 requirements pertaining to ASBS Monitoring, TMDL Monitoring, 303(d) Monitoring or Receiving Water Monitoring, which are completed by permittees individually or through regional programs. For additional information regarding the Central Coast ASBS Regional Monitoring Program, please visit: <http://ccasbrmp.stanford.edu/>

## **Methods**

The same protocols and laboratory analyses are used for all of the MRSWMP water quality monitoring events. Volunteers take field measurements (water temperature, pH, electrical conductivity, and transparency) and collect water samples for lab analysis of nutrients (nitrate, orthophosphate, ammonia and urea), bacteria (*Escherichia coli* and enterococcus), metals (copper, lead and zinc) and total suspended solids, color, Methylene Blue Active Substances (MBAS) detergents, fluoride, hardness (as CaCO<sub>3</sub>), potassium and turbidity.

All results (lab and field) in this study are compared to receiving water standards established for beneficial uses in a stream, lake, or the ocean (see Table 1). These receiving water quality standards are not meant for end of pipe monitoring, such as for this MRSWMP water quality monitoring program. However, lacking any standards for end-of-pipe monitoring these receiving water standards are used for comparison. MBAS detergents and metal results are compared to the Water Quality Control Plan for the Central Coast Basin (Basin Plan) Water Quality Objectives (WQO) set by the Regional Water Quality Control Board (RWQCB) for the protection of marine aquatic life. Because there are no numerical water quality objectives in the Basin Plan for *E. coli*, enterococcus, nitrate, orthophosphate, and total suspended solids (TSS), those results are compared with the U.S. Environmental Protection Agency (U.S. EPA) WQO and Central Coast Ambient Monitoring

Program's (CCAMP) Action Levels. The U.S. EPA objectives are for the protection of human health while CCAMP's Action Levels are benchmarks that are set for receiving water concentrations at which pollutants may impact cold-water fish. Action Levels typically represent existing regulatory standards; levels derived from the literature or other agency references; or from data that shows levels are elevated relative to the data distribution for that parameter on the Central Coast. It is important to reiterate that both RWQCB Basin Plan water quality objectives and CCAMP Action Levels are established for receiving waters and not for end of pipe discharges such as is collected for the MRSWMP monitoring. There are no end of pipe objectives for most of the monitored analytes of the MRSWMP monitoring program, however, the State Water Resources Control Board (SWRCB) National Pollution Discharge and Elimination System (NPDES) MS4 General Permit does provide end of pipe water quality standards or Action Levels for: ammonia, color, hardness, potassium and turbidity. For turbidity the SWRCB NPDES MS4 Action Levels have been supplanted by CCAMP Action Levels that are more protective of water quality. No Action Level was provided in the SWRCB NPDES MS4 General Permit for fluoride.

Dry Run monitoring entails collecting a single grab sample from each site with flowing water. Those sites that did not have water flowing during any event were documented as "no flow" on a field data sheet. Greenwood Park (Pacific Grove) is monitored for the Dry Run despite the flow being diverted into the sanitary sewer. Results provide important information about what was in the runoff and diverted from flowing to the ocean. During the First Flush, grab samples were collected 30 minutes apart for two time series, and results were averaged. In this report, First Flush averaged results are reported by analyte with individual time series results reported by jurisdiction in Appendix 3. Samples for urea were only collected during the first time series and are therefore not an average but a single sample result for each event.

Grab sample results are reported as concentration, consistent with how the water quality objectives are defined. However, this does not give an indication of the load or total amount of pollutants being discharged. To calculate instantaneous load, flow was measured by filling a container of known volume (a bucket), timing how fast the container filled, and estimating how much of the flow was captured while filling the container. First Flush instantaneous flow estimates are an average of two time series samples while the Dry Run calculations are from a single sample.



**Volunteers gather at Twins (Monterey) for Dry Run practice.**



**Water rushes from 8<sup>th</sup> St (Pacific Grove) during the First Flush.**



**Volunteers make it all happen during the First Flush.**

**Table 1: Receiving Water Quality Objectives**

<b><u>Parameter</u></b> <b><u>(reporting units)</u></b>	<b><u>Water Quality Objectives</u></b>	<b><u>Source of Objective</u></b>
Ammonia	Not to exceed 50 mg/L	SWRCB NPDES MS4 General Permit
Color	Not to exceed 500	SWRCB NPDES MS4 General Permit
Copper (µg/L)	Not to exceed 30 <sup>1</sup>	Water Quality Control Plan for the Central Coast
<i>E. coli</i> (MPN/100ml)	Not to exceed 235 <sup>2</sup>	EPA Ambient Water Quality Criteria
Enterococcus (MPN/100ml)	Not to exceed 104	EPA Ambient Water Quality Criteria
Fluoride (mg/L)	NA	NA
Hardness as CaCO <sub>3</sub> (mg/L)	Not less than or = to 10 or greater than or = to 2,000	SWRCB NPDES MS4 General Permit
Lead (µg/L)	Not to exceed 30 <sup>1</sup>	Water Quality Control Plan for the Central Coast
MBAS Detergents (mg/L)	Not to exceed 0.2	Water Quality Control Plan for the Central Coast
Nitrate as N (mg/L)	Not to exceed 2.25 <sup>3</sup>	Central Coast Ambient Monitoring Program (CCAMP)
Orthophosphate as P (mg/L)	Not to exceed 0.12 <sup>4</sup>	Central Coast Ambient Monitoring Program (CCAMP)
pH	Not < 6.5 or > 8.5	Water Quality Control Plan for the Central Coast
Potassium (mg/L)	Not to exceed 20	SWRCB NPDES MS4 General Permit
Total Suspended Solids (TSS) (mg/L)	Not to exceed 500 <sup>5</sup>	Central Coast Ambient Monitoring Program (CCAMP)
Transparency (cm)	Not less than 25 <sup>6</sup>	Central Coast Ambient Monitoring Program (CCAMP)
Turbidity (NTU)	Not to exceed 25	Central Coast Ambient Monitoring Program (CCAMP)
Urea (µg/L)	NA	NA
Zinc (µg/L)	Not to exceed 200 <sup>1</sup>	Water Quality Control Plan for the Central Coast

<sup>1</sup> Water Quality Control Plan for Central Coast Cold Water objective for hard water

<sup>2</sup> Environmental Protection Agency, Updated WQO.

<sup>3</sup> Central Coast Ambient Monitoring Program, Pajaro River Watershed Characterization Report 1998, rev 2003.

<sup>4</sup> Williamson, The Establishment of Nutrient Objectives, Sources, Impacts and Best Management Practices for the Pajaro River and Llagas Creek, 1994.

<sup>5</sup> Central Coast Ambient Monitoring Program, Salinas River Watershed Characterization Report 1999, rev. 2000.

<sup>6</sup> Based upon equivalent guideline value used for 303(d) Listing Guideline Value (Sigler et al., 1985)

## Results

Two monitoring events took place during the 2016-2017 MRSWMP permit year:

- The Dry Run was conducted on September 10<sup>th</sup>, 2016 at 15 sites with the help of 26 volunteers. Only 3 of the 15 sites had enough water flowing to be sampled.
- The first major storm of the rainy season hit the central Monterey Bay on the evening of November 15<sup>th</sup>, 2015. Volunteers for Pajaro (Monterey County) were mobilized at 10:30 pm that same evening. The storm continued to creep south and finally came ashore on the Monterey Peninsula in the early morning hours on October 16<sup>th</sup>, 2016 when over an inch of rain fell in a seven hour period of time as reported at the Monterey airport (Figure 2). Volunteers for the remaining MRSWMP sites were mobilized at 3:30 am. A total of 32 volunteers assisted with the collection of field data and samples at all 15 sites.

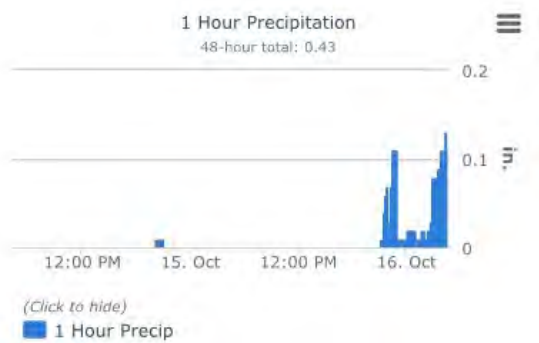


Figure 2. Rainfall totals reported at 4:22 am from the Monterey airport on October 16<sup>th</sup>, 2016.

Flow is measured by volunteers at the time of sampling except at the following sites: Bay Street (Seaside) and Lovers (Pacific Grove) due to the end of pipe inaccessibility; Pajaro (Monterey County) and Crossroads (Monterey County) due to flap gates at the end of the outfalls that impede natural flow. All other instantaneous flow estimates are listed in Table 2.

**Table 2:** Instantaneous flow estimates in gallons per minute (gpm). NA= data not available due to issues with pipe and/or accessibility, NF= no flow.

Sites	Dry Run	First Flush
Pajaro (Monterey County)	NF	NA
Bay Street (Seaside)	NF	NA
Twins (Monterey)	12.1	2000
San Carlos Beach (Monterey)	NF	400
Steinbeck (Monterey)	NF	900
HopkinsMon (Pacific Grove)	NF	36
HopkinPG (Pacific Grove)	NF	40
8 <sup>th</sup> Street (Pacific Grove)	NF	140
Greenwood Park (Pacific Grove)	4.2	2025
Lover's (Pacific Grove)	NF	NA
Pico (Pacific Grove)	NA	875
4 <sup>th</sup> Avenue (Carmel)	NF	>1200
Ocean Avenue (Carmel)	NF	1575
8 <sup>th</sup> Avenue (Carmel)	NF	1000
Crossroads (Monterey County)	NF	NA

**Table 3.** The range of results for field measurements and lab samples. First Flush range results are not averaged; both time series samples were taken into account.

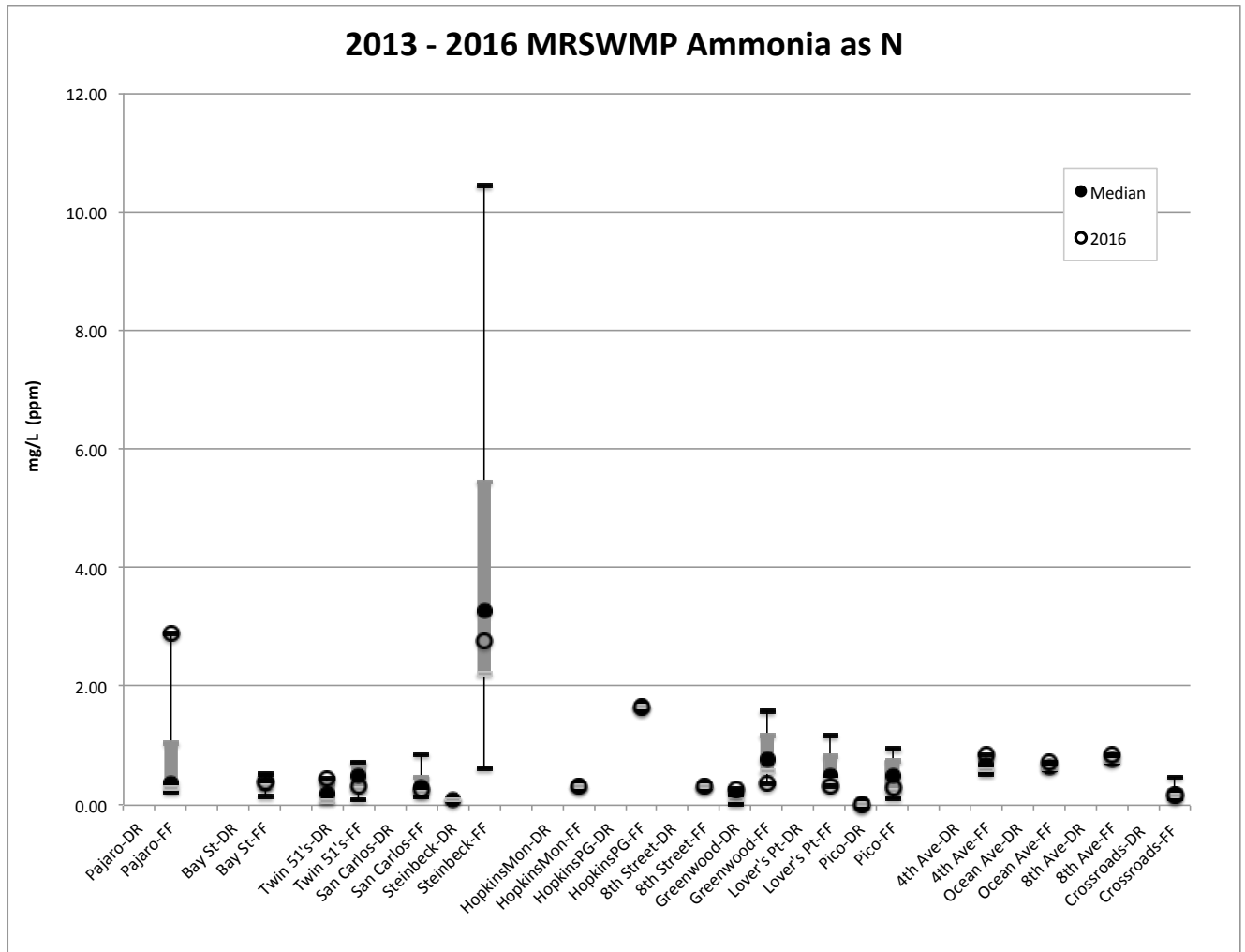
<b>Parameter</b>	<b>Units</b>	<b>Dry Run</b>	<b>First Flush</b>
Ammonia as N	mg/L	ND – 0.44	0.17 – 5.08
Color	color units	24 - 60	7 - 250
Conductivity	µS	1370 - 4900	70 - 590
Copper- total	µg/L	4 - 13	15 - 112
<i>Escherichia coli (E. coli)</i>	MPN/ 100 ml	30 – 141,361	1,449 – 54,750
Enterococcus	MPN/ 100 ml	400 – 1470	2,590 – 36,540
Fluoride	mg/L	0.1 – 0.7	ND – 2.2
Hardness	mg/L	179 - 905	17 - 128
Lead- total	µg/L	ND	ND - 34
MBAS Detergents	mg/L	0.08 – 0.14	0.27 – 0.80
Nitrate as N	mg-N/L	0.4 – 1.1	0.1 – 1.1
Orthophosphate as P	mg-P/L	ND – 0.3	0.2 – 1.4
pH	pH units	6.5 – 7.25	NA
Potassium	mg/L	4.6 – 8.3	1.6 - 13
Total Suspended Solids	mg/L	ND - 2	5 - 120
Transparency	cm	>120	NA
Turbidity	NTU	4.5 – 10.0	2.1 - 60
Urea	µg/L	ND - 102	89 - 5260
Water temperature	°C	15.8 – 17.0	17.4 – 22.5
Zinc- total	µg/L	ND - 56	62 - 394

Analyte descriptions below are listed alphabetically and include box and whisker graphs showing the data divided into dry weather monitoring (DR) and wet weather monitoring (FF) by site. Dry Weather monitoring events include Dry Run and any Spring Run and Summer Run events; wet weather monitoring is inclusive of First Flush and any Second Flush events. Box and whisker graphs show a distribution of the dataset in a convenient format for making comparisons. The box represents the range of 50% of the data with a point in the middle that represents the median value. The upper and lower whiskers represent the remaining upper and lower 25% of the data. The end point of the whiskers show the maximum and minimum result for that analyte at that location and give an indication of best and worst case scenarios. Each graph includes a marker for the most recent years results to gain insight into pollutant concentrations for the current year and how they compare to past years results.

## Ammonia as N

Ammonia, in conjunction with other analytes, can assist in identifying a discharge of sewage, industrial or commercial liquid wastes. The SWRCB NPDES MS4 General Permit Action Level for ammonia as N is 50 mg/L; the MDL was 0.05 mg/L for both the Dry Run and the First Flush. Figure 3 represents all MRSWMP ammonia as N data since 2013 for both dry weather (DR) and wet weather (FF) and is inclusive of past MRSWMP monitoring events including Dry Runs, First Flushes, Spring Runs, Summer Runs and Second Flushes. All 2016 results are listed in Appendix 2.

- **Dry Run and First Flush** results for all sites were below the Action Level.



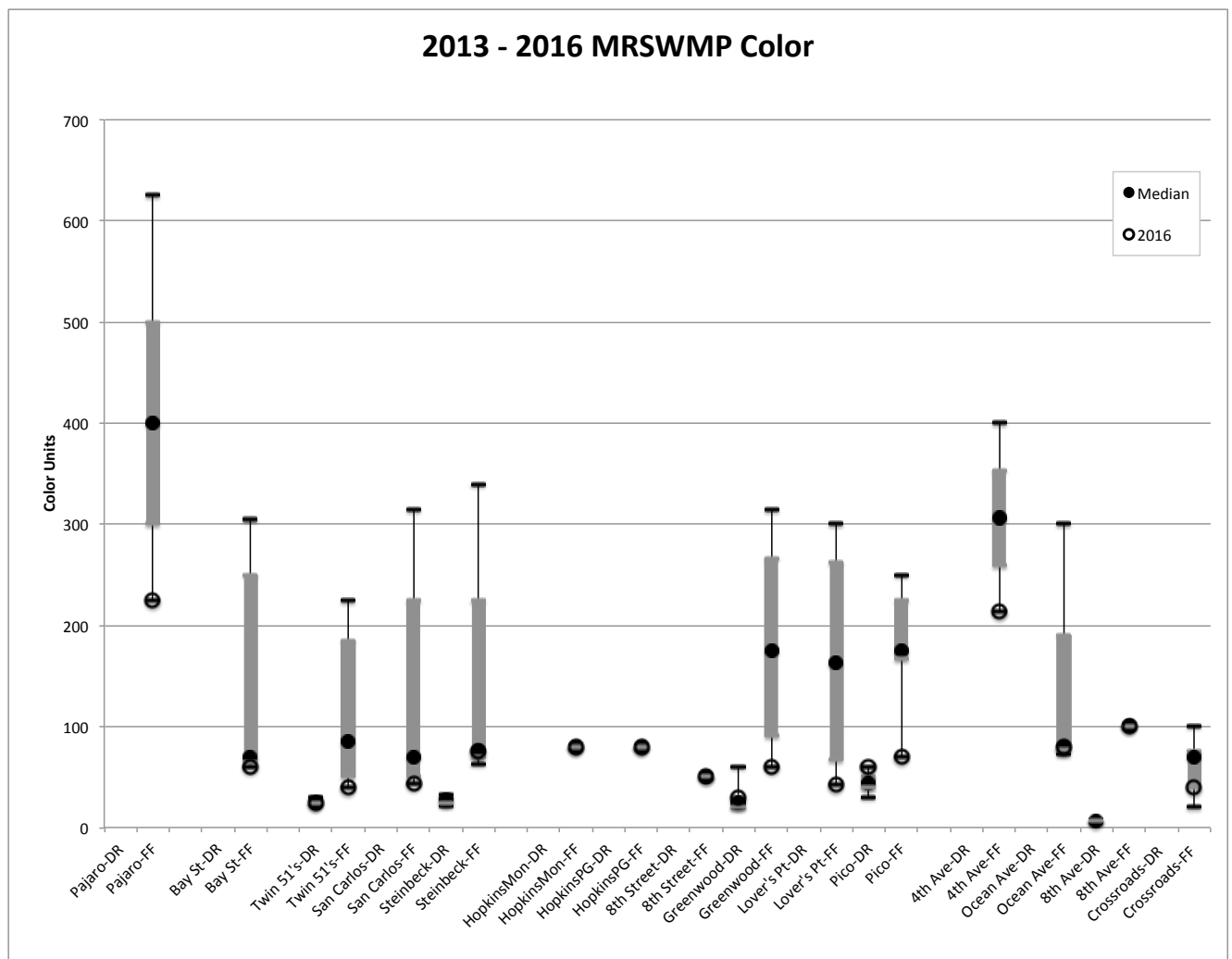
**Figure 3.** 2013- 2016 MRSWMP ammonia as N results. Non-detects were given the value of half the Minimum Detection Limit (MDL) but their true value lies between the zero and the MDL. Sites are listed north to south.



## Color

Color, in conjunction with other analytes, can assist in identifying a discharge of sewage, wash water or industrial or commercial liquid wastes. The SWRCB NPDES MS4 General Permit Action Level for color is 500 units; the MDL for color for both the dry and wet results varies based upon the turbidity of the sample water from 3 to 150 color units. Figure 4 represents all MRSWMP color data since 2013, for both dry weather (DR) and wet weather (FF) and is inclusive of past MRSWMP monitoring events including Dry Runs, First Flashes, Spring Runs, Summer Runs and Second Flashes. All 2016 results are listed in Appendix 2.

- **Dry Run and First Flush** results for all sites were below the Action Level.



