



**Monterey Bay Sanctuary Citizen Watershed Monitoring Network**  
99 Pacific Street, Bldg 455, Monterey, CA 93940 Bus. (831) 647-4227 Fax (831) 647-4250

# Dry Run & First Flush 2013 Monitoring Report

Prepared by:  
Lisa Emanuelson, Volunteer Monitoring Coordinator  
Monterey Bay National Marine Sanctuary

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## **Acknowledgements**

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## **Introduction**

Urban pollutants that are deposited on hard surfaces during dry weather are then washed away in winter rainstorms into rivers, storm drains and the ocean. The first winter rainstorm can have the highest concentration of pollutants because it is flushing months of built up pollutants that accumulate during the dry weather. These pollutants can be from sources such as brake dust, emissions from cars, animal waste, detergents from car washing, pesticides and fertilizers, among other chemicals commonly found in and around homes and businesses. By monitoring the water quality of the first rain event, it can give an indication of pollution sources and pollution loads going into the ocean.

The Monterey Bay National Marine Sanctuary (MBNMS) and the Coastal Watershed Council (CWC) teamed up with volunteers to monitor a dry weather event called the Dry Run and the water flowing into the ocean during the first major rain storm called the First Flush. The geographic scope of this program extends from the City of Santa Cruz in the north, to the Carmel River in Monterey County in the south (Fig. 1).

The Monterey Bay National Marine Sanctuary (MBNMS) was responsible for monitoring sites for the Monterey Regional Storm Water Monitoring Program (MRSWMP) in Monterey County. The Coastal Watershed Council (CWC) coordinated the monitoring sites in the City of Santa Cruz, the City of Soquel and the City of Capitola, all in Santa Cruz County.

For the past fourteen years, volunteers have braved winter weather and early morning hours to collect samples of water at storm drain outfalls in cities on the Central California coast. Volunteers are on call twenty-four hours a day seven days a week. Having willing and trained volunteers is critical for a program with this range and scope. Samples are analyzed for common urban pollutants: bacteria (*Escherichia coli* (*E. coli*) and enterococcus), nutrients (nitrate, phosphate and urea), metals (total copper, total lead, total zinc) and total suspended solids.

The Dry Run was conducted on September 8<sup>th</sup> in Santa Cruz and Monterey Counties. The First Flush for the City of Santa Cruz sites occurred on September 21<sup>st</sup> at mid-day. Not enough rain fell in the other areas to collect samples at any other sites in Santa Cruz or Monterey Counties. The next rain storm, with enough moisture to be able to sample, occurred mid-morning on October 28<sup>th</sup> in Monterey County. Seven of the 11 sites were sampled during this brief storm. The last storm to drop enough moisture to sample, occurred on November 19<sup>th</sup> and 20<sup>th</sup>. During this storm, sites in Capitola, Soquel and Pajaro were sampled starting at around 6 pm. The rest of the Monterey County sites were sampled starting at 2 am on the 20<sup>th</sup>. In all, twenty-two storm drain outfalls were monitored by fifty-four extraordinary volunteers.