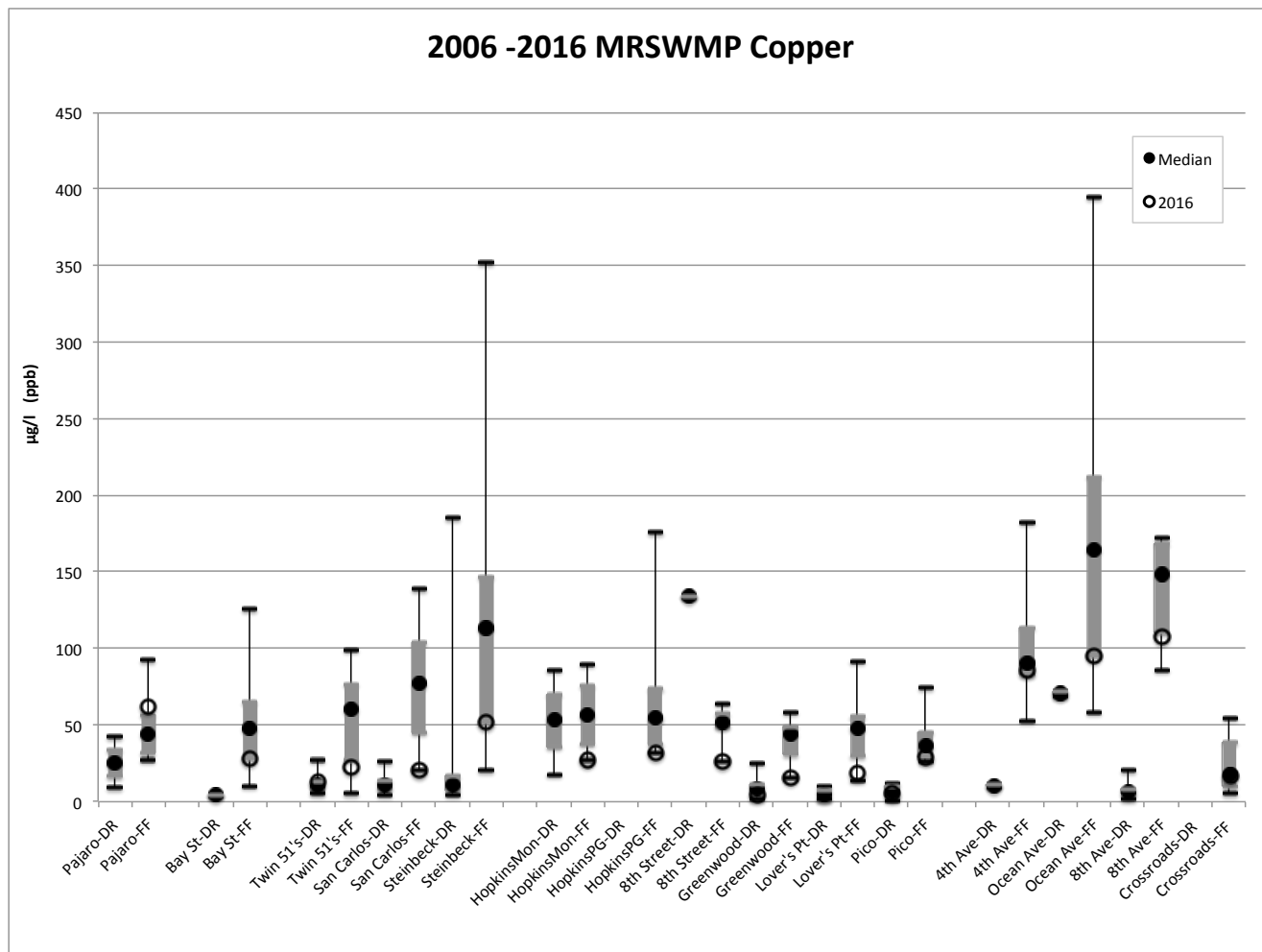
**Figure 4.** 2013 - 2016 MRSWMP color results. Non-detects were given the value of half the Minimum Detection Limit (MDL) but their true value lies between the zero and the MDL. Sites are listed north to south.

## Copper

Copper is toxic to marine organisms causing reduced reproduction, developmental deformities, reduced photosynthesis and mortality. Copper and other heavy metal toxicity can be mitigated by the presence of sediment or other binding compounds that may reduce the metals bioavailability. Copper is present in brake pads, copper pesticides, wood preservatives, roofing materials, and architectural copper.

The Basin Plan WQO established for total copper is 30 µg/L; the MDL for copper was 4 µg/L for both the Dry Run and First Flush. Figure 5 represents all MRSWMP copper data since 2006, for both dry weather (DR) and wet weather (FF) and is inclusive of past MRSWMP monitoring events including Dry Runs, First Flushes, Spring Runs, Summer Runs and Second Flushes. All 2016 results are listed in Appendix 2.

- **Dry Run** results: Copper concentrations were all below the WQO.
- **First Flush** results: Six of the sites monitored (40%) were above the WQO. The highest average result was from 8<sup>th</sup> Avenue (Carmel) with a value of 108 µg/L.



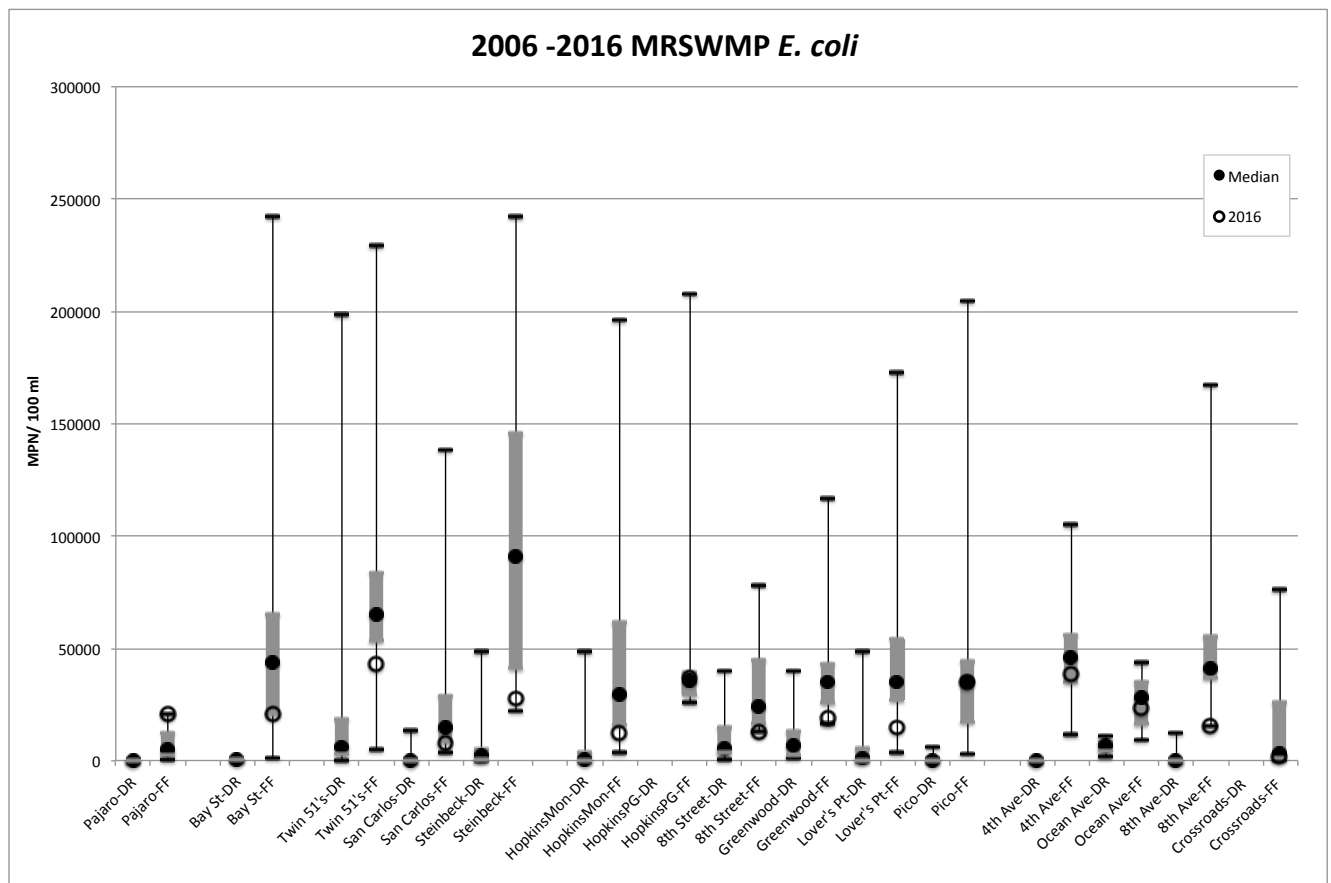
**Figure 5.** 2006-2016 MRSWMP total copper results. Non-detects were given the value of half the Minimum Detection Limit (MDL) but their true value lies between the zero and the MDL. Sites are listed north to south.

## Escherichia coli (E. coli)

*Escherichia coli* (*E. coli*) and enterococcus are types of indicator bacteria found in warm-blooded animals. While *E. coli* and enterococcus do not cause disease in humans, they are pollutants of concern because they indicate the potential presence of pathogens that do cause disease in humans and wildlife.

The U.S. EPA Ambient Water Quality Criteria for *E. coli* is 235 MPN/100 ml. The Dry Run MDL for *E. coli* was 10 MPN/ 100 ml for Pico (Pacific Grove) and Greenwood Park (Pacific Grove) and 1 MPN/ 100 ml for Twins (Monterey). The MDL was 100 MPN/ 100ml for the First Flush. Figure 6 represents all MRSWMP *E. coli* data since 2006, for both dry weather (DR) and wet weather (FF) and is inclusive of past MRSWMP monitoring events including Dry Runs, First Flushes, Spring Runs, Summer Runs and Second Flushes. All 2016 results are listed in Appendix 2.

- **Dry Run** results: Two of the three of the sites monitored were above the WQO for *E. coli*. The highest *E. coli* result was 141,361 MPN/100 ml from Twins (Monterey).
- **First Flush** results: All of the sites were above the WQO. The highest average result was from Twins (Monterey) with a value of 42,755 MPN/ 100 ml.



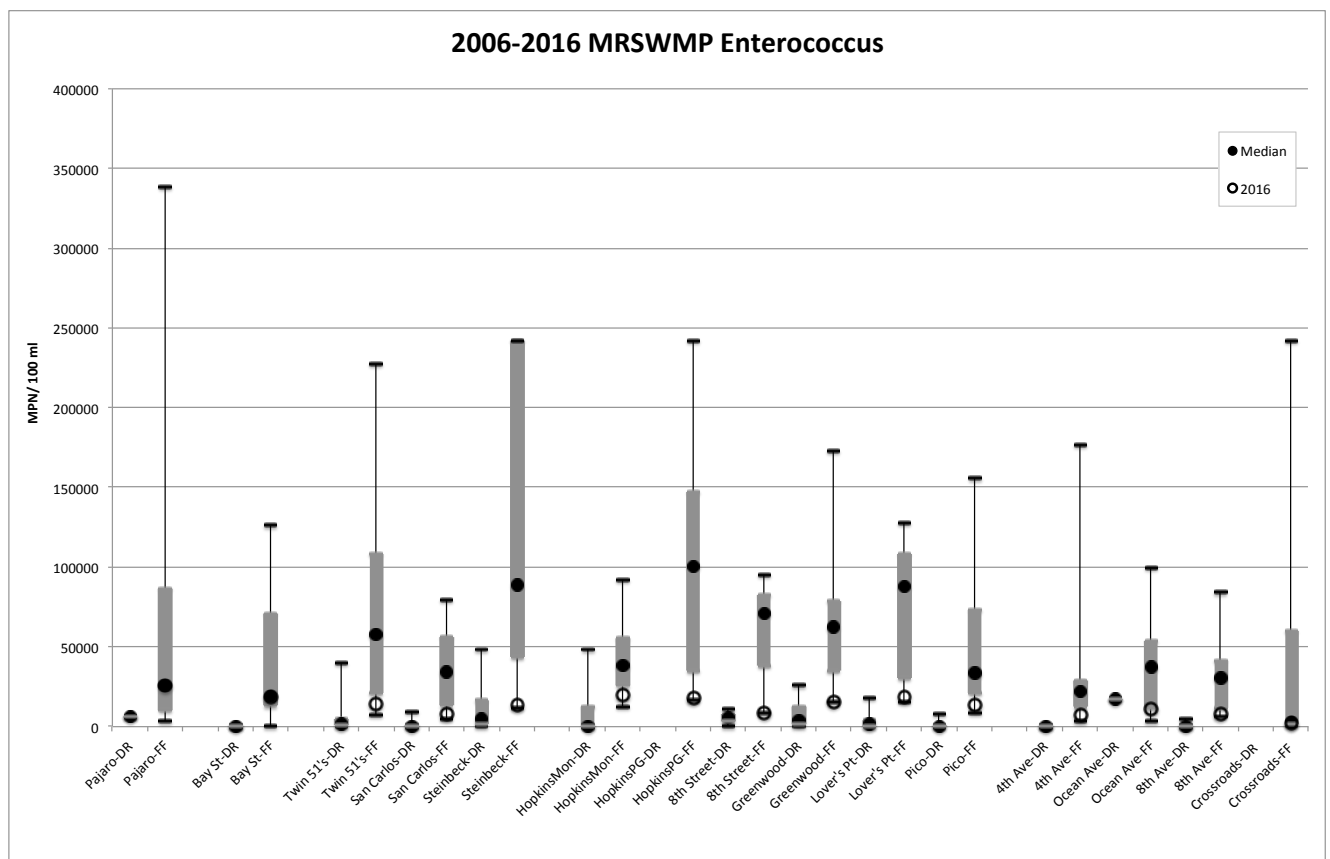
**Figure 6.** 2006-2016 MRSWMP *E. coli* results. Non-detects were given the value of half the Minimum Detection Limit (MDL) but their true value lies between the zero and the MDL. Sites are listed north to south.

## Enterococcus

*Escherichia coli* (*E. coli*) and enterococcus are types of indicator bacteria found in warm blooded animals. While they do not cause disease in humans, they are pollutants of concern because they indicate the potential presence of pathogens that do cause disease in humans and wildlife.

The U.S EPA Ambient Water Quality Criteria for enterococcus is 104 MPN/100 ml. The MDL for enterococcus was 10 MPN/ 100ml for the Dry Run and 100 MPN/ 100 ml for the First Flush. Figure 7 represents all MRSWMP enterococcus data since 2006, for both dry weather (DR) and wet weather (FF) and is inclusive of past MRSWMP monitoring events including Dry Runs, First Flushes, Spring Runs, Summer Runs and Second Flushes. All results are listed in Appendix 2.

- **Dry Run** results: Two of the three sites exceeded the WQO. The highest enterococcus result was 1,470 MPN/ 100 ml at Twins (Monterey).
- **First Flush** results: All sites exceeded the WQO. The highest average result was 25,545 MPN/100 ml at Pajaro (Monterey County).

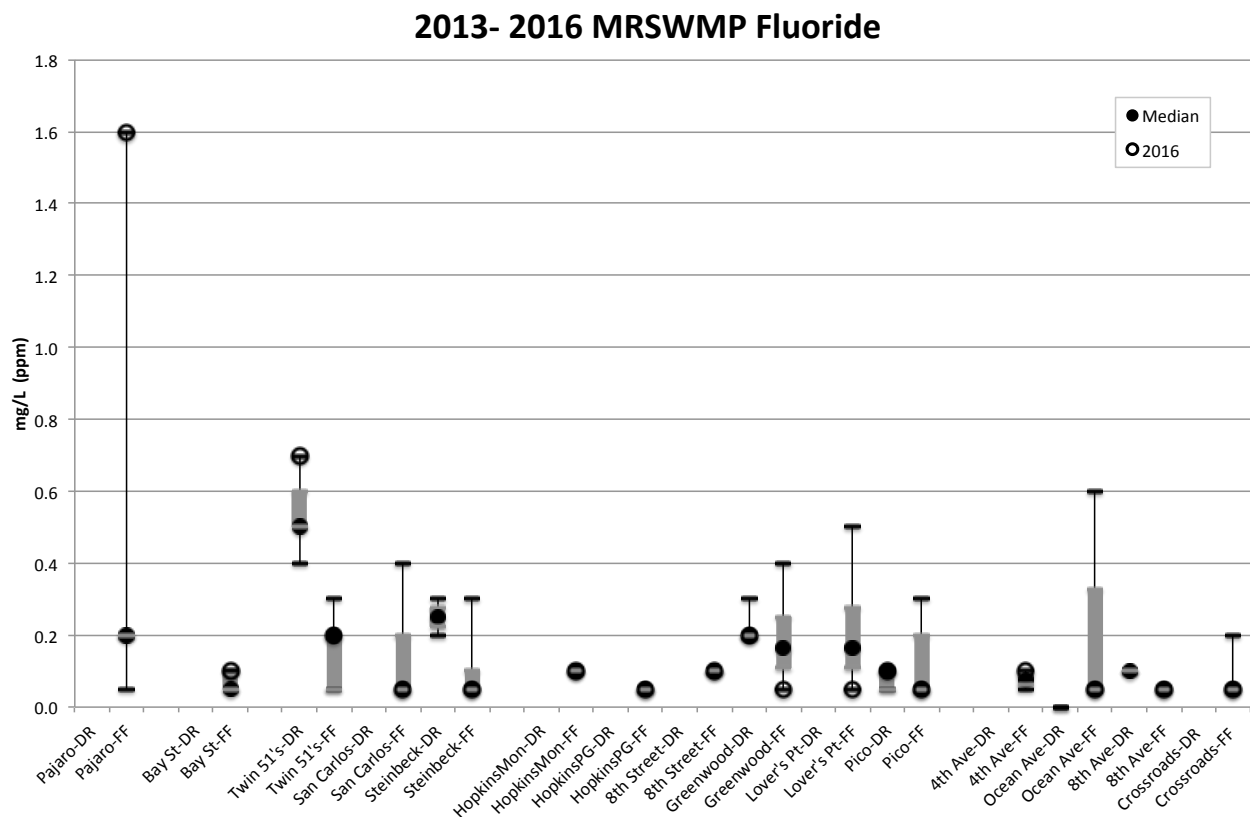


**Figure 7.** 2006-2016 MRSWMP enterococcus results. Non-detects were given the value of half the Minimum Detection Limit (MDL) but their true value lies between the zero and the MDL. Sites are listed north to south.

## Fluoride

Fluoride, in conjunction with other analytes, can assist in identifying a discharge of sewage, wash water, tap water or industrial or commercial liquid wastes. However, California American Water, the local water provider for Monterey Peninsula cities, does not add fluoride to local tap water and reports that tap water on the Monterey Peninsula contains from 0.25 - 0.60 mg/L of fluoride from natural sources. Sunny Mesa Community Services District manages the water for the Pajaro (Monterey County) area and reports that fluoride is not added to the water supply which contains 0.20 mg/L from natural sources. There is no Action Level for fluoride. The Dry Run MDL for fluoride was 0.1 mg/L for Pico (Pacific Grove) and Greenwood Park (Pacific Grove) and 0.4 for Twins (Monterey). The MDL for Fluoride for the First Flush was 0.1 mg/L. Figure 8 represents all MRSWMP fluoride data since 2013, for both dry weather (DR) and wet weather (FF) and is inclusive of past MRSWMP monitoring events including Dry Runs, First Flushes, Spring Runs, Summer Runs and Second Flushes. All results are listed in Appendix 2.

- **Dry Run** results: The highest fluoride result was from Twins (Monterey) with a value of 0.7 mg/L.
- **First Flush** results: The highest average fluoride result was 1.60 mg/L from Pajaro (Monterey County). Nine sites had non-detects during both time series samples.



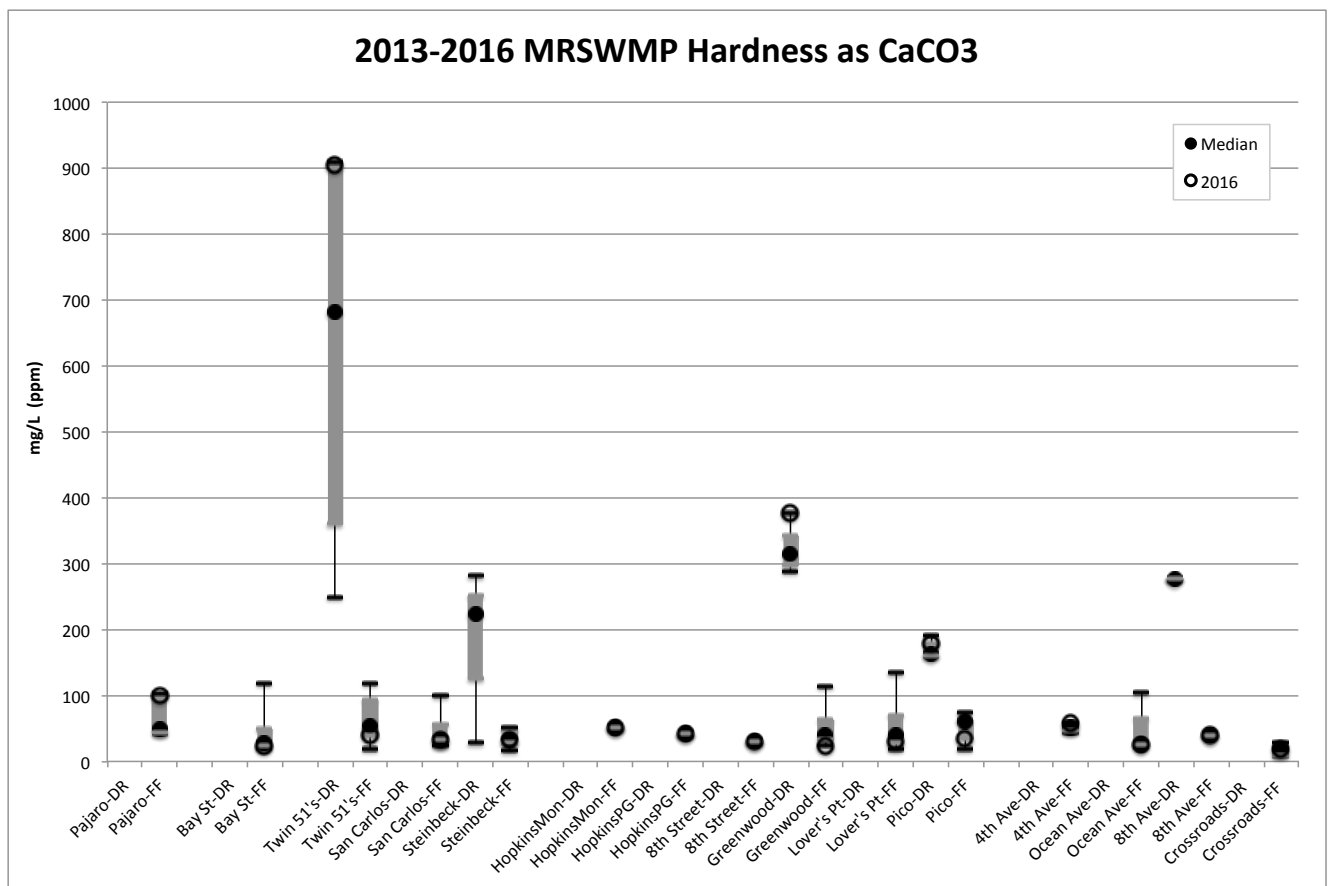
**Figure 8.** 2013- 2016 MRSWMP fluoride results. Non-detects were given the value of half the Minimum Detection Limit (MDL) but their true value lies between the zero and the MDL. Sites are listed north to south.

## Hardness (as CaCO<sub>3</sub>)

Hardness (as CaCO<sub>3</sub>) in conjunction with other analytes, can assist in identifying a discharge of sewage, wash water, tap water or industrial or commercial liquid wastes. Additionally, when hardness increases the amount of dissolved metals biologically available to aquatic and marine life decreases, resulting in a decrease in the toxicity of the metal.

The SWRCB NPDES MS4 General Permit Action Level for hardness is not less than or equal to 10 mg/L or greater than or equal to 2,000 mg/L; the MDL for hardness (as CaCO<sub>3</sub>) was 10 mg/L for both the Dry Run and First Flush. Figure 9 represents all MRSWMP hardness data since 2013, for both dry weather (DR) and wet weather (FF) and is inclusive of past MRSWMP monitoring events including Dry Runs, First Flushes, Spring Runs, Summer Runs and Second Flushes. All 2016 results are listed in Appendix 2.

- **Dry Run and First Flush results:** All sites were within the acceptable range.



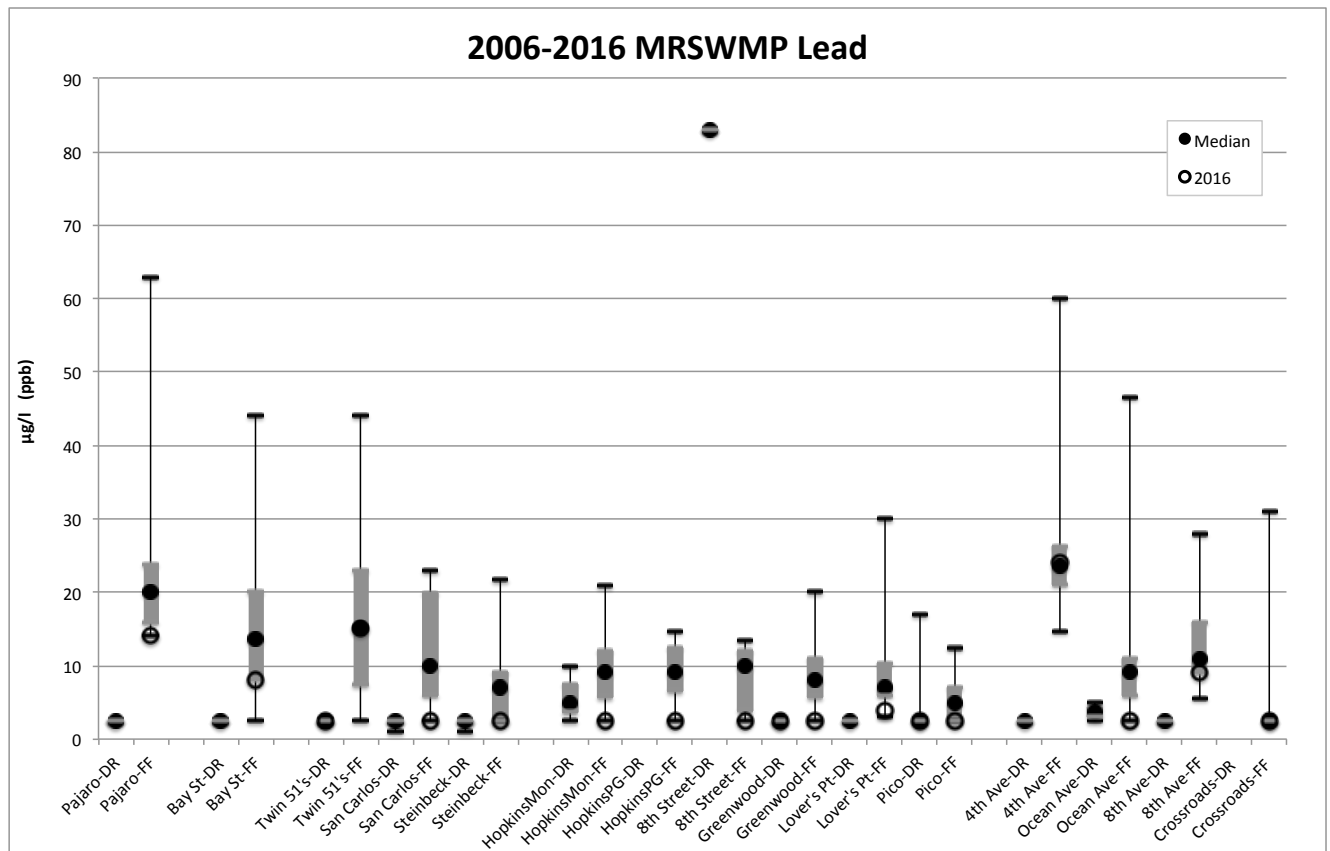
**Figure 9.** 2013 - 2016 MRSWMP hardness (as CaCO<sub>3</sub>) results. Non-detects were given the value of half the Minimum Detection Limit (MDL) but their true value lies between the zero and the MDL. Sites are listed north to south.

## Lead

Lead is toxic to marine organisms causing reduced reproduction, developmental deformities, reduced photosynthesis and mortality. Lead and other heavy metal toxicity can be mitigated by the presence of sediment or other binding compounds that may reduce the metals bioavailability. Lead is present in some types of paint, water distribution systems, and auto emissions. It can be passed through the food web through uptake by plants that are grown in lead contaminated soils.

The Basin Plan WQO established for total lead is 30  $\mu\text{g/l}$ ; the MDL for lead was 5  $\mu\text{g/L}$  for both the Dry Run and First Flush. Figure 10 represents all MRSWMP lead data since 2006, for both dry weather (DR) and wet weather (FF) and is inclusive of past MRSWMP monitoring events including Dry Runs, First Flushes, Spring Runs, Summer Runs and Second Flushes. All 2016 results are listed in Appendix 2.

- **Dry Run** results: Lead results for all sites were non-detect.
- **First Flush** results: None of the monitored sites was above the WQO. Nine sites had non-detects: San Carlos (Monterey), Steinbeck (Monterey), HopkinsMon (Pacific Grove), HopkinsPG (Pacific Grove), Greenwood Park (Pacific Grove), 8<sup>th</sup> Street (Pacific Grove), Pico (Pacific Grove), Ocean Avenue (Carmel), Crossroads (Monterey County).



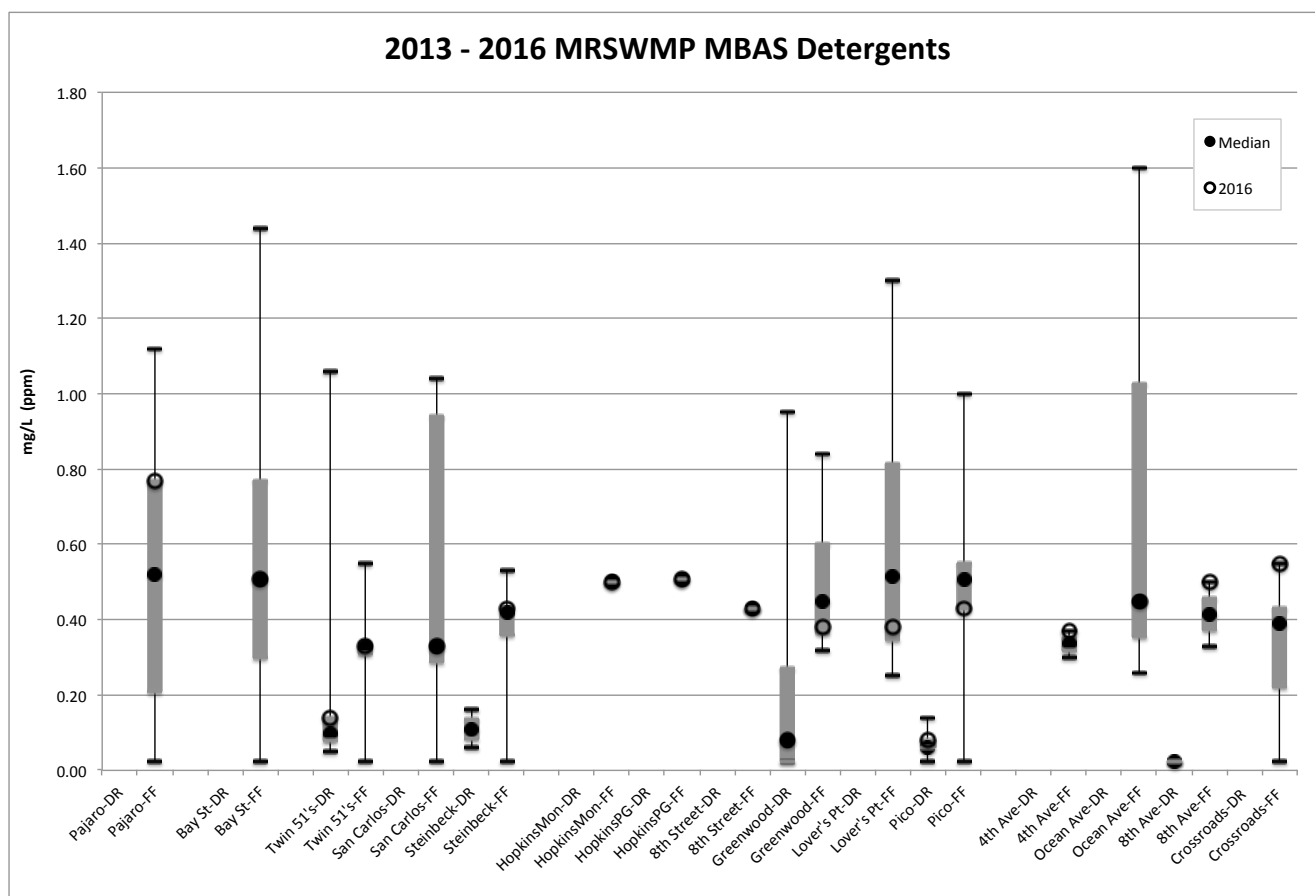
**Figure 10.** 2006-2016 MRSWMP lead results. Non-detects were given the value of half the Minimum Detection Limit (MDL) but their true value lies between the zero and the MDL. Sites are listed north to south.

## MBAS Detergents

MBAS detergents in sample water can determine if a discharge is from sewage or wash water, and in conjunction with other analytes, can assist in identifying a discharge of industrial or commercial liquid wastes.

The Basin Plan's WQO established for MBAS detergents is 0.2 mg/L; the MDL for MBAS detergents was 0.05 mg/L for the Dry Run and First Flush. Figure 11 represents all MRSWMP MBAS detergent data since 2013, for both dry weather (DR) and wet weather (FF) and is inclusive of past MRSWMP monitoring events including Dry Runs, First Flushes, Spring Runs, Summer Runs and Second Flushes. All 2016 results are listed in Appendix 2.

- **Dry Run** results: MBAS concentrations were all below the WQO.
- **First Flush** results: All of the sites monitored (100%) were above the WQO. The highest average result was from Pajaro (Monterey County) with a concentration of 0.77 mg/L.



**Figure 11.** 2013 - 2016 MRSWMP MBAS detergent results. Non-detects were given the value of half the Minimum Detection Limit (MDL) but their true value lies between the zero and the MDL. Sites are listed north to south.

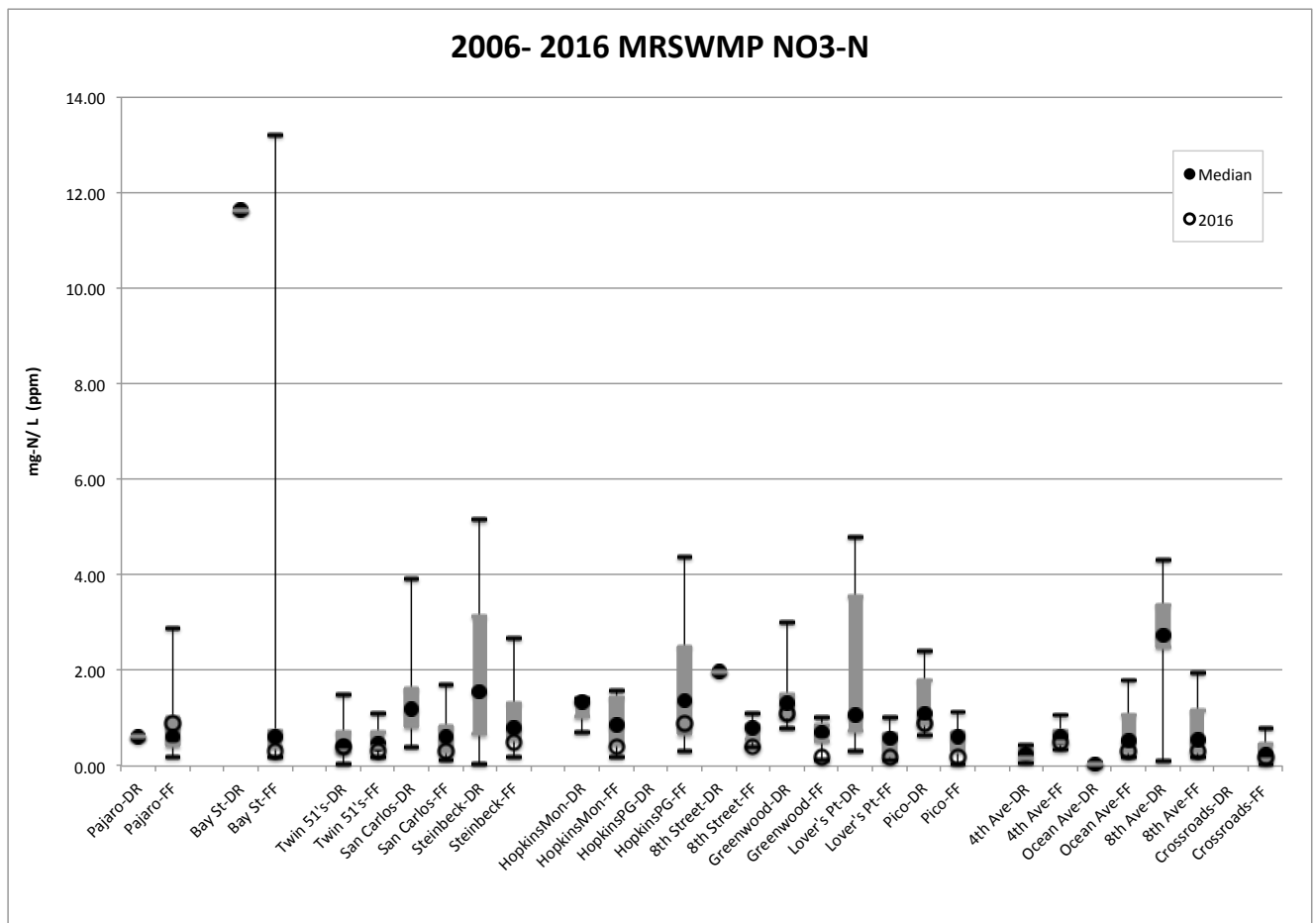


## Nitrate as N

Nitrogen is an element needed for plant growth. Primary sources of nitrate include runoff from fertilized lawns, agricultural and pasture lands, construction sites and septic or sewer system leachate. Nitrate in runoff can lead to excessive nitrate in groundwater or increased growth of algal blooms that degrade water quality as those plants die off and consume oxygen in their decomposition.

The CCAMP Action Level for nitrate as N ( $\text{NO}_3\text{-N}$ ) is 2.25 mg-N/L. The MDL for the Dry Run was 0.1 mg-N/L for Pico (Pacific Grove) and Greenwood Park (Pacific Grove) and 0.4 mg-N/L for Twins (Monterey); the MDL for the First Flush was 0.1 mg-N/L. Figure 12 represents all MRSWMP nitrate as N data since 2006, for both dry weather (DR) and wet weather (FF) and is inclusive of past MRSWMP monitoring events including Dry Runs, First Flushes, Spring Runs, Summer Runs and Second Flushes. All 2016 results are listed in Appendix 2.

- **Dry Run and First Flush** results for all sites were below the Action Level.



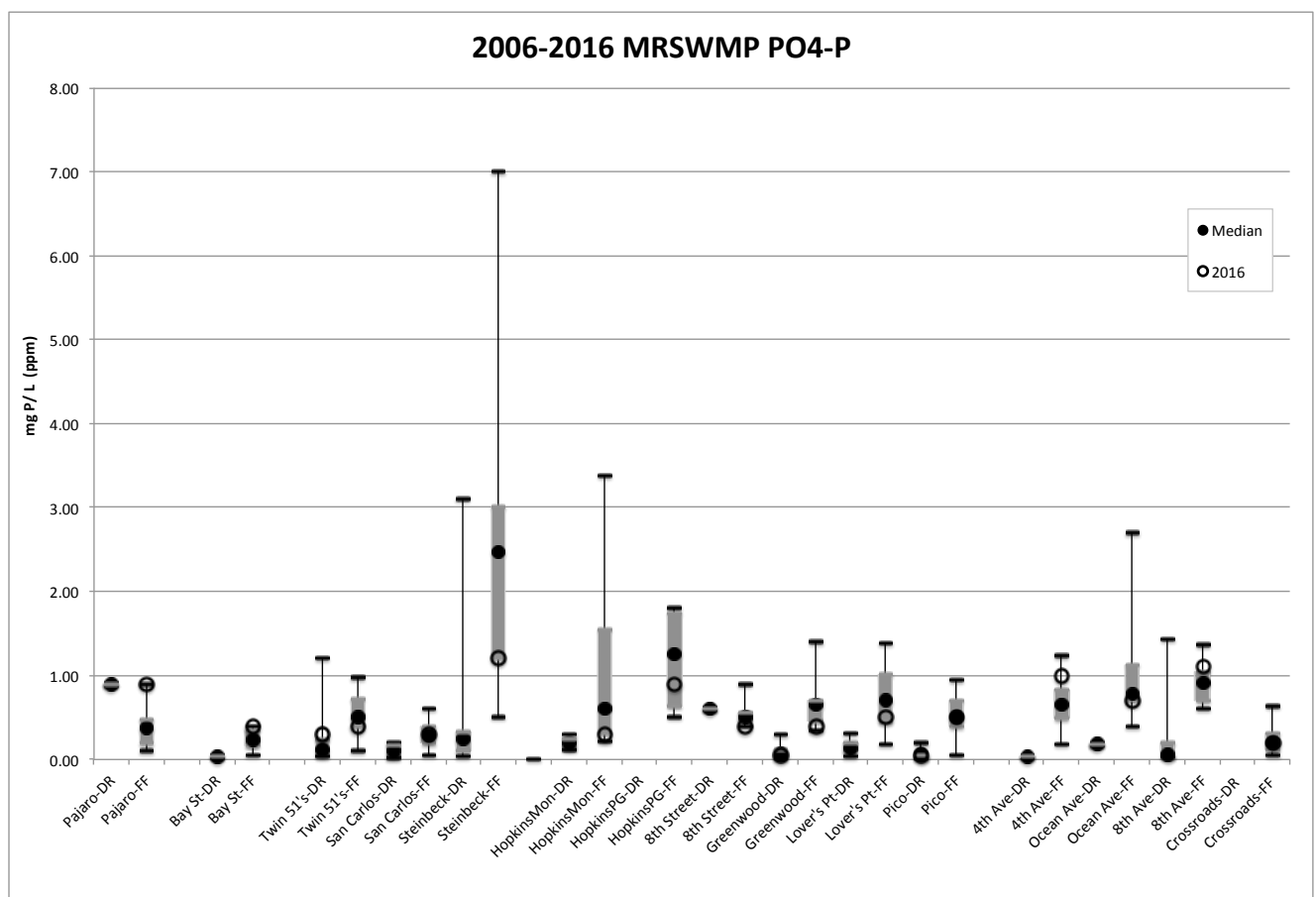
**Figure 12.** 2006-2016 MRSWMP nitrate as N ( $\text{NO}_3\text{-N}$ ) results. Non-detects were given the value of half the Minimum Detection Limit (MDL) but their true value lies between the zero and the MDL. Sites are listed north to south.

## Orthophosphate as P

Phosphorus is an essential element for plant growth. Orthophosphate is a form of phosphorus commonly found bound to soil particles, in sewage, fertilizers, and in detergents that contain phosphates. In aquatic systems, orthophosphate is rapidly taken up by algae and aquatic plants. With excessive amounts present, large algal blooms can occur which can lead to degraded water quality conditions toxic to aquatic life.

The CCAMP Action Level for orthophosphate as P ( $\text{PO}_4\text{-P}$ ) is 0.12 mg-P/L; the MDL was 0.1 mg-P/L for both the Dry Run and First Flush MDL. Figure 13 represents all MRSWMP orthophosphate as P data since 2006, for both dry weather (DR) and wet weather (FF) and is inclusive of past MRSWMP monitoring events including Dry Runs, First Flushes, Spring Runs, Summer Runs and Second Flushes. All 2016 results are listed in Appendix 2.

- **Dry Run** results: Only one of the sites monitored had results above the WQO: Twins (Monterey) with a result of 0.3 mg-P/L.
- **First Flush** results: All of the sampled sites were above the Action Level. The highest average result was from Steinbeck (Monterey) with a value of 1.2 mg-P/L.



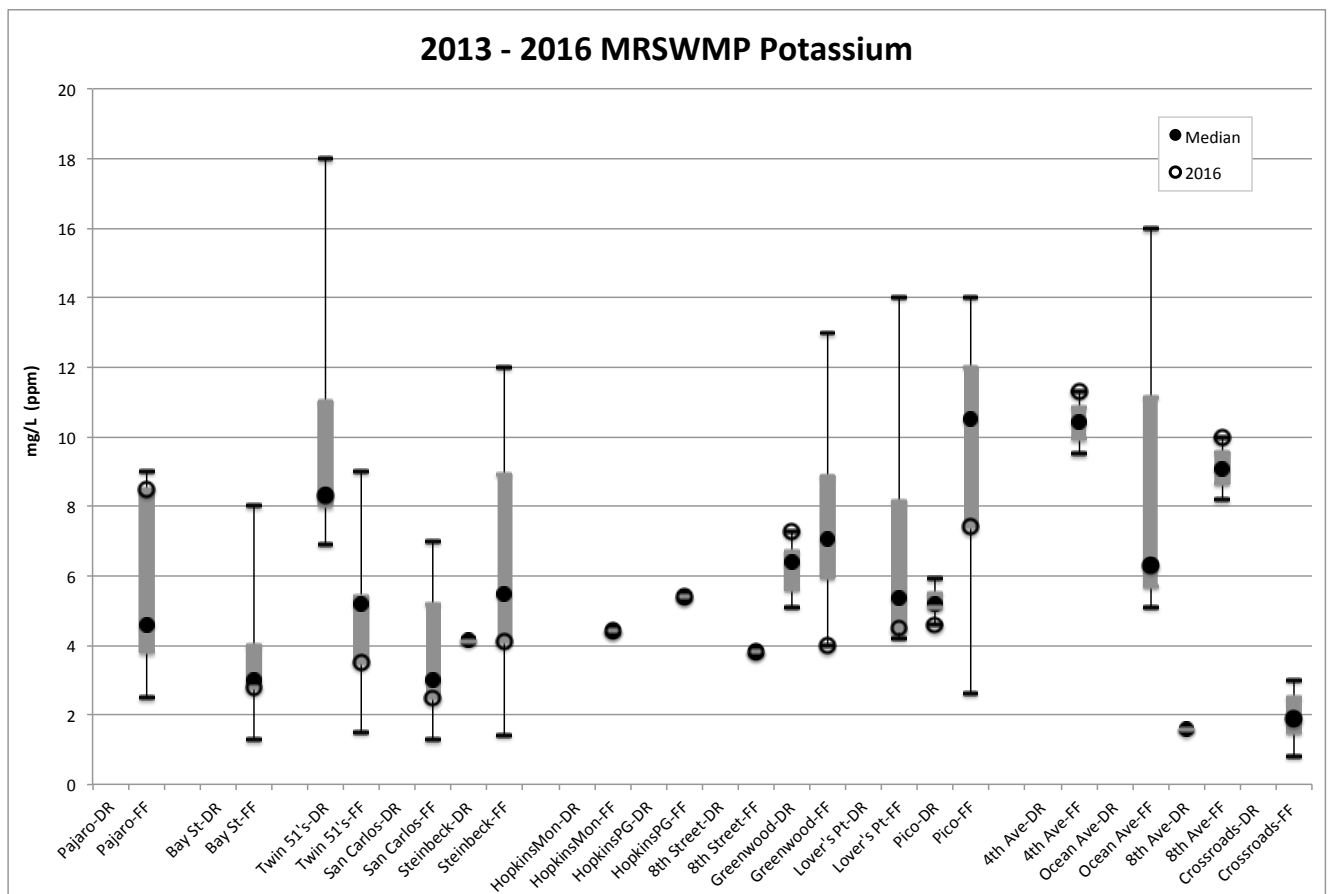
**Figure 13.** 2006-2016 MRSWMP orthophosphate as P ( $\text{PO}_4\text{-P}$ ) results. Non-detects were given the value of half the Minimum Detection Limit (MDL) but their true value lies between the zero and the MDL. Sites are listed north to south.

## Potassium

Potassium, in conjunction with other analytes, can assist in identifying a discharge of sewage, industrial or commercial liquid wastes.

The SWRCB NPDES MS4 General Permit Action Level for potassium is 20 mg/L; the MDL was 0.5 mg/L for both the Dry Run and First Flush. Figure 14 represents all MRSWMP potassium data since 2013, for both dry weather (DR) and wet weather (FF) and is inclusive of past MRSWMP monitoring events including Dry Runs, First Flushes, Spring Runs, Summer Runs and Second Flushes. All results are listed in Appendix 2.

- **Dry Run and First Flush** results for all sites were below the Action Level.



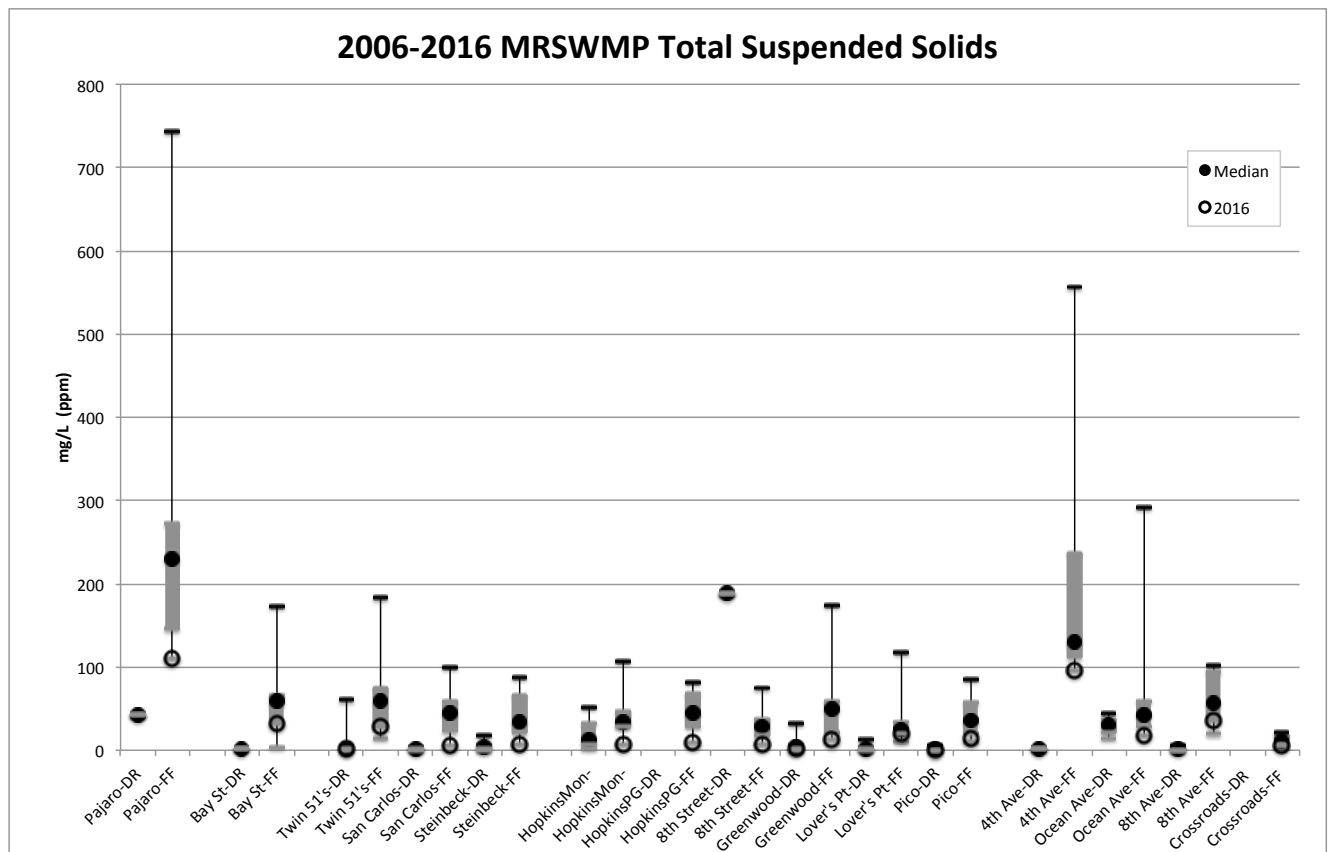
**Figure 14.** 2013 - 2016 MRSWMP potassium results. Non-detects were given the value of half the Minimum Detection Limit (MDL) but their true value lies between the zero and the MDL. Sites are listed north to south.

## Total Suspended Solids

Total suspended solids (TSS) are measured because high amounts of sediment can destroy habitat, suffocate eggs in fresh water systems, limit the food supply, clog gills or impair an organism's vision when feeding.

The CCAMP Action Level for TSS is 500 mg/L; the MDL was 2 mg/L for both the Dry Run and First Flush. Figure 15 represents all MRSWMP TSS data since 2006, for both dry weather (DR) and wet weather (FF) and is inclusive of past MRSWMP monitoring events including Dry Runs, First Flushes, Spring Runs, Summer Runs and Second Flushes. All 2016 results are listed in Appendix 2.

- **Dry Run and First Flush** results for all sites were below the Action Level.



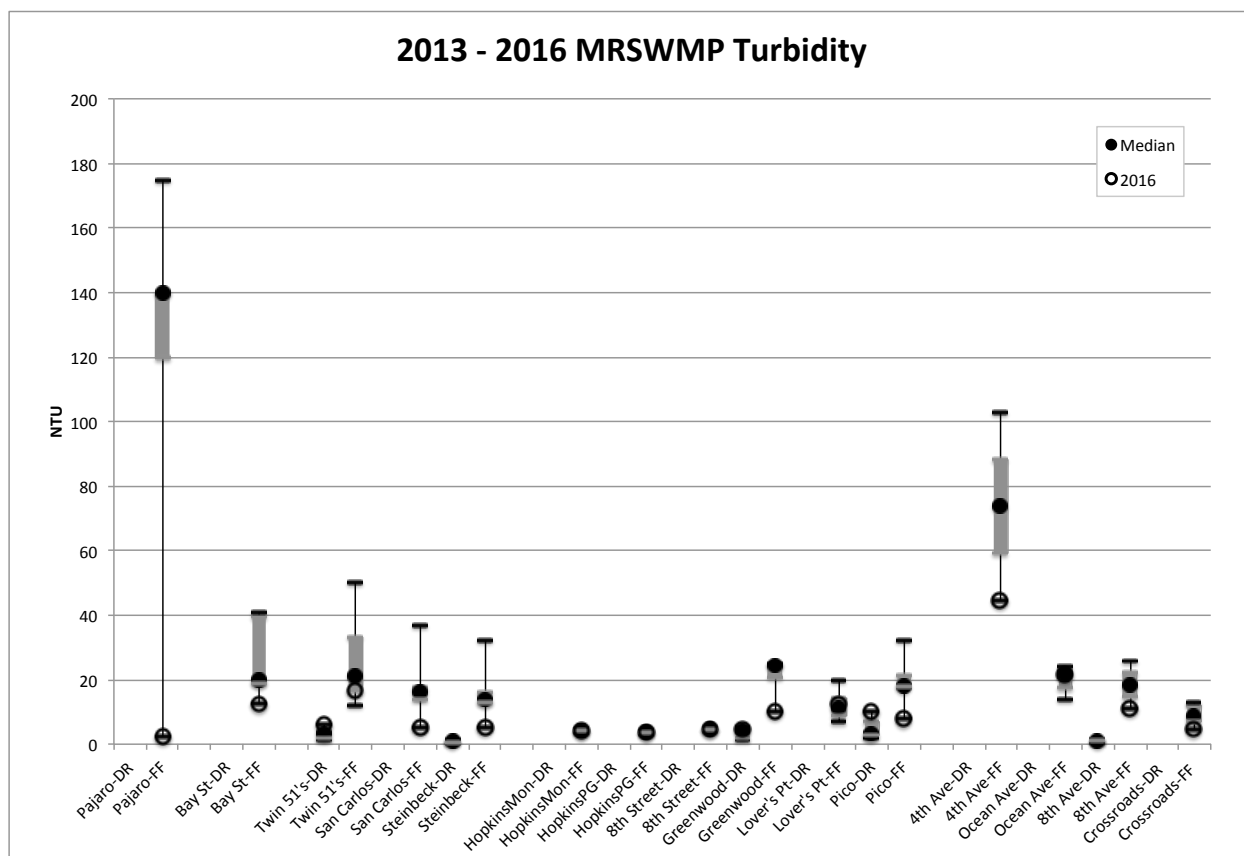
**Figure 15.** 2006-2016 MRSWMP TSS results. A result of 3080 mg/L from San Carlos (Monterey) during the DR in 2007 was removed from the graph to better illustrate all other results. Non-detects were given the value of half the Minimum Detection Limit (MDL) but their true value lies between the zero and the MDL. Sites are listed north to south.

## Turbidity

Turbidity measures the transparency of water while TSS measures the weight of the solids in the water that contribute to less transparency. Both are useful measurements for water clarity but have different methodologies for analysis.

The Action Level for turbidity provided by the State Board in the General Permit is not greater than 1000 NTU. As a comparison CCAMP lists turbidity to be not greater than 25 NTU; the CCAMP Action Level will be used for this set of data as it is more protective of water quality. The MDL for the Dry Run was 0.05 NTU; the MDL for the First Flush was 2.5 NTU for the first samples from 4<sup>th</sup> Avenue (Carmel) and Greenwood Park (Pacific Grove). Pajaro (Monterey County) and Ocean Avenue (Carmel) had an MDL of 2.5 NTU for both samples collected during the First Flush, all other samples had an MDL of 0.1 NTU. Figure 16 represents all MRSWMP turbidity data since 2013, for both dry weather (DR) and wet weather (FF) and is inclusive of past MRSWMP monitoring events including Dry Runs, First Flushes, Spring Runs, Summer Runs and Second Flushes. All 2016 results are listed in Appendix 2.

- **Dry Run** results for all sites were below the Action Level.
- **First Flush** results: One of the monitored sites (7%) was above the Action Level. The highest average result was 45 NTU from 4<sup>th</sup> Avenue (Carmel).

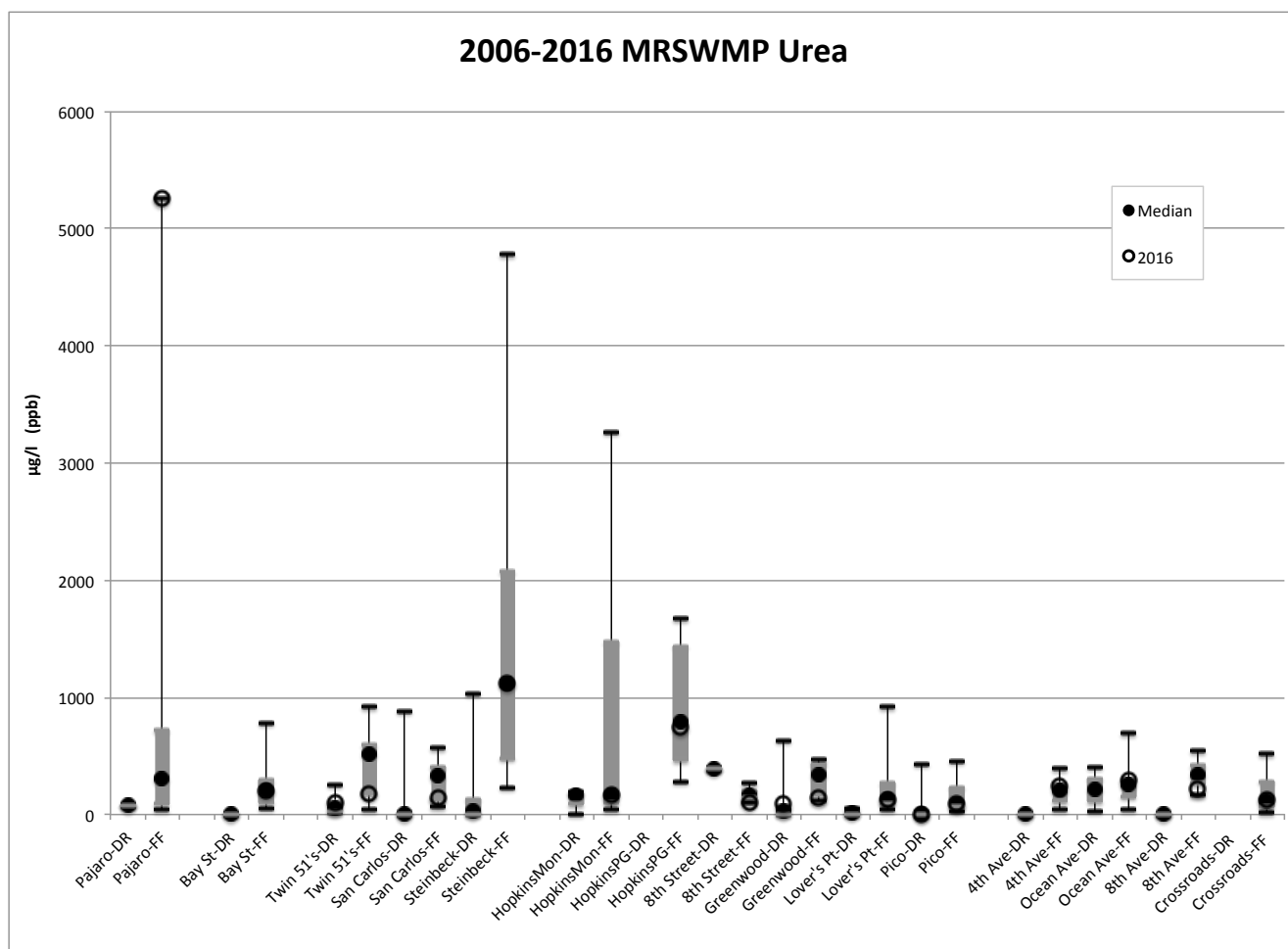


**Figure 16.** 2013- 2016 MRSWMP turbidity results. Non-detects were given the value of half the Minimum Detection Limit (MDL) but their true value lies between the zero and the MDL. Sites are listed north to south.

## Urea

Urea is an organic compound that is often used in agricultural and urban fertilizers. While there is not an established Action Level, urea concentrations are compared between sites. The MDL for urea was 10 µg/L for the Dry Run; the MDL for the First Flush was also 10 µg/L except for Twins (Monterey) which had an MDL of 100 µg/L and Pajaro (Monterey County) with an MDL of 200 µg/L. Figure 17 represents all MRSWMP urea data since 2006, for both dry weather (DR) and wet weather (FF) and is inclusive of past MRSWMP monitoring events including Dry Runs, First Flushes, Spring Runs, Summer Runs and Second Flushes. During the First Flush urea was collected in the first time series only; results shown in Figure 18 are not averaged. All 2016 results are listed in Appendix 2.

- **Dry Run** results: The highest urea result was from Twins (Monterey) with a value of 102 µg/L.
- **First Flush** results: The highest result was from Pajaro (Monterey County) with a value of 5260 µg/L.



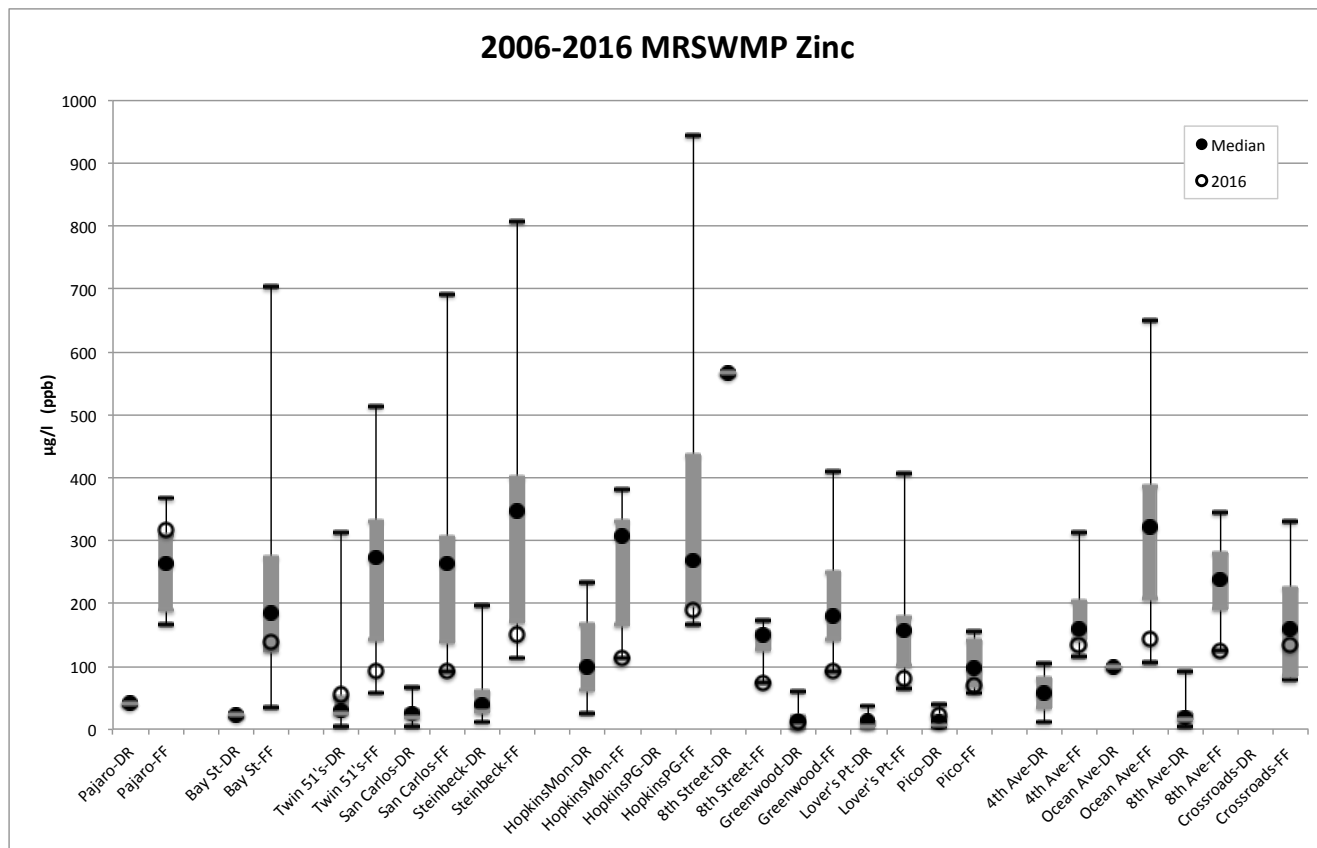
**Figure 17.** 2006–2016 MRSWMP urea results. Non-detects were given the value of half the Minimum Detection Limit (MDL) but their true value lies between the zero and the MDL. Sites are listed north to south.

## Zinc

Zinc is toxic to marine organisms causing reduced reproduction, developmental deformities and mortality. Zinc and other heavy metal toxicity can be mitigated by the presence of sediment or other binding compounds that may reduce the metal's bioavailability. Zinc sources in urban runoff include tires, zinc containing paint and outdoor zinc surfaces such as galvanized surfaces.

The Basin Plan WQO for total zinc is 200 µg/L. The Dry Run MDL for zinc was either 10 or 20 µg/L depending on the site. Figure 18 represents all MRSWMP zinc data since 2006, for both dry weather (DR) and wet weather (FF) and is inclusive of past MRSWMP monitoring events including Dry Runs, First Flushes, Spring Runs, Summer Runs and Second Flushes. All 2016 results are listed in Appendix 2.

- **Dry Run** results for all sites were below the Action Level.
- **First Flush** results: One site was above the WQO with an average result of 317 µg/L at Pajaro (Monterey County). A single time series sample result was above the WQO at HopkinsPG (Pacific Grove) with a result of 209 µg/L but an average of 189 µg/L.



**Figure 18.** 2006-2016 MRSWMP zinc results. Non-detects were given the value of half the Minimum Detection Limit (MDL) but their true value lies between the zero and the MDL. Sites are listed north to south.

## **Results by Jurisdiction**

The following section is broken out by city or county for this permit year.

### **Carmel**

For the 2016-2017 permit year, three sites were monitored in Carmel: 4<sup>th</sup> Avenue, Ocean Avenue and 8<sup>th</sup> Avenue. There was no flow at any of the Carmel sites for the Dry Run.

For the First Flush:

- *E. coli* and enterococcus exceeded the U.S. EPA WQO in all samples at all sites.
- MBAS surfactants exceeded the Basin Plan WQO in all samples at all sites.
- Copper exceeded the Basin Plan WQO in all samples at all sites.
- Lead exceeded the Basin Plan WQO in the first time series samples for 4<sup>th</sup> Avenue.
- Orthophosphate exceeded the CCAMP Action Level in all samples at all sites.
- MBAS Surfactants exceeded the Basin Plan WQO for all samples at all sites.
- Turbidity exceeded the Action Level for both samples at 4<sup>th</sup> Avenue.
- Ammonia, color, hardness, nitrate as N, potassium, total suspended solids and Zinc were all below WQOs and Action Levels for both time series samples at all sites.

All 2016 results can be found in Appendix 2 and by jurisdiction in Appendix 3.

### **Monterey**

For the 2016-2017 permit year, three sites were monitored: Twins, San Carlos and Steinbeck.

For the Dry Run:

- Twins was the only Monterey site that had flowing water.
- *E. coli* result at Twins was above the U.S. EPA WQO with the highest of all results at 141,361 MPN/ 100 ml.
- Enterococcus result at Twins was above the U.S. EPA WQO with the highest of all results at 1,470 MPN/ 100 ml.
- Orthophosphate result at Twins was above the CCAMP Action Level with the highest result of 0.3 mg/L.
- Ammonia, color, copper, hardness, lead, nitrate as N, potassium, total suspended solids, turbidity and zinc did not exceed any WQOs or Action Levels.

During the First Flush:

- *E. coli* exceeded the U.S. EPA WQO in all samples at all Monterey sites. Twins had the highest average time series result of 42,755 MPN/ 100 ml.
- Enterococcus exceeded the U.S. EPA WQO in all samples at all Monterey sites.
- Copper exceeded the Basin Plan WQO in both time series samples at Steinbeck.
- MBAS detergents exceeded the Basin Plan WQO in all samples at all Monterey sites.
- Orthophosphate exceeded the CCAMP Action Level in all samples at all Monterey sites. Steinbeck had the highest average of all site with a result of 1.2 mg-P/L.
- Ammonia, color, copper, hardness, lead, nitrate as N, potassium, total suspended solids, turbidity and zinc were all below WQOs and Action Levels for both time series samples at all sites.

All 2016 results can be found in Appendix 2 and by jurisdiction in Appendix 3.



## **Monterey County**

For the 2016-2017 permit year, two sites were monitored: Pajaro and Crossroads. There was no flow at either site during the Dry Run monitoring event.

During the First Flush:

- *E. coli* exceeded the U.S. EPA WQO in all samples at both Monterey County sites.
- Enterococcus exceeded the U.S. EPA WQO in all samples at both Monterey County sites. Pajaro had the highest single sample of all sites monitored with a result of 36,540 MPN/ 100 ml and the highest average of all sites monitored with a result of 25,545 MPN/ 100 ml..
- Copper exceeded the RWQCB Basin Plan WQO in both samples at Pajaro.
- MBAS surfactants exceeded the RWQCB Basin Plan WQO in all samples at both Monterey County sites. Pajaro had the highest results in the two time series samples of all sites monitored with results of 0.74 mg/L and 0.80 mg/L.
- Orthophosphate exceeded the CCAMP Action Level in all samples at both Monterey County sites.
- Pajaro had the highest result for urea of 5260 µg/L.
- Zinc exceeded the RWQCB Basin Plan WQO for all samples at Pajaro. In fact, Pajaro was the only site to exceed the RWQCB Basin Plan WQO with both time series above the WQO.
- Ammonia, color, hardness, lead, nitrate as N, potassium, total suspended solids and turbidity results did not exceed WQOs or Action Levels for any samples during the First Flush.

All 2016 results can be found in Appendix 2 and by jurisdiction in Appendix 3.

## **Pacific Grove**

For 2016-2017 permit year six sites were monitored: HopkinsMon, HopkinsPG, 8<sup>th</sup> Street, Greenwood Park Lovers and Pico. Hopkins Mon, Hopkins PG, 8<sup>th</sup> Street, Greenwood Park and Lovers are upstream of a dry weather diversion that diverts dry weather urban runoff to the Monterey Regional Water Pollution Control Agency for treatment, usually April through October. Even though Greenwood Park water is diverted during dry weather, we continue to sample it because it flows into an urban park and is indicative of what dry weather flows are not entering the ocean. Due to the operation of the dry weather diversion, only two of the three Pacific Grove sites had flowing water for the Dry Run: Greenwood Park and Pico.

For the Dry Run:

- *E. coli* was above the U.S. EPA WQO while enterococcus was below the WQO at Greenwood Park.
- *E. coli* was below the U.S. EPA WQO while enterococcus was over the WQO at Pico.
- Orthophosphate was not detected at either Greenwood Park and Pico.

During the First Flush:

- *E. coli* was over the U.S. EPA WQO in all samples at all sites.
- Enterococcus was over the U.S. EPA WQO in all samples at all sites.
- Copper exceeded the RWQCB Basin Plan WQO at HopkinsMon during the first time series, at HopkinsPG and Pico during the second time series.
- Orthophosphate exceeded the CCAMP Action Level in all samples at all sites.

- Zinc exceeded the RWQCB Basin Plan WQO at HopkinsPG during the second time series.
- Ammonia, color, hardness, lead, nitrate as N, potassium, total suspended solids and turbidity were all below WQOs and Action Levels for both time series samples at all sites.

All 2016 results can be found in Appendix 2 and by jurisdiction in Appendix 3.

### **Seaside**

For the 2016-2017 permit year, Bay Street was the only Seaside site monitored and had no flow for the Dry Run monitoring event.

During the First Flush:

- *E. coli* and enterococcus exceeded the U.S. EPA WQO for all samples.
- Copper exceeded the RWQCB Basin Plan WQO during the first time series sample.
- MBAS surfactants exceeded the RWQCB Basin Plan WQO for all samples.
- Orthophosphate exceeded the CCAMP Action Level for all samples.
- Ammonia, color, hardness, lead, nitrate as N, potassium, total suspended solids, turbidity and zinc results did not exceed any WQOs or Action Levels for any samples.

All 2016 results can be found in Appendix 2 and by jurisdiction in Appendix 3.

## Conclusion

Since 2006, the MRSWMP program has utilized the MBNMS' Dry Run and First Flush programs to ascertain what concentrations of pollutants are found in both dry and wet weather flows through storm drains discharging into the ocean. The sites monitored as part of the MRSWMP program are sites that can provide a good representation of water quality throughout a jurisdiction and in some cases have been monitored for many years. For 2016- 2017 permit year, fifteen sites were monitored for Dry Run and the First Flush in six jurisdictions: Monterey County, Seaside/Sand City, Monterey, Pacific Grove and Carmel.

In past years, approximately half of the MRSWMP sites did not flow during the dry weather months. This year, three (20%) of the storm drains had flow for the Dry Run: Twins (Monterey), Greenwood Park (Pacific Grove) and Pico (Pacific Grove). Dry weather data is an indicator of the effectiveness of storm water programs and allows an opportunity for additional tracking for potential sources of contamination in the discharges. It is our recommendation that all jurisdictions utilize dry weather results to determine potential pollutant sources.

First Flush average results from all sites exceeded the U.S. EPA WQO's for *E. coli* and enterococcus, however they were lower in concentration than in previous years. Additionally, average results from all sites exceeded the RWQCB Basin Plan Action Level for MBAS detergents during the First Flush. While wet weather samples do indicate the worst-case scenario of high pollutant concentrations discharging into the ocean after months of accumulating on the land, it is important to identify how sub-watersheds compare to each other and if they should be prioritized for follow up investigation. For example, due to the overall exceedances of MBAS detergents at all sites during the First Flush, a regional approach might address this issue through best practices, education and source tracking. Copper continues to exceed the Basin Plan WQO during wet weather events. Copper is extremely toxic to marine organisms, addressing how to prevent copper from entering the storm drain system or receiving water might best address this issue.

The First Flush event provides an understanding of the types of pollutants flowing into Monterey Bay National Marine Sanctuary after months of dry weather during which contaminants build up on streets, roofs and parking lots. The results are valuable for a better understanding of potential impacts to the marine environment, however they do not always easily correlate to management activities. By coupling First Flush with the Dry Run and source tracking within each watershed, a better understanding of each watershed's specific characteristics and problem areas can be achieved, providing needed information for decision making and effective storm water programs.

**Appendix 1: MRSWMP Monitoring sites- listed from north to south**

Jurisdiction	Site ID	Site Name	Drainage Area (acres)	Primary Land Use	MRSWMP Outfall #	Pipe ID (Inches)
Monterey County	PASD-01	Pajaro	30	70% residential 30% commercial	MC-1	
Seaside	SSD-02	Bay Street	1200	80% residential 10% commercial 10% public/ other	SC-1	90
Monterey	MSD-03	Twin 51's	291	63% residential 15% commercial 22% public/ other	M-15	51" (x2)
Monterey	MSD-04	San Carlos	22	12% commercial 38% residential 50% public/ other	M-7	24"
Monterey	MSD-05	Steinbeck	37	66% commercial 12% residential 22% public/ other	M-3	36"
Pacific Grove	PGSD-09	HopkinsMon	40.7	45% residential 30% commercial 25% public /other	PG-41	
Pacific Grove	PGSD-08	HopkinsPG			PG-40	
Pacific Grove	PGSD-01	8 <sup>th</sup> Street	35	100% residential	PG-32	
Pacific Grove	CENTR-31	Greenwood Park	238.3	71% residential 25% public/ other 5% commercial	PG-28	36"
Pacific Grove	PGSD-03	Lover's Point	240	54% residential 1% commercial 20% other	PG-22	54"
Pacific Grove	PGSD-04	Pico	17.56	60% residential 40% public	PG-03	40"
Carmel	CASD-01	4 <sup>th</sup> Avenue	128.0	86% residential 7% comm/ res 7% public/ other	C-1	36"x60" box culvert
Carmel	CASD-02	Ocean Avenue	115.2	22% commercial 71% residential 7% comm/ res	C-2	24"
Carmel	CAS-03	8 <sup>th</sup> Avenue	44.8	58% residential 27% comm/ res 13% commercial 1% public/ other	C-3	24"
Monterey County	CVSD-01	Crossroads	21	100% commercial		

**Appendix 2: Results by Analyte (listed alphabetically)**

## Ammonia as N

Comparison of ammonia results for MRSWMP monitoring and reported in mg/L. Shaded boxes indicate that the General Permit Action Level of 50 mg/L was exceeded; NA= Not Analyzed; ND= Non-detect; NF= No Flow; NS= Not Sampled; -- = Not included in MRSWMP monitoring for this analyte.

Site Name	DR 2013	FF 2013	SF 2014	SuR 2014	DR 2014	FF 2014	DR 2015	FF 2015	DR 2016	FF 2016
Pajaro	NF	NA	0.23	NF	NF	0.44	NF	0.31	NF	2.90
Bay St	NF	NA	0.13	NF	NF	0.37	NF	0.53	NF	0.39
Twin 51's	NA	NA	0.10	0.06	0.07	0.72	0.34	0.69	0.44	0.32
San Carlos	NF	NA	0.14	NF	NF	0.86	NF	0.35	NF	0.26
Steinbeck	NF	NA	0.61	0.08	0.09	10.46	NF	3.79	NF	2.76
HopkinsMon	--	--	--	--	--	--	--	--	NF	0.33
HopkinsPG	--	--	--	--	--	--	--	--	NF	1.66
8 <sup>th</sup> Street	--	--	--	--	--	--	--	--	NF	0.32
Greenwood	NA	NA	NS	0.11	0.21	1.57	ND	0.78	0.26	0.36
Lover's	NF	NA	NS	NF	NF	1.18	NF	0.49	NF	0.33
Pico	NA	NA	0.11	ND	ND	0.94	ND	0.68	ND	0.29
4 <sup>th</sup> Avenue	NF	NS	NS	NF	--	--	NF	0.53	NF	0.84
Ocean	NF	NA	NS	NF	--	--	NF	0.59	NF	0.73
8 <sup>th</sup> Avenue	NA	NS	NS	NF	--	--	NF	0.73	NF	0.84
Crossroads	NF	NA	0.12	NF	NF	0.46	NF	0.18	NF	0.18

## Color

Comparison of color results for MRSWMP monitoring, reported in Color Units. Shaded boxes indicate that the General Permit action level of 500 color units was exceeded. ND= Non-detect; NF= No Flow; NS= Not Sampled; -- = Not included in MRSWMP monitoring of this analyte.

Site Name	DR 2013	FF 2013	SF 2014	SuR 2014	DR 2014	FF 2014	DR 2015	FF 2015	DR 2016	FF 2016
Pajaro	NF	625	500	NF	NF	300	NF	400	NF	255
Bay St	NF	250	70	NF	NF	305	NF	65	NF	60
Twin 51's	24	225	50	30	25	185	30	85	24	40
San Carlos	NF	225	70	NF	NF	315	NF	50	NF	44
Steinbeck	NF	225	70	33	22	340	NF	63	NF	75
HopkinsMon	--	--	--	--	--	--	--	--	NF	80
HopkinsPG	--	--	--	--	--	--	--	--	NF	80
8 <sup>th</sup> Street	--	--	--	--	--	--	--	--	NF	50
Greenwood	60	250	NS	20	20	315	25	100	30	60
Lover's	NF	300	NS	NF	NF	250	NF	75	NF	42
Pico	44	250	167	40	30	225	50	175	60	70
4 <sup>th</sup> Avenue	NF	NS	NS	NF	--	--	NF	400	NF	213
Ocean	NF	300	NS	NF	--	--	NF	73	NF	80
8 <sup>th</sup> Avenue	7	NS	NS	NF	--	--	NF	100	NF	100
Crossroads	NF	75	70	NF	NF	100	NF	20	NF	40

## Copper

Comparison of total copper results for MRSWMP monitoring reported in µg/L. Shaded boxes indicate that the Basin Plan Objective of 30 µg/L was exceeded; ND= Non-detect; NF= No Flow; NS= Not Sampled; -- = Not included in MRSWMP monitoring. The table is broken into two sections to facilitate printing.

Site Name	DR 2006	FF 2006	DR 2007	FF 2007	DR 2008	FF 2008	DR 2009	FF 2009	SpR 2010	SuR 2010	DR 2010	FF 2010	SpR 2011	SuR 2011	DR 2011	FF 2011	SpR 2012	SuR 2012
Pajaro	--	--	--	--	NF	93	9	44	NF	NF	NF	73	NF	NF	NF	28	NF	NF
Bay St	NF	ND	NF	50	NF	42	NF	126	NF	NF	NF	65	4	NF	NF	52	NF	NF
Twin 51's	ND	92	5	60	7	69	11	78	6	20	12	99	11	5	9	52	8	16
San Carlos	ND	139	11	73	18	84	16	77	7	10	26	124	8	4	8	65	13	14
Steinbeck	ND	125	17	83	185	126	6	148	10	12	15	352	18	8	9	77	20	31
HopkinsMon	NF	89	NF	57	54	49	86	79	25	24	18	72	16	9	NF	27	NS	22
HopkinsPG	--	--	NF	47	NF	63	NF	77	NF	NF	NF	176	NF	NF	NF	35	NS	NF
8 <sup>th</sup> Street	NF	49	NF	55	NF	49	NF	59	NF	NF	134	64	13	17	NF	NF	11	NF
Greenwood	ND	41	3	46	17	44	6	44	25	9	5	56	13	17	10	38	12	8
Lover's	NF	57	ND	48	4	51	ND	54	7	5	5	14	10	4	NF	40	9	NF
Pico	ND	33	ND	44	12	37	5	45	9	11	7	62	10	ND	6	43	11	10
4 <sup>th</sup> Avenue	--	--	NF	152	NF	53	NF	183	NF	NF	NF	101	10	NF	11	96	NF	NF
Ocean	--	--	NF	212	NF	148	NF	184	NF	69	NF	395	NF	NF	NF	165	NF	72
8 <sup>th</sup> Avenue	--	--	14	148	6	170	ND	166	5	7	5	172	8	4	6	114	21	7
Crossroads	--	--	--	--	--	--	NF	44	NF	NF	NF	55	NF	NF	NF	11	NF	NF



## Copper continued

Site Name	DR 2012	FF 2012	SF 2013	SuR 2013	DR 2013	FF 2013	SF 2014	SuR 2014	DR 2014	FF 2014	DR 2015	FF 2015	DR 2016	FF 2016
Pajaro	NF	44	32	NF	NF	51	42	NF	NF	32	NF	27	NF	62
Bay St	NF	28	48	NF	NF	88	21	NF	NF	106	NF	26	NF	28
Twin 51's	10	46	16	13	16	75	ND	ND	11	76	27	27	13	22
San Carlos	NF	--	--	12	NF	86	24	NF	NF	121	NF	25	NF	21
Steinbeck	6	147	37	12	NF	113	21	ND	4	248	NF	39	NF	52
HopkinsMon	NS	NS	NS	25	--	--	--	--	--	--	--	--	NF	27
HopkinsPG	NS	NS	NS	NF	--	--	--	--	--	--	--	--	NF	32
8 <sup>th</sup> Street	NF	NS	NS	NF	--	--	--	--	--	--	--	--	NF	26
Greenwood	ND	24	NS	ND	6	52	NS	ND	ND	58	8	22	4	16
Lover's	NF	36	NS	NF	NF	92	NS	NF	NF	68	NF	24	NF	19
Pico	ND	28	26	7	6	75	28	ND	ND	61	ND	30	5	29
4 <sup>th</sup> Avenue	NF	86	NS	NF	NF	NS	NS	NF	--	--	NF	73	NF	86
Ocean	NF	87	NS	NF	NF	248	NS	NF	--	--	NF	58	NF	95
8 <sup>th</sup> Avenue	NF	NS	NS	14	6	NS	NS	NF	--	--	NF	86	NF	108
Crossroads	NF	40	7	NF	NF	18	ND	NF	NF	35	NF	10	NF	17

## *E. coli*

Comparison of *E. coli* results for MRSWMP monitoring reported in MPN/ 100 ml. Shaded boxes indicate that the EPA Water Quality Objective of 235 MPN/ 100 ml was exceeded; NA= Not Analyzed; ND= Non-detect; NF= No Flow; NS= Not Sampled; -- = Not included in MRSWMP monitoring. The table is broken into two sections to facilitate printing.

Site Name	DR 2006	FF 2006	DR 2007	FF 2007	DR 2008	FF 2008	DR 2009	FF 2009	SpR 2010	SuR 2010	DR 2010	FF 2010	SpR 2011	SuR 2011	DR 2011	FF 2011	SpR 2012	SuR 2012
Pajaro	--	--	--	--	NF	15186	40	4681	NF	NF	NF	2050	NF	NF	NF	16075	NF	NF
Bay St	NF	856	NF	46464	NF	20277	NF	34162	NF	NF	NF	64900	672	NF	NF	44059	NF	NF
Twin 51's	50	185536	25993	165301	6150	83819	296	229170	12263	48384	13340	61300	19608	6152	7746	65081	17329	2289
San Carlos	798	14749	218	16304	40	17484	8212	8770	149	244	13734	40400	20	40	20	41525	20	20
Steinbeck	2602	158848	9768	40925	48400	112738	4494	90824	220	398	1974	145400	126	194	6511	241960	218	653
HopkinsMon	NF	196179	NF	82782	312	3741	48392	19735	3912	20	104	29650	3912	20	NF	39726	NS	169
HopkinsPG	--	--	NF	27742	NF	27742	NF	25994	NF	NF	NF	40300	NF	NF	NF	207625	NS	NF
8 <sup>th</sup> Street	--	50978	NF	14636	NF	26485	NF	77979	6511	4283	39726	20976	456	NF	NF	NF	456	NF
Greenwood	20529	73322	11588	16767	13000	31528	1976	44059	2966	8212	1814	32700	10950	12976	6896	116644	1253	6511
Lover's	NF	172534	48384	60214	1390	24916	170	34659	3870	82	82	3807	220	6152	NF	48391	5510	NF
Pico	606	43926	5818	155639	3840	204626	104	17063	148	40	410	15050	61	80	2802	32860	40	20
4 <sup>th</sup> Avenue	--	--	NF	49590	NF	11413	NF	73916	NF	NF	NF	22400	126	NF	<20	105013	NF	NF
Ocean	--	--	NF	43374	NF	9214	NF	34658	NF	10950	NF	9950	NF	NF	NF	41525	NF	1918
8 <sup>th</sup> Avenue	--	--	82	59067	126	36119	80	NA	20	20	520	38450	20	104	12263	167021	20	<20
Crossroads	--	--	--	--	--	--	NF	NA	NF	NF	NF	25950	NF	NF	NF	44059	NF	NF

*E. coli* continued

Site Name	DR 2012	FF 2012	SF 2013	SuR 2013	DR 2013	FF 2013	SF 2014	SuR 2014	DR 2014	FF 2014	DR 2015	FF 2015	DR 2016	FF 2016
Pajaro	NF	8766	618	NF	NF	3163	860	NF	NF	7617	NF	4693	NF	20660
Bay St	NF	43518	241960	NF	NF	148335	6488	NF	NF	94500	NF	38969	NF	21026
Twin 51's	296	72294	4962	2878	4978	67265	9208	3106	6152	60200	198629	53713	141361	42755
San Carlos	NF	NS	NS	5206	NF	3475	4106	NF	NF	138000	NF	13973	NF	8044
Steinbeck	2500	130847	241960	34658	NF	88662	21870	196	3836	65300	NF	25024	NF	27860
HopkinsMon	NS	NS	NS	3316	--	--	--	--	--	--	--	--	NF	12246
HopkinsPG	NS	NS	NS	NF	--	--	--	--	--	--	--	--	NF	36606
8 <sup>th</sup> Street	NF	NS	NS	NF	--	--	--	--	--	--	--	--	NF	12885
Greenwood	31062	35076	NS	1980	39726	19585	NS	5510	6152	36590	28272	41922	1153	19105
Lover's	NF	42288	NS	NF	NF	30745	NS	NF	NF	60200	NF	28761	NF	14634
Pico	1720	37769	3214	40	244	58030	4884	2092	402	42603	<20	25572	30	35076
4 <sup>th</sup> Avenue	NF	45645	NS	NF	NF	NS	NS	NF	--	--	NF	46181	NF	38799
Ocean	NF	28322	NS	NF	NF	16250	NS	NF	--	--	NF	32817	NF	23084
8 <sup>th</sup> Avenue	NF	NS	NS	82	<20	NS	NS	NF	--	--	NF	43788	NF	15252
Crossroads	NF	76395	296	NF	NF	1095	703	NF	NF	94500	NF	14265	NF	2020

## Enterococcus

Comparison of enterococcus results for MRSWMP monitoring reported in MPN/ 100 ml. Shaded boxes indicate that the EPA Water Quality Objective of 104 MPN/ 100 ml was exceeded; NA= Not Analyzed; ND= Non-detect; NF= No Flow; NS= Not Sampled; -- = Not included in MRSWMP monitoring. The table is broken into two sections to facilitate printing.

Site Name	DR 2006	FF 2006	DR 2007	FF 2007	DR 2008	FF 2008	DR 2009	FF 2009	SpR 2010	SuR 2010	DR 2010	FF 2010	SpR 2011	SuR 2011	DR 2011	FF 2011	SpR 2012	SuR 2012
Pajaro	--	--	--	--	NF	100612	6339	51797	NF	NF	NF	339000	NF	NF	NF	80189	NF	NF
Bay St	--	341	NF	13435	NF	13650	NF	90327	NF	NF	NF	70700	20	NF	NF	47396	NF	NF
Twin 51's	--	227516	39726	57609	8700	139002	125	111501	2669	498	970	108150	2306	5819	346	67477	1587	431
San Carlos	--	63487	20	25993	62	67560	531	38751	1918	9768	4196	34450	146	40	346	48391	313	20
Steinbeck	--	241960	14540	112902	48400	193983	16328	241960	1249	976	3232	12100	393	2184	16328	241957	4494	16328
HopkinsMon	--	--	NF	91787	292	31828	48291	47619	917	172	148	38000	700	747	NF	63725	NS	242
HopkinsPG	--	--	NF	16523	NF	84778	NF	157330	NF	NF	NF	116000	NF	NF	NF	241957	NS	NF
8th St	--	66298	NF	29202	NF	75211	NF	95062	NF	NF	10950	85350	242	12976	NF	NF	218	NF
Greenwood	--	62567	17382	29372	5820	76803	3571	111501	1188	2792	1918	75150	1625	13733	8703	173291	1024	25993
Lover's	--	99442	18416	39739	4130	87231	104	88435	10950	104	82	15372	521	3571	NF	116644	1352	NF
Pico	--	43965	1760	81652	8210	155638	583	33310	220	512	1210	33550	20	20	126	101332	61	40
4 <sup>th</sup> Avenue	--	--	NF	3328	NF	25567	NF	40438	NF	NF	NF	21650	20	NF	20	176971	NF	NF
Ocean	--	--	NF	3381	NF	100120	NF	48392	NF	81640	NF	33900	NF	NF	NF	41125	NF	17329
8 <sup>th</sup> Avenue	--	--	436	6168	942	36000	220	NA	40	40	100	43700	187	82	4564	84547	20	20
Crossroads	--	--	--	--	--	--	NF	NA	NF	NF	NF	60200	NF	NF	NF	116723	NF	NF

## Enterococcus continued

Site Name	DR 2012	FF 2012	SF 2013	SuR 2013	DR 2013	FF 2013	SF 2014	SuR 2014	DR 2014	FF 2014	DR 2015	FF 2015	DR 2016	FF 2016
Pajaro	NF	92342	6260	NF	NF	3163	7541	NF	NF	20013	NF	12311		25545
Bay St	NF	82392	12229	NF	NF	23415	17329	NF	NF	126500	NF	17265		18458
Twin 51's	492	79326	6896	942	22398	21000	8164	1760	1417	37150	7746	25867	1470	14298
San Carlos	NF	NS	NS	374	NF	4825	8164	NF	NF	79650	NF	18471		7921
Steinbeck	1587	241957	43517	48392	NF	88662	34480	270	4962	54200	NF	56518		13667
HopkinsMon	NS	NS	NS	12976	--	--	--	--	--	--	--	--		19241
HopkinsPG	NS	NS	NS	NF	--	--	--	--	--	--	--	--		18168
8th St	NF	NS	NS	NF	--	--	--	--	--	--	--	--		8704
Greenwood	14540	81461	NS	1226	8704	20880	NS	2290	4374	41950	20925	40794	40	16001
Lover's	NF	95634	NS	NF	NF	127750	NS	NF	NF	20768	NF	119844		18572
Pico	583	70697	7308	746	322	9005	15650	3978	83	23118	<20	29926	416	13415
4 <sup>th</sup> Avenue	NF	14554	NS	NF	NF	NS	NS	NF	--	--	NF	22801		7039
Ocean	NF	55607	NS	NF	NF	9665	NS	NF	--	--	NF	14901		11051
8 <sup>th</sup> Avenue	NF	NS	NS	974	104	NS	NS	NF	--	--	NF	25451		7607
Crossroads	NF	241960	559	NF	NF	1095	1434	NF	NF	1530	NF	8083		2607

## Fluoride

Comparison of fluoride results for MRSWMP monitoring reported in mg/L. There is no water quality objective for fluoride; ND= Non-detect; NF= No Flow; NS= Not Sampled; -- = Not included in MRSWMP monitoring of this analyte.

Site Name	DR 2013	FF 2013	SF 2014	SuR 2014	DR 2014	FF 2014	DR 2015	FF 2015	DR 2016	FF 2016
Pajaro	NF	0.2	ND	NF	NF	0.2	NF	0.20	NF	1.60
Bay St	NF	ND	ND	NF	NF	0.1	NF	ND	NF	0.10
Twin 51's	0.5	0.2	ND	0.6	0.4	0.3	0.5	ND	0.70	0.20
San Carlos	NF	0.4	ND	NF	NF	0.2	NF	ND	NF	ND
Steinbeck	NF	0.1	ND	0.3	0.2	0.3	NF	ND	NF	ND
HopkinsMon	--	--	--	--	--	--	--	--	NF	0.10
HopkinsPG	--	--	--	--	--	--	--	--	NF	ND
8 <sup>th</sup> Street	--	--	--	--	--	--	--	--	NF	0.10
Greenwood	0.2	0.4	NS	0.3	0.2	0.2	0.2	0.13	0.20	ND
Lover's	NF	0.5	NS	NF	NF	0.2	NF	0.13	NF	ND
Pico	0.1	0.2	ND	0.1	ND	0.3	0.1	ND	0.10	ND
4 <sup>th</sup> Avenue	NF	NS	NS	NF	--	--	NF	ND	NF	0.10
Ocean	NF	0.6	NS	NF	--	--	NF	ND	NF	ND
8 <sup>th</sup> Avenue	0.1	NS	NS	NF	--	--	NF	ND	NF	ND
Crossroads	NF	ND	ND	NF	NF	0.2	NF	ND	NF	ND

## Hardness

Comparison of hardness results for MRSWMP monitoring reported in mg/L. Shaded boxes indicate that the General Permit Action Level of less than or equal to 10 mg/L or greater than or equal to 2000 mg/L was exceeded; ND= Non-detect; NF= No Flow; NS= Not Sampled; -- = Not included in MRSWMP monitoring.

Site Name	DR 2013	FF 2013	SF 2014	SuR 2014	DR 2014	FF 2014	DR 2015	FF 2015	DR 2016	FF 2016
Pajaro	NF	102	50	NF	NF	45	NF	41	NF	101
Bay St	NF	120	21	NF	NF	48	NF	28	NF	23
Twin 51's	360	119	19	682	910	93	248	53	905	39
San Carlos	NF	100	23	NF	NF	57	NF	34	NF	32
Steinbeck	NF	52	17	281	224	47	NF	29	NF	33
HopkinsMon	--	--	--	--	--	--	--	--	NF	51
HopkinsPG	--	--	--	--	--	--	--	--	NF	42
8 <sup>th</sup> Street	--	--	--	--	--	--	--	--	NF	31
Greenwood	341	114	NS	289	314	45	298	35	376	23
Lover's	NF	135	NS	NF	NF	48	NF	20	NF	31
Pico	163	75	18	192	161	60	161	62	179	36
4 <sup>th</sup> Avenue	NF	NS	NS	NF	--	--	NF	44	NF	58
Ocean	NF	105	NS	NF	--	--	NF	25	NF	25
8 <sup>th</sup> Avenue	277	NS	NS	NF	--	--	NF	40	NF	40
Crossroads	NF	28	9	NF	NF	18	NF	9	NF	20

## Lead

Comparison of total lead results for MRSWMP monitoring reported in µg/L. Shaded boxes indicate that the Basin Plan Objective of 30 µg/L was exceeded; NA= Not Analyzed; ND= Non-detect; NF= No Flow; NS= Not Sampled; -- = Not included in MRSWMP. The table below is broken into two sections to facilitate printing.

Site Name	DR 2006	FF 2006	DR 2007	FF 2007	DR 2008	FF 2008	DR 2009	FF 2009	SpR 2010	SuR 2010	DR 2010	FF 2010	SpR 2011	SuR 2011	DR 2011	FF 2011	SpR 2012	SuR 2012
Pajaro	--	--	--	--	NF	63	ND	24	NF	NF	NF	34	NF	NF	NF	17	NF	NF
Bay St	NF	ND	NF	15	NF	14	NF	33	NF	NF	NF	28	ND	NF	NF	16	NF	NF
Twin 51's	ND	13	5	36	5	17	ND	8	ND	ND	ND	44	ND	ND	ND	ND	ND	ND
San Carlos	ND	11	5	18	5	6	ND	6	ND	ND	1	22	ND	ND	ND	22	ND	ND
Steinbeck	ND	7	5	22	5	6	ND	7	ND	ND	1	9	ND	ND	ND	13	ND	ND
HopkinsMon	NF	10	NF	9	5	7	10	21	ND	ND	ND	9	ND	ND	NF	14	NS	ND
HopkinsPG	--	--	NF	15	NF	ND	NF	7	NF	NF	NF	11	NF	NF	NF	13	NS	NF
8th St	NF	12	NF	12	NF	ND	NF	14	NF	NF	83	8	ND	6	NF	NF	ND	NF
Greenwood	ND	8	5	18	5	6	ND	6	ND	ND	ND	11	ND	ND	ND	20	ND	ND
Lover's	NF	9	5	16	5	7	ND	10	ND	ND	ND	3	ND	ND	NF	30	ND	NF
Pico	ND	5	5	12	5	8	ND	ND	ND	ND	ND	6	ND	ND	ND	7	ND	ND
4 <sup>th</sup> Avenue	--	--	NF	18	NF	15	NF	25	NF	NF	NF	22	ND	NF	ND	60	NF	NF
Ocean	--	--	NF	47	NF	6	NF	ND	NF	5	NF	8	NF	NF	NF	26	NF	ND
8 <sup>th</sup> Avenue	--	--	5	13	5	6	ND	9	ND	ND	ND	11	ND	ND	ND	19	ND	ND
Crossroads	--	--	--	--	--	--	--	ND	NF	NF	NF	ND	NF	NF	NF	ND	NF	NF



## Lead Continued

Site Name	DR 2012	FF 2012	SF 2013	SuR 2013	DR 2013	FF 2013	SF 2014	SuR 2014	DR 2014	FF 2014	DR 2015	FF 2015	DR 2016	FF 2016
Pajaro	NF	20	22	NF	NF	16	24	NF	NF	14	NF	16	NF	14
Bay St	NF	8	9	NF	NF	20	10	NF	NF	44	NF	7	NF	8
Twin 51's	ND	23	ND	ND	ND	31	ND	ND	ND	12	ND	15	ND	15
San Carlos	NF	NS	NS	ND	NF	8	10	NF	NF	23	NF	5	NF	ND
Steinbeck	ND	7	ND	ND	NF	ND	8	ND	ND	15	NF	ND	NF	ND
HopkinsMon	NA	NS	NS	ND	--	--	--	--	--	--	--	--	NF	ND
HopkinsPG	NF	NS	NS	NF	--	--	--	--	--	--	--	--	NF	ND
8th St	NF	NS	NS	NF	--	--	--	--	--	--	--	--	NF	ND
Greenwood	ND	4	NS	ND	ND	8	NS	ND	ND	11	ND	9	ND	ND
Lover's	NF	6	NS	NF	NF	6	NS	NF	NF	11	NF	6	NF	4
Pico	ND	ND	ND	ND	ND	6	8	17	ND	ND	ND	5	ND	ND
4 <sup>th</sup> Avenue	NF	23	NS	NF	NF	NS	NS	NF	--	--	NF	32	NF	24
Ocean	NF	11	NS	NF	NF	9	NS	NF	--	--	NF	11	NF	ND
8 <sup>th</sup> Avenue	NF	NS	NS	ND	ND	NS	NS	NF	--	--	NF	28	NF	9
Crossroads	NF	ND	ND	NF	NF	ND	31	NF	NF	ND	NF	ND	NF	ND

## MBAS Detergents

Comparison of MBAS surfactant results for MRSWMP monitoring reported in mg/L. Shaded boxes indicate that the Basin Plan Water Quality Objective of 0.2 mg/L was exceeded; ND= Non-detect; NF= No Flow; NS= Not Sampled; -- = Not included in MRSWMP monitoring.

Site Name	DR 2013	FF 2013	SF 2014	SuR 2014	DR 2014	FF 2014	DR 2015	FF 2015	DR 2016	FF 2016
Pajaro	NF	1.12	ND	NF	NF	0.52	NF	0.21	NF	0.77
Bay St	NF	1.44	ND	NF	NF	0.77	NF	0.30	NF	0.51
Twin 51's	0.05	0.31	ND	0.1	0.08	0.55	1.06	0.33	0.14	0.33
San Carlos	NF	1.04	ND	NF	NF	0.94	NF	0.29	NF	0.33
Steinbeck	NF	0.42	ND	0.06	0.16	0.53	NF	0.36	NF	0.43
HopkinsMon	--	--	--	--	--	--	--	--	NF	0.50
HopkinsPG	--	--	--	--	--	--	--	--	NF	0.51
8 <sup>th</sup> Street	--	--	--	--	--	--	--	--	NF	0.43
Greenwood	ND	0.52	NS	ND	0.27	0.84	0.95	0.32	0.08	0.38
Lover's	NF	0.65	NS	NF	NF	1.30	NF	0.25	NF	0.38
Pico	0.06	0.55	ND	0.06	ND	1.00	0.14	0.51	0.08	0.43
4 <sup>th</sup> Avenue	NF	NS	NS	NF	--	--	NF	0.30	NF	0.37
Ocean	NF	1.6	NS	NF	--	--	NF	0.26	NF	0.45
8 <sup>th</sup> Avenue	ND	NS	NS	NF	--	--	NF	0.33	NF	0.50
Crossroads	NF	0.43	ND	NF	NF	0.39	NF	0.22	NF	0.55

## Nitrate as N

Comparison of nitrate as N (NO<sub>3</sub>-N) results for 2006-2014 MRSWMP monitoring reported in mg-N/ L. Shaded boxes indicate that the Basin Plan Objective of 2.25 mg-N/ L was exceeded; ND= Non-detect; NF= No Flow; NS= Not Sampled; -- = Not included in MRSWMP monitoring. The table below is broken into two sections to facilitate printing.

Site Name	DR 2006	FF 2006	DR 2007	FF 2007	DR 2008	FF 2008	DR 2009	FF 2009	SpR 2010	SuR 2010	DR 2010	FF 2010	SpR 2011	SuR 2011	DR 2011	FF 2011	SpR 2012	SuR 2012
Pajaro	--	--	--	--	NF	2.90	0.60	0.60	NF	NF	NF	1.12	NF	NF	NF	0.39	NF	NF
Bay St	NF	13.20	NF	0.69	NF	0.60	NF	0.40	NF	NF	NF	0.7	11.64	NF	NF	0.22	NF	NF
Twin 51's	0.16	0.45	0.32	0.99	0.60	0.90	0.40	0.40	0.20	1.30	0.98	1.1	0.39	0.47	0.7	0.46	0.1	0.39
San Carlos	3.92	1.69	2.17	0.64	1.20	0.87	1.20	0.50	0.64	1.20	2.84	0.81	1.18	0.41	0.83	0.12	1.43	0.8
Steinbeck	4.71	1.72	1.07	0.79	0.10	1.10	ND	0.70	5.15	1.20	1.39	1.96	4.81	2.92	ND	0.28	2.97	2.45
HopkinsMon	NF	1.39	NF	1.59	0.70	0.87	1.40	0.50	1.80	1.30	1.35	1.5	1.76	1.25	NF	0.20	NS	1.29
HopkinsPG	--	--	NF	0.60	NF	1.87	NF	2.70	NF	NF	NF	4.38	NF	NF	NF	0.31	NS	NF
8th St	NF	0.79	NF	0.48	NF	1.10	NF	0.80	NF	NF	1.99	0.87	1.05	1.83	NF	NF	0.95	NF
Greenwood	2.17	0.78	3.00	0.66	1.90	0.97	1.10	0.60	1.35	1.30	1.47	0.9	0.93	1.05	1.54	0.13	1.07	1.01
Lover's	NF	0.68	0.86	0.56	4.80	0.87	4.80	0.60	0.74	2.30	3.54	0.12	0.73	0.31	NF	0.12	1.06	NF
Pico	1.03	0.61	2.04	0.54	1.50	0.83	1.00	0.60	0.76	0.90	0.82	0.81	0.92	0.65	1.12	0.1	1.09	1.55
4 <sup>th</sup> Avenue	--	--	NF	0.73	NF	0.77	NF	0.60	NF	NF	NF	1.07	0.43	NF	0.08	0.33	NF	NF
Ocean	--	--	NF	0.71	NF	1.07	NF	0.20	NF	0.03	NF	1.58	NF	NF	NF	0.20	NF	ND
8 <sup>th</sup> Avenue	--	--	2.17	0.91	0.10	1.40	2.60	0.20	3.63	3.60	2.92	1.94	2.64	2.73	3.19	0.31	3.36	4.31
Crossroads	--	--	--	--	--	--	NF	0.30	NF	NF	NF	0.81	NF	NF	NF	0.11	NF	NF

Nitrate as N continued

Site Name	DR 2012	FF 2012	SF 2013	SuR 2013	DR 2013	FF 2013	SF 2014	SuR 2014	DR 2014	FF 2014	DR 2015	FF 2015	DR 2016	FF 2016
Pajaro	NF	0.47	0.6	NF	NF	1.2	0.2	NF	NF	0.5	NF	0.35	NF	0.9
Bay St	NF	0.74	1.0	NF	NF	1.4	0.2	NF	NF	0.4	NF	0.45	NF	0.3
Twin 51's	0.73	0.44	0.2	ND	0.8	0.7	0.2	0.3	0.3	0.7	1.5	0.45	0.40	0.3
San Carlos	NF	NS	NS	1.6	NF	0.9	0.2	NF	NF	0.6	NF	0.30	NF	0.3
Steinbeck	0.78	2.67	0.6	3.6	NF	1.3	0.2	1.7	0.4	1.1	NF	0.55	1.10	0.5
HopkinsMon	NS	NS	NS	1.2	--	--	--	--	--	--	--	--	NF	0.4
HopkinsPG	NF	NS	NS	NF	--	--	--	--	--	--	--	--	NF	0.9
8th St	NF	NS	NS	NF	--	--	--	--	--	--	--	--	NF	0.4
Greenwood	2.09	0.79	NS	1.4	1.0	1.0	NS	0.8	0.9	0.7	1.4	0.45	NF	0.2
Lover's	NF	0.59	NS	NF	NF	1.0	NS	NF	NF	0.7	NF	0.25	NF	0.2
Pico	1.91	1.13	0.3	1.7	2.2	0.6	ND	1.9	2.4	0.7	0.9	0.35	0.90	0.2
4 <sup>th</sup> Avenue	NF	0.43	NS	NF	NF	NS	NS	NF	--	--	NF	0.60	NF	0.5
Ocean	NF	0.51	NS	NF	NF	1.8	NS	NF	--	--	NF	0.45	NF	0.3
8 <sup>th</sup> Avenue	NF	NS	NS	2.5	2.2	NS	NS	NF	--	--	NF	0.55	NF	0.3
Crossroads	NF	0.59	0.05	NF	NF	0.5	ND	NF	NF	0.3	NF	0.20	NF	0.2

## Orthophosphate as P

Comparison of orthophosphate as P results for MRSWMP monitoring reported as mg-P/ L. Shaded boxes indicate that the Basin Plan Objective of 0.12 mg-P/ L was exceeded; ND= Non-detect; NF= No Flow; NS= Not Sampled; -- = Not included in MRSWMP monitoring. The table below is broken into two sections to facilitate printing.

Site Name	DR 2006	FF 2006	DR 2007	FF 2007	DR 2008	FF 2008	DR 2009	FF 2009	SpR 2010	SuR 2010	DR 2010	FF 2010	SpR 2011	SuR 2011	DR 2011	FF 2011	SpR 2012	SuR 2012
Pajaro	--	--	--	--	NF	0.50	0.90	0.31	NF	NF	NF	0.38	NF	NF	NF	0.17	NF	NF
Bay St	NF	0.32	NF	0.09	NF	0.40	NF	0.31	NF	NF	NF	0.34	ND	NF	NF	0.17	NF	NF
Twin 51's	0.35	0.56	ND	0.72	0.20	0.97	0.30	0.92	0.25	0.20	ND	0.94	0.11	NF	0.09	0.52	0.11	0.13
San Carlos	ND	0.46	ND	0.38	0.20	0.60	0.20	0.18	0.19	0.10	0.17	0.33	0.15	ND	ND	0.19	0.10	ND
Steinbeck	0.38	3.01	0.09	2.69	3.10	3.77	0.30	2.48	0.35	0.30	0.32	7.01	0.10	ND	ND	0.98	0.15	0.31
HopkinsMon	NF	2.37	NF	3.38	0.20	0.73	0.30	0.34	0.18	0.10	0.11	0.60	ND	ND	NF	0.22	NS	ND
HopkinsPG	--	--	NF	0.51	NF	1.80	NF	1.60	NF	NF	NF	1.79	NF	NF	NF	0.54	NS	NF
8th St	NF	0.49	NF	0.52	NF	0.90	NF	0.56	NF	NF	0.60	0.46	0.12	ND	NF	NF	0.21	NF
Greenwood	ND	0.53	0.07	0.65	0.20	1.40	0.10	0.51	0.18	0.20	0.08	0.68	0.10	ND	ND	0.35	0.10	ND
Lover's	NF	1.38	ND	0.93	0.20	1.30	0.10	0.70	0.32	0.20	0.12	0.18	0.18	ND	NF	0.41	0.13	NF
Pico	ND	0.44	ND	0.73	0.20	0.70	0.10	0.40	0.13	0.05	ND	0.58	ND	ND	ND	0.37	0.10	ND
4 <sup>th</sup> Avenue	--	--	NF	1.24	NF	0.70	NF	0.78	NF	NF	NF	0.54	ND	NF	ND	0.32	NF	NF
Ocean	--	--	NF	0.77	NF	0.93	NF	0.81	NF	2.70	NF	1.18	NF	NF	NF	0.77	NF	0.19
8 <sup>th</sup> Avenue	--	--	ND	0.99	0.20	1.37	0.20	0.75	0.24	ND	ND	0.92	ND	1.44	ND	0.65	0.10	ND
Crossroads	--	--	--	--	--	--	NF	0.31	NF	NF	NF	0.64	NF	NF	NF	0.16	NF	NF

## Orthophosphate as P continued

Site Name	DR 2012	FF 2012	SF 2013	SuR 2013	DR 2013	FF 2013	SF 2014	SuR 2014	DR 2014	FF 2014	DR 2015	FF 2015	DR 2016	FF 2016
Pajaro	NF	0.46	0.1	NF	NF	0.70	0.20	NF	NF	0.4	NF	0.2	NF	0.9
Bay St	NF	0.23	ND	NF	NF	0.40	0.10	NF	NF	0.2	NF	0.2	NF	0.4
Twin 51's	0.11	0.31	0.10	0.20	ND	0.40	0.20	ND	ND	0.5	1.2	0.4	0.3	0.4
San Carlos	NF	NS	NS	ND	NF	0.40	ND	NF	NF	0.3	NF	0.2	NF	0.3
Steinbeck	0.14	1.82	0.50	0.40	NF	4.20	0.50	0.10	0.2	2.8	NF	1.4	NF	1.2
HopkinsMon	NS	NS	NS	ND	--	--	--	--	--	--	--	--	NF	0.3
HopkinsPG	NS	NS	NS	NF	--	--	--	--	--	--	--	--	NF	0.9
8th St	NF	NS	NS	NF	--	--	--	--	--	--	--	--	NF	0.4
Greenwood	0.13	0.37	NS	0.30	ND	0.70	NS	ND	ND	0.8	ND	0.7	ND	0.4
Lover's	NF	0.63	NS	NF	NF	1.10	NS	NF	NF	0.8	NF	0.3	NF	0.5
Pico	ND	0.41	ND	ND	ND	0.90	0.10	ND	ND	1.0	ND	0.7	ND	0.5
4 <sup>th</sup> Avenue	NF	0.19	NS	NF	NF	NS	NS	NF	--	--	NF	0.6	NF	1.0
Ocean	NF	0.67	NS	NF	NF	2.00	NS	NF	--	--	NF	0.4	NF	0.7
8 <sup>th</sup> Avenue	NF	NS	NS	ND	ND	NS	NS	NF	--	--	NF	0.6	NF	1.1
Crossroads	NF	0.37	ND	NF	NF	0.20	ND	NF	NF	0.3	NF	0.1	NF	0.2

## Potassium

Comparison of potassium results for MRSWMP monitoring reported as mg/L. Shaded boxes indicate that the General Permit Action Level of 20 mg/L was exceeded; ND= Non-detect; NF= No Flow; NS= Not Sampled; -- = Not included in MRSWMP monitoring.

Site Name	DR 2013	FF 2013	SF 2014	SuR 2014	DR 2014	FF 2014	DR 2015	FF 2015	DR 2016	FF 2016
Pajaro	NF	9	2.5	NF	NF	4.6	NF	3.8	NF	8.5
Bay St	NF	8	1.3	NF	NF	3.0	NF	4.0	NF	2.8
Twin 51's	6.9	9	1.5	11	18.0	5.4	8	5.2	8.3	3.5
San Carlos	NF	7	1.3	NF	NF	5.2	NF	3.0	NF	2.5
Steinbeck	NF	12	1.4	4.1	4.2	8.9	NF	5.5	NF	4.1
HopkinsMon	--	--	--	--	--	--	--	--	NF	4.4
HopkinsPG	--	--	--	--	--	--	--	--	NF	5.4
8 <sup>th</sup> Street	--	--	--	--	--	--	--	--	NF	3.8
Greenwood	6.4	13	NS	5.6	6.7	6.6	5.1	7.5	7.3	4.0
Lover's	NF	14	NS	NF	NF	6.2	NF	4.2	NF	4.5
Pico	5.1	12	2.6	5.5	5.9	10.5	5.2	14.0	4.6	7.4
4th Ave.	NF	NS	NS	NF	--	--	NF	9.5	NF	11.3
Ocean Ave.	NF	16	NS	NF	--	--	NF	5.1	NF	6.3
8th Ave	1.6	NS	NS	NF	--	--	NF	8.2	NF	10.0
Crossroads	NF	3	0.8	NF	NF	2.5	NF	1.5	NF	1.9

## Total Suspended Solids (TSS)

Comparison of Total Suspended Solids (TSS) results for MRSWMP monitoring reported in mg/L. Shaded boxes indicate that the CCAMP Action Level of 500 mg/L was exceeded; NA= Not Analyzed; ND= Non-detect; NF= No Flow; NS= Not Sampled; -- = Not included in MRSWMP monitoring. The table below is broken into two sections to facilitate printing.

Site Name	DR 2006	FF 2006	DR 2007	FF 2007	DR 2008	FF 2008	DR 2009	FF 2009	SpR 2010	SuR 2010	DR 2010	FF 2010	SpR 2011	SuR 2011	DR 2011	FF 2011	SpR 2012	SuR 2012
Pajaro	--	--	--	--	NF	743	42	270	NF	NF	NF	348	NF	NF	NF	230	NF	NF
Bay St	NF	3	NF	38	NF	66	NF	123	NF	NF	NF	173	ND	NF	NF	59	NF	NF
Twin 51's	2	41	3	137	5	74	6	44	ND	5	61	183	ND	ND	ND	15	ND	ND
San Carlos	ND	46	3080	47	5	32	ND	22	ND	ND	3	69	ND	ND	ND	100	ND	ND
Steinbeck	12	14	4	66	8	49	8	68	ND	ND	6	56	ND	ND	ND	88	2	18
HopkinsMon	NF	29	NF	36	12	34	51	106	7	8	ND	30	ND	8	NF	57	NS	ND
HopkinsPG	--	--	NF	43	NF	25	NF	45	NF	NF	NF	82	NF	NF	NF	75	NS	NF
8th St		39	NF	75	NF	15	NF	31	NF	NF	188	26	ND	20	NF	NF	2	NF
Greenwood	33	23	3	71	14	19	0	60	0	6	5	50	7	ND	ND	174	4	ND
Lover's	NF	24	5	35	1.9	25	ND	52	ND	ND	3	20	12	9	NF	118	ND	NF
Pico	ND	40	5	86	ND	45	ND	20	ND	6	ND	36	ND	ND	ND	57	ND	ND
4th Ave.	--	--	NF	103	NF	116	NF	121	NF	NF	NF	212	ND	NF	ND	557	NF	NF
Ocean Ave.	--	--	NF	59	NF	34	NF	28	NF	45	NF	42	NF	NF	NF	292	NF	14
8th Ave	--	--	4	89	5	20	ND	57	ND	ND	3	36	ND	ND	ND	99	ND	ND
Crossroads	--	--	--	--	--	--	NF	21	NF	NF	NF	15	NF	NF	NF	11	NF	NF



## Total Suspended Solids (TSS) continued

Site Name	DR 2012	FF 2012	SF 2013	SuR 2013	DR 2013	FF 2013	SF 2014	SuR 2014	DR 2014	FF 2014	DR 2015	FF 2015	DR 2016	FF 2016
Pajaro	NF	140	276	NF	NF	132	244	NF	NF	152	NF	191	NF	111
Bay St	NF	33	63	NF	NF	66	33	NF	NF	173	NF	35	NF	32
Twin 51's	ND	74	19	6	3	69	14	ND	ND	73	3	59	2	28
San Carlos	NF	NS	NS	3	NF	13	44	NF	NF	91	NF	25	NF	6
Steinbeck	7	30	8	4	NF	21	34	ND	ND	84	NF	24	NF	7
HopkinsMon	NS	NS	NS	35	--	--	--	--	--	--	--	--	NF	7
HopkinsPG	NS	NS	NS	NF	--	--	--	--	--	--	--	--	NF	9
8th St	NF	NS	NS	NF	--	--	--	--	--	--	--	--	NF	7
Greenwood	2	17	NS	3	4	36	NS	8	3	59	6	50	2	12
Lover's	NF	21	NS	NF	NF	11	NS	NF	NF	33	NF	20	NF	20
Pico	ND	10	12	2	ND	32	68	ND	ND	27	ND	61	ND	14
4th Ave.	NF	139	NS	NF	NF	NS	NS	NF	--	--	NF	312	NF	96
Ocean Ave.	NF	57	NS	NF	NF	20	NS	NF	--	--	NF	62	NF	18
8th Ave	NF	NS	NS	ND	ND	NS	NS	NF	--	--	NF	101	NF	36
Crossroads	NF	11	5	NF	NF	7	20	NF	NF	12	NF	20	NF	6

## Turbidity

Comparison of turbidity results for MRSWMP monitoring reported in NTU. Shaded boxes indicate that the CCRWQCB Action Level of 25 NTU was exceeded; NA= Not Analyzed; ND= Non-detect; NF= No Flow; NS= Not Sampled; -- = Not included in MRSWMP monitoring.

Site Name	DR 2013	FF 2013	SF 2014	SuR 2014	DR 2014	FF 2014	DR 2015	FF 2015	DR 2016	FF 2016
Pajaro	NF	175.0	120.0	NF	NF	140.0	NF	140.0	NF	2.3
Bay St	NF	40.0	20.0	NF	NF	41.0	NF	19.0	NF	12.3
Twin 51's	3.8	50.0	12.0	1.6	2.0	21.0	3.4	33.0	6.1	16.5
San Carlos	NF	17.3	16.0	NF	NF	37.0	NF	14.0	NF	5.2
Steinbeck	NF	13.0	16.0	0.7	0.7	32.0	NF	14.0	NF	5.0
HopkinsMon	--	--	--	--	--	--	--	--	NF	4.4
HopkinsPG	--	--	--	--	--	--	--	--	NF	3.9
8th St	--	--	--	--	--	--	--	--	NF	4.6
Greenwood	1.5	24.0	NS	2.1	4.0	25.0	5.0	25.0	4.5	10.1
Lover's	NF	7.1	NS	NF	NF	20.0	NF	10.0	NF	12.3
Pico	3.0	18.0	18.0	2.1	7.2	21.0	3.3	32.0	10.0	7.9
4th Ave.	NF	NS	NS	NF	--	--	NF	103.0	NF	44.5
Ocean Ave.	NF	24.0	NS	NF	--	--	NF	14.0	NF	21.5
8th Ave	1.1	NS	NS	NF	--	--	NF	26.0	NF	11.0
Crossroads	NF	7.0	13.0	NF	NF	12.0	NF	9.0	NF	4.7

## Urea

Comparison of urea results for MRSWMP monitoring reported in µg/L. There is no water quality objective and First Flush results are from a single sample during the first time series; NA= Not Analyzed; ND= Non-detect; NF= No Flow; NS= Not Sampled; -- = Not included in MRSWMP monitoring. The table below is broken into two sections to facilitate printing.

Site Name	DR 2006	FF 2006	DR 2007	FF 2007	DR 2008	FF 2008	DR 2009	FF 2009	SpR 2010	SuR 2010	DR 2010	FF 2010	SpR 2011	SuR 2011	DR 2011	FF 2011	SpR 2012	SuR 2012
Pajaro	--	--	--	--	NF	98	74	241	NF	NF	NF	609	NF	NF	NF	44	NF	NF
Bay St	NF	60	NF	205	NF	108	NF	62	NF	NF	NF	284	ND	NF	NF	143	NF	NF
Twin 51's	53	724	116	560	45	753	250	920	258	16	21	520	16	53	35	179	61	87
San Carlos	13	370	35	440	15	336	ND	331	10	15	878	326	ND	10	ND	73	5	ND
Steinbeck	152	4777	1028	1965	1	740	11	1547	213	10	11	2234	ND	42	30	393	5	127
HopkinsMon	NF	3263	NF	2495	173	38	193	456	36	ND	ND	160	ND	30	NF	55	NS	ND
HopkinsPG	--	--	NF	275	NF	840	NF	1671	NF	NF	NF	1628	NF	NF	NF	378	NS	NF
8th St	NF	139	NF	210	NF	267	NF	141	NF	NF	389	192	ND	83	NF	NF	1861	NF
Greenwood	485	348	428	455	71	470	14	120	31	636	5	280	70	44	12	168	5	11
Lover's	NF	217	23	320	57	41	20	118	13	ND	5	54	ND	12	NF	97	57	NF
Pico	ND	150	10	240	69	104	15	35	13	24	5	96	20	10	ND	25	5	ND
4th Ave.	--	--	NF	195	NF	84	NF	393	NF		NF	225	ND	NF	ND	46	NF	NF
Ocean Ave.	--	--	NF	280	NF	250	NF	105	NF	400	NF	417	NF	NF	NF	47	NF	31
8th Ave	--	--	10	345	10	331	ND	419	ND	ND	ND	426	ND	10	ND	547	5	ND
Crossroads	--	--	--	--	--	--	NF	321	NF	NF	NF	519	NF	NF	NF	52	NF	NF

## Urea continued

Site Name	DR 2012	FF 2012	SF 2013	SuR 2013	DR 2013	FF 2013	SF 2014	SuR 2014	DR 2014	FF 2014	DR 2015	FF 2015	DR 2016	FF 2016
Pajaro	NF	312	98	NF	NF	838	49	NF	NF	313	NF	827	NF	5260
Bay St	NF	158	349	NF	NF	787	57	NF	NF	298	NF	304	NF	205
Twin 51's	32	193	55	93	131	595	45	22	45	598	254	266	102	186
San Carlos	NF	NS	NS	ND	NF	572	68	NF	NF	434	NF	118	NF	145
Steinbeck	29	478	405	938	NF	2075	228	27	24	4490	NF	914	NF	1120
HopkinsMon	NS	NS	NS	ND	--	--	--	--	--	--	--	--	NF	168
HopkinsPG	NS	NS	NS	NF	--	--	--	--	--	--	--	--	NF	740
8th St	NF	NS	NS	NF	--	--	--	--	--	--	--	--	NF	102
Greenwood	11	423	NS	56	11	446	NS	17	43	378	ND	180	92	143
Lover's	NF	98	NS	NF	NF	450	NS	NF	NF	914	NF	150	NF	135
Pico	ND	63	63	42	ND	225	34	435	10	292	ND	451	ND	89
4th Ave.	NF	293	NS	NF	NF	NS	NS	NF	--	--	NF	122	NF	239
Ocean Ave.	NF	156	NS	NF	NF	699	NS	NF	--	--	NF	187	NF	289
8th Ave	NF	NS	NS	ND	ND	NS	NS	NF	--	--	NF	173	NF	212
Crossroads	NF	289	20	NF	NF	114	56	NF	NF	271	NF	80	NF	129

## Zinc

Comparison of total zinc results for MRSWMP monitoring reported in µg/L. Shaded boxes indicate that the Basin Plan Objective of 200 µg/L was exceeded; NA= Not Analyzed; ND= Non-detect; NF= No Flow; NS= Not Sampled; -- = Not included in MRSWMP monitoring. The table below is broken into two sections to facilitate printing.

Site Name	DR 2006	FF 2006	DR 2007	FF 2007	DR 2008	FF 2008	DR 2009	FF 2009	SpR 2010	SuR 2010	DR 2010	FF 2010	SpR 2011	SuR 2011	DR 2011	FF 2011	SpR 2012	SuR 2012
Pajaro	--	--	--	--	NF	368	41	273	NF	NF	NF	351	NF	NF	NF	170	NF	NF
Bay St	NF	33	NF	185	NF	124	NF	345	NF	NF	NF	272	22	NF	NF	219	NF	NF
Twin 51's	ND	295	25	330	28	273	29	313	20	52	46	385	25	25	20	142	40	ND
San Carlos	ND	342	10	269	18	157	19	213	25	28	28	351	67	29	17	264	43	ND
Steinbeck	ND	411	130	384	110	347	196	400	40	29	31	808	62	31	19	258	60	21
HopkinsMon	NF	307	NF	382	99	194	234	341	35	22	24	322	24	36	NF	138	NS	ND
HopkinsPG	--	--	NF	231	NF	305	NF	477	NF	NF	NF	945	NF	NF	NF	166	NS	NF
8th St		153	NF	173	NF	121	NF	147	NF	NF	567	156	15	88	NF	NF	22	NF
Greenwood	27	180	11	236	35	156	ND	167	14	ND	5	232	12	16	ND	300	21	ND
Lover's Pt	NF	158	13	175	10	123	ND	166	14	ND	5	65	36	16	NF	182	14	NF
Pico	ND	142	10	154	12	96	ND	87	11	16	17	139	34	11	ND	86	12	ND
4 <sup>th</sup> Avenue	--	--	NF	170	NF	116	NF	226	NF	NF	NF	195	104	NF	11	312	NF	NF
Ocean	--	--	NF	361	NF	225	NF	288	NF	439	NF	650	NF	NF	NF	354	NF	98
8 <sup>th</sup> Avenue	--	--	61	303	20	237	19	256	17	14	15	344	ND	19	20	214	26	ND
Crossroads	--	--	--	--	--	--	NF	303	NF	NF	NF	330	NF	NF	NF	97	NF	NF

## Zinc continued

Site Name	DR 2012	FF 2012	SF 2013	SuR 2013	DR 2013	FF 2013	SF 2014	SuR 2014	DR 2014	FF 2014	DR 2015	FF 2015	DR 2016	FF 2016
Pajaro	NF	198	182	NF	NF	297	264	NF	NF	231	NF	167	NF	317
Bay St	NF	94	187	NF	NF	402	119	NF	NF	703	NF	141	NF	138
Twin 51's	28	147	70	46	93	504	58	48	313	513	114	167	56	93
San Carlos	NF	NS	NS	36	NF	269	96	NF	NF	692	NF	118	NF	92
Steinbeck	38	392	158	43	NF	293	112	25	53	764	NF	170	NF	149
HopkinsMon	NS	NS	NS	60	--	--	--	--	--	--	--	--	NF	112
HopkinsPG	NS	NS	NS	NF	--	--	--	--	--	--	--	--	NF	189
8th St	NF	NS	NS	NF	--	--	--	--	--	--	--	--	NF	74
Greenwood	ND	102	NS	14	20	263	NS	48	60	410	ND	129	ND	93
Lover's Pt	NF	114	NS	NF	NF	204	NS	NF	NF	406	NF	87	NF	80
Pico	21	58	70	ND	37	129	63	ND	39	144	ND	150	23	68
4 <sup>th</sup> Avenue	NF	145	NS	NF	NF	NS	NS	NF	--	--	NF	148	NF	133
Ocean	NF	203	NS	NF	NF	395	NS	NF	--	--	NF	106	NF	144
8 <sup>th</sup> Avenue	NF	NS	NS	92	24	NS	NS	NF	--	--	NF	169	NF	125
Crossroads	NF	211	79	NF	NF	185	81	NF	NF	229	NF	78	NF	134

**Appendix 3: Results by Jurisdiction (listed alphabetically)**

## Carmel 2016 MRSWMP monitoring results.

Table results include the Dry Run (DR), First Flush time series (FF-A and FF-B) and FF results averaged for the two time series (FF-Avg). Shaded boxes indicate that a Water Quality Objective (WQO) or Action Level was exceeded. ND= Non-detect; NF= No Flow; -- = Not included in MRSWMP.

Analytes	WQO or Action Level	4 <sup>th</sup> Avenue				Ocean Avenue				8 <sup>th</sup> Avenue			
		DR	FF- A	FF - B	FF Avg	DR	FF- A	FF - B	FF Avg	DR	FF- A	FF - B	FF Avg
Ammonia (mg/L)	50 mg/L	NF	0.93	0.74	0.84	NF	0.70	0.76	0.73	NF	0.64	1.03	0.84
Color (Color Units)	500 color units	NF	250	175	213	NF	80	80	80	NF	100	100	100
Copper (ug/L)	30 ug/L	NF	86	86	86	NF	112	77	95	NF	104	111	108
<i>E. coli</i> (MPN/ 100 ml)	235 MPN/ 100 ml	NF	41058	36540	38799	NF	26025	20142	23084	NF	13761	16743	15252
Enterococcus (MPN/ 100 ml)	104 MPN/ 100 ml	NF	9854	4223	7039	NF	14672	7430	11051	NF	9086	6127	7607
Fluoride (mg/L)	None currently	NF	0.1	ND	0.08	NF	ND	ND	ND	NF	ND	ND	ND
Hardness mg/L	10 and 2000 mg/L	NF	70	46	58	NF	27	23	25	NF	38	41	40
Lead (ug/L)	30 ug/L	NF	34	14	24	NF	ND	ND	ND	NF	10	8	9
MBAS Surfactants	0.2 mg/L	NF	0.27	0.46	0.37	NF	0.54	0.36	0.45	NF	0.54	0.45	0.50
NO3-N (mg-N/ L)	2.25 mg-N/ L	NF	0.6	0.3	0.5	NF	0.3	0.3	0.3	NF	0.2	0.3	0.3
PO4-P (mg-P/ L)	0.12 mg-P/ L	NF	1.0	1.0	1.0	NF	0.7	0.7	0.7	NF	0.9	1.3	1.1
Potassium (mg/L)	20 mg/ L	NF	13.0	9.6	11.3	NF	6.4	6.2	6.3	NF	8.9	11.0	10.0
TSS (mg/L)	500 mg/L	NF	120	72	96	NF	22	13	18	NF	50	21	36
Turbidity (NTU)	25 NTU	NF	60.0	29.0	44.5	NF	18.0	25.0	21.5	NF	13.0	9.0	11.0
Urea (ug/L)	None currently	NF	239	--	--	NF	289	--	--	NF	212	--	--
Zinc (ug/L)	200 ug/L	NF	146	119	133	NF	148	140	144	NF	131	119	125



## Monterey 2016 MRSWMP monitoring results.

Table results include the Dry Run (DR), First Flush time series (FF-A and FF-B) and FF results averaged for the two time series (FF-Avg). Shaded boxes indicate that a Water Quality Objective (WQO) or Action Level was exceeded. ND= Non-detect; NF= No Flow; -- = Not included in MRSWMP monitoring.

Analytes	WQO or Action Level	Twins				San Carlos				Steinbeck			
		DR	FF- A	FF - B	FF Avg	DR	FF- A	FF - B	FF Avg	DR	FF- A	FF - B	FF Avg
Ammonia (mg/L)	50 mg/L	0.44	0.42	0.22	0.32	NF	0.25	0.27	0.26	NF	2.21	3.30	2.76
Color (Color Units)	500 color units	24	40	40	40	NF	60	28	44	NF	75	75	75
Copper (ug/L)	30 ug/L	13	25	18	22	NF	20	22	21	NF	44	59	52
<i>E. coli</i> (MPN/100 ml)	235 MPN/ 100 ml	141361	54750	30759	42755	NF	8547	7541	8044	NF	19179	36540	27860
Enterococcus (MPN/100 ml)	104 MPN/ 100 ml	1470	9086	19510	14298	NF	9086	6756	7921	NF	14137	13197	13667
Fluoride (mg/L)	None currently	0.70	0.2	0.1	0.2	NF	ND	ND	ND	NF	ND	ND	ND
Hardness mg/L	<10 and >2000 mg/L	905	37	41	39	NF	28	35	32	NF	26	40	33
Lead (ug/L)	30 ug/L	ND	15	15	15	NF	ND	ND	ND	NF	ND	ND	ND
MBAS Surfactants	0.2 mg/L	0.14	0.36	0.30	0.33	NF	0.33	0.33	0.33	NF	0.39	0.46	0.43
NO3-N (mg-N/ L)	2.25 mg-N/ L	0.4	0.3	0.3	0.3	NF	0.2	0.3	0.3	NF	0.3	0.6	0.5
PO4-P (mg-P/ L)	0.12 mg-P/ L	0.3	0.5	0.3	0.4	NF	0.3	0.3	0.3	NF	1.0	1.4	1.2
Potassium (mg/L)	20 mg/ L	8.3	3.6	3.3	3.5	NF	2.4	2.5	2.5	NF	3.5	4.7	4.1
TSS (mg/L)	500 mg/L	2	19	37	28	NF	6	6	6	NF	7	7	7
Turbidity (NTU)	25 NTU	6.1	12.0	21.0	16.5	NF	4.4	5.9	5.2	NF	4.2	5.8	5.0
Urea (ug/L)	None currently	102	186	--	--	NF	145	--	--	NF	1120	--	--
Zinc (ug/L)	200 ug/L	56	107	78	93	NF	89	94	92	NF	135	162	149

## Monterey County 2016 MRSWMP monitoring results.

Table results include the Dry Run (DR), First Flush time series (FF-A and FF-B) and FF results averaged for the two time series (FF-Avg). Shaded boxes indicate that a Water Quality Objective (WQO) or Action Level was exceeded. ND= Non-detect; NF= No Flow, -- = Not included in MRSWMP monitoring.

Analytes	WQO or Action Level	Pajaro				Crossroads			
		DR	FF- A	FF- B	FF-Avg	DR	FF- A	FF- B	FF-Avg
Ammonia (mg/L)	50 mg/L	NF	5.08	0.71	2.90	NF	0.17	0.19	0.18
Color (Color Units)	500 color units	NF	250	200	225	NF	40	40	40
Copper (ug/L)	30 ug/L	NF	72	52	62	NF	16	17	17
<i>E. coli</i> (MPN/ 100 ml)	235 MPN/ 100 ml	NF	22818	18501	20660	NF	2590	1449	2020
Enterococcus (MPN/ 100 ml)	104 MPN/ 100 ml	NF	36540	14549	25545	NF	2624	2590	2607
Fluoride (mg/L)	None currently	NF	2.2	0.9	1.6	NF	ND	ND	ND
Hardness mg/L	<10 and >2000 mg/L	NF	128	73	101	NF	23	17	20
Lead (ug/L)	30 ug/L	NF	13	14	14	NF	ND	ND	ND
MBAS Surfactants (mg/L)	0.2 mg/L	NF	0.74	0.80	0.77	NF	0.44	0.66	0.55
NO3-N (mg-N/ L)	2.25 mg-N/ L	NF	1.1	0.7	0.9	NF	0.2	0.1	0.2
PO4-P (mg-P/ L)	0.12 mg-P/ L	NF	1.2	0.6	0.9	NF	0.2	0.2	0.2
Potassium (mg/L)	20 mg/ L	NF	11.0	6.0	8.5	NF	2.1	1.6	1.9
TSS (mg/L)	500 mg/L	NF	110	112	111	NF	5	6	6
Turbidity (NTU)	25 NTU	NF	2.5	2.1	2.3	NF	4.3	5.0	4.7
Urea (ug/L)	None currently	NF	5260	--	--	NF	129	--	--
Zinc (ug/L)	200 ug/L	NF	394	239	317	NF	138	129	134

## Pacific Grove 2016 MRSWMP Monitoring results.

Table results include the Dry Run (DR), First Flush time series (FF-A and FF-B) and FF results averaged for the two time series (FF-Avg). Shaded boxes indicate that a Water Quality Objective (WQO) or Action Level was exceeded. ND= Non-detect; NF= No Flow; -- = Not included in MRSWMP monitoring.

Analytes	WQO or Action Level	HopkinsMon				HopkinsPG				8 <sup>th</sup> Street			
		DR	FF- A	FF - B	FF Ave	DR	FF- A	FF - B	FF Ave	DR	FF- A	FF - B	FF Ave
Ammonia (mg/L)	50 mg/L	NF	0.31	0.35	0.33	NF	1.31	2.00	1.66	NF	0.29	0.34	0.32
Color (Color Units)	500 color units	NF	80	80	80	NF	80	80	80	NF	40	60	50
Copper (ug/L)	30 ug/L	NF	19	34	27	NF	26	38	32	NF	24	27	26
<i>E. coli</i> (MPN/100 ml)	235 MPN/ 100 ml	NF	8329	16162	12246	NF	34480	38732	36606	NF	12229	13540	12885
Enterococcus (MPN/100 ml)	104 MPN/ 100 ml	NF	26025	12457	19241	NF	11446	24890	18168	NF	6695	10712	8704
Fluoride (mg/L)	None currently	NF	ND	0.2	0.1	NF	ND	ND	ND	NF	ND	0.2	0.1
Hardness mg/L	<10 and >2000 mg/L	NF	32	70	51	NF	39	44	42	NF	26	35	31
Lead (ug/L)	30 ug/L	NF	ND	ND	ND	NF	ND	ND	ND	NF	ND	ND	ND
MBAS Surfactants	0.2 mg/L	NF	0.53	0.46	0.50	NF	0.42	0.59	0.51	NF	0.39	0.47	0.43
NO3-N (mg-N/ L)	2.25 mg-N/ L	NF	0.2	0.5	0.4	NF	0.8	0.9	0.9	NF	0.3	0.5	0.4
PO4-P (mg-P/ L)	0.12 mg-P/ L	NF	0.3	0.3	0.3	NF	0.7	1.0	0.9	NF	0.4	0.4	0.4
Potassium (mg/L)	20 mg/ L	NF	3.7	5.0	4.4	NF	5.1	5.7	5.4	NF	3.6	4.0	3.8
TSS (mg/L)	500 mg/L	NF	7	7	7	NF	9	8	9	NF	8	6	7
Turbidity (NTU)	25 NTU	NF	4.0	4.7	4.4	NF	3.7	4.1	3.9	NF	4.8	4.4	4.6
Urea (ug/L)	None currently	NF	168	--	--	NF	740	--	--	NF	102	--	--
Zinc (ug/L)	200 ug/L	NF	100	124	112	NF	168	209	189	NF	75	72	74

**Pacific Grove 2016 MRSWMP Monitoring results continued**

Analytes	WQO or Action Level	Greenwood Park				Lovers				Pico			
		DR	FF- A	FF - B	FF Ave	DR	FF- A	FF - B	FF Ave	DR	FF- A	FF - B	FF Ave
Ammonia (mg/L)	50 mg/L	0.26	0.38	0.34	0.36	NF	0.33	0.33	0.33	ND	0.31	0.26	0.29
Color (Color Units)	500 color units	30	60	60	60	NF	24	60	42	60	60	80	70
Copper (ug/L)	30 ug/L	4	16	15	16	NF	19	19	19	5	27	31	29
<i>E. coli</i> (MPN/100 ml)	235 MPN/ 100 ml	1153	14287	23822	19105	NF	13197	16071	14634	30	41058	29093	35076
Enterococcus (MPN/100 ml)	104 MPN/ 100 ml	40	19038	12963	16001	NF	20982	16162	8704	416	10758	16071	13415
Fluoride (mg/L)	None currently	0.20	ND	ND	ND	NF	ND	ND	ND	0.10	ND	ND	ND
Hardness mg/L	<10 and >2000 mg/L	376	23	23	23	NF	26	35	31	179	38	34	36
Lead (ug/L)	30 ug/L	ND	ND	ND	ND	NF	6	ND	4	ND	ND	ND	ND
MBAS Surfactants	0.2 mg/L	0.08	0.38	0.37	0.38	NF	0.36	0.40	0.38	0.08	0.52	0.33	0.43
NO3-N (mg-N/ L)	2.25 mg-N/ L	1.1	0.2	0.2	0.2	NF	0.2	0.2	0.2	0.9	0.2	0.2	0.2
PO4-P (mg-P/ L)	0.12 mg-P/ L	ND	0.4	0.4	0.4	NF	0.5	0.5	0.5	ND	0.5	0.5	0.5
Potassium (mg/L)	20 mg/ L	7.3	4.2	3.7	4.0	NF	4.3	4.7	4.5	4.6	7.6	7.1	7.4
TSS (mg/L)	500 mg/L	2	12	11	12	NF	25	15	20	ND	14	13	14
Turbidity (NTU)	25 NTU	4.5	13.0	7.2	10.1	NF	15.0	9.6	12.3	10.0	6.2	9.5	7.9
Urea (ug/L)	None currently	92	143	--	--	NF	135	--	--	ND	89	--	--
Zinc (ug/L)	200 ug/L	ND	96	90	93	NF	83	76	80	23	74	62	68

## Seaside 2016 MRSWMP Monitoring results.

Table results include the Dry Run (DR), First Flush time series (FF-A and FF-B) and FF results averaged for the two time series. Shaded boxes indicate that a Water Quality Objective (WQO) or Action Level was exceeded. ND= Non-detect; NF= No Flow; -- = Not included in MRSWMP monitoring.

Analytes	WQO or Action Level	Bay Street			
		Dry Run	First Flush-A	First Flush - B	FF Average
Ammonia (mg/L)	50 mg/L	NF	0.35	0.42	0.39
Color (Color Units)	500 color units	NF	60	60	60
Copper (ug/L)	30 ug/L	NF	32	24	28
<i>E. coli</i> (MPN/ 100 ml)	235 MPN/ 100 ml	NF	21416	20635	21026
Enterococcus (MPN/ 100 ml)	104 MPN/ 100 ml	NF	19683	17233	18458
Fluoride (mg/L)	None currently	NF	ND	0.2	0.1
Hardness mg/L	<10 and >2000 mg/L	NF	23	23	23
Lead (ug/L)	30 ug/L	NF	10	6	8
MBAS Surfactants (mg/L)	0.2 mg/L	NF	0.48	0.53	0.51
NO3-N (mg-N/ L)	2.25 mg-N/ L	NF	0.2	0.3	0.3
PO4-P (mg-P/ L)	0.12 mg-P/ L	NF	0.3	0.4	0.4
Potassium (mg/L)	20 mg/ L	NF	2.4	3.2	2.8
TSS (mg/L)	500 mg/L	NF	48	16	32
Turbidity (NTU)	25 NTU	NF	16.0	8.5	12.3
Urea (ug/L)	None currently	NF	205	--	--
Zinc (ug/L)	200 ug/L	NF	159	117	138

## **Appendix 4: Receiving Water Sampling**

## **Appendix 4. Receiving Water Monitoring**

### **Introduction**

The 2016-2017 MRSWMP monitoring program added the collection and analysis of receiving water samples from two sites in Pacific Grove during the First Flush. Collecting receiving water samples and discharge samples can provide a more complete understanding of the fate of common urban pollutants once they flow into the ocean during a major rainstorm. Specific receiving water sites were selected based upon ease of sample collection and to compliment previous Areas of Special Biological Significance (ASBS) monitoring that was done at the end of pipe and in the receiving water at Lovers Point and 8<sup>th</sup> Street.

### **Methods**

Sample collection protocols were the same as those used for all of the MRSWMP water quality monitoring events. However, because these samples were collected from the ocean, a different laboratory was used to analyze copper, lead and zinc in order to achieve lower MDLs. Receiving water samples were collected by MBNMS staff and a volunteer and analyzed for the same parameters as those for the other MRSWMP monitoring (Table 1).

Samples were collected and analyzed for the same list of analytes as for the outfall monitoring: nutrients (nitrate, orthophosphate, ammonia and urea), bacteria (*Escherichia coli* and enterococcus), metals (copper, lead and zinc) and total suspended solids, color, Methylene Blue Active Substances (MBAS) detergents, fluoride, hardness (as CaCO<sub>3</sub>), potassium and turbidity. Receiving water samples were to be collected from the ocean as close to the point where the water flows from the outfall into the ocean.

All results from this receiving water study are compared to actual receiving water standards established for beneficial uses in the ocean. All Water Quality Objectives and Action Levels and their accompanying sources are listed in Table A1. In cases where the Ocean Plan provided more protection of receiving water quality than those water quality objectives used for end of pipe monitoring, the Ocean Plan water quality objectives are used and noted.



MBNMS staff, Lisa Emanuelson, approaches waves at 8<sup>th</sup> Street (Pacific Grove) to collect a sample.

**Table A1: Receiving Water Quality Objectives**

<b>Parameter (reporting units)</b>	<b>Water Quality Objectives</b>	<b>Source of Objective</b>
Ammonia	Not to exceed 50 mg/L	SWRCB NPDES MS4 General Permit
Color	Not to exceed 500	SWRCB NPDES MS4 General Permit
Copper (µg/L)	Not to exceed 30	California Ocean Plan 2015
<i>E. coli</i> (MPN/100ml)	Not to exceed 235 <sup>1</sup>	EPA Ambient Water Quality Criteria
Enterococcus (MPN/100ml)	Not to exceed 104	EPA Ambient Water Quality Criteria
Fluoride (mg/L)	NA	NA
Hardness as CaCO <sub>3</sub> (mg/L)	Not less than or = to 10 or greater than or = to 2,000	SWRCB NPDES MS4 General Permit
Lead (µg/L)	Not to exceed 20	California Ocean Plan 2015
MBAS Detergents (mg/L)	Not to exceed 0.2	Water Quality Control Plan for the Central Coast
Nitrate as N (mg/L)	Not to exceed 2.25 <sup>2</sup>	Central Coast Ambient Monitoring Program (CCAMP)
Orthophosphate as P (mg/L)	Not to exceed 0.12 <sup>3</sup>	Central Coast Ambient Monitoring Program (CCAMP)
Potassium (mg/L)	Not to exceed 20	SWRCB NPDES MS4 General Permit
Total Suspended Solids (TSS) (mg/L)	Not to exceed 500 <sup>4</sup>	Central Coast Ambient Monitoring Program (CCAMP)
Turbidity (NTU)	Not to exceed 225	California Ocean Plan 2015
Urea (µg/L)	NA	NA
Zinc (µg/L)	Not to exceed 200 <sup>1</sup>	California Ocean Plan 2015

<sup>1</sup> Environmental Protection Agency, Updated WQO.

<sup>2</sup> Central Coast Ambient Monitoring Program, Pajaro River Watershed Characterization Report 1998, rev 2003.

<sup>3</sup> Williamson, The Establishment of Nutrient Objectives, Sources, Impacts and Best Management Practices for the Pajaro River and Llagas Creek, 1994.

<sup>4</sup> Central Coast Ambient Monitoring Program, Salinas River Watershed Characterization Report 1999, rev. 2000.



Receiving water samples were all grab samples, collected as close as possible to the point of discharge where the water meets the ocean. Receiving water samples were collected during daylight hours to provide a safe environment for sample collection. For this reason, samples were collected approximately 5 hours after the outfall sampling occurred. Samples were collected using the same equipment as that used for the Dry Run and First Flush; however no field measurements were collected. The 8<sup>th</sup> Street sample was collected using a bucket from the beach approximately 30 feet from the outfall while the Lovers Point sample was collected with the aid of a surfer who paddled out into the cove, several hundred yards from the outfall, and filled sample bottles and then paddled the bottles back to the beach.

## **Results**

Receiving water results are presented for each site along with that site's average results from First Flush as a comparison. First Flush average results are from two samples collected 30 minutes apart. Receiving water samples are from a single grab sample. Receiving water samples could not be collected at the same time as outfall samples due to the lack of daylight and safety concerns at the two sites.

The 8<sup>th</sup> street beach is a small pocket beach with a drainage area of 35 acres. The watershed area is all residential. 8<sup>th</sup> Street 2016 outfall and receiving water results are listed in Table A2.

**Table A2** 8<sup>th</sup> Street outfall and receiving water results for First Flush samples.

Parameter	Units	Outfall Monitoring		Receiving Water Monitoring	
		Result	MDL	Result	MDL
Ammonia	mg/L	0.32	0.05	0.06	0.05
Color	color units	50	12	40	12
Copper- total	µg/L	26	1.0	4.2000	0.0038
<i>Escherichia coli (E. coli)</i>	MPN/ 100 ml	12,885	100	1,919	20
Enterococcus	MPN/ 100 ml	8,704	100	2,627	20
Fluoride	mg/L	0.10	0.02	1.10	0.04
Hardness	mg/L	31	10	4962	10
Lead- total	µg/L	ND	0.2	0.9100	0.0014
MBAS Detergents	mg/L	0.43	0.05	0.21	0.05
Nitrate as N	mg-N/L	0.40	0.01	0.2	0.02
Orthophosphate as P	mg-P/L	0.40	0.02	0.10	0.04
Potassium	mg/L	3.8	0.3	329	6
Total Suspended Solids	mg/L	7	2	7	2
Turbidity	NTU	4.60	0.03	5.00	0.03
Urea	µg/L	102	8	20	8
Zinc- total	µg/L	74	20	12.000	0.036

Overall constituent concentrations decreased in seawater except fluoride, lead, turbidity, hardness and potassium. Hardness and potassium were above the Action Levels, however the ocean contains quite a

bit of calcium carbonate and potassium so much so that calcium and potassium are within the top six constituents in seawater. Bacteria and detergents were still over the Water Quality Objectives (WQO) for receiving water samples, however the concentrations are lower by more than half.

The Lovers Point watershed is the largest of all Pacific Grove watersheds at 240 acres. The watershed consists of primarily residential with some commercial land uses. Due to high storm surge and the difficulty of getting to the base of the outfall, the Lovers Point receiving water sample was taken from the middle of the cove with the help of a local surfer. Lovers Point 2016 outfall and receiving water results are listed in Table A3.

**Table A3.** Lovers Point outfall and receiving water results for First Flush samples.

Parameter	Units	Outfall Monitoring		Receiving Water Monitoring	
		Result	MDL	Result	MDL
Ammonia	mg/L	0.33	0.05	ND	0.05
Color	color units	42	12	7	3
Copper- total	µg/L	19	1	0.4500	0.0038
<i>Escherichia coli (E. coli)</i>	MPN/ 100 ml	14,634	100	313	20
Enterococcus	MPN/ 100 ml	18,572	100	398	20
Fluoride	mg/L	ND	0.02	1.1	0.04
Hardness	mg/L	31	10	5,613	10
Lead- total	µg/L	4.0	0.2	0.1900	0.0014
MBAS Detergents	mg/L	0.38	0.05	0.12	0.05
Nitrate as N	mg-N/L	0.2	0.01	0.1	0.02
Orthophosphate as P	mg-P/L	0.5	0.02	0.1	0.04
Potassium	mg/L	4.5	0.3	380	6
Total Suspended Solids	mg/L	20	2	7	2
Turbidity	NTU	12.30	0.03	1.90	0.03
Urea	µg/L	135	8	ND	8
Zinc- total	µg/L	80	20	2.000	0.038

As with 8<sup>th</sup> Street, overall constituent concentrations decreased in seawater except fluoride, hardness and potassium. Hardness and potassium were above the Action Levels, however the ocean contains quite a bit of calcium carbonate and potassium so much so that calcium and potassium were within the top six constituents in seawater. *E. coli* and enterococcus results were over the Water Quality Objectives (WQO) for both end of pipe and receiving water samples.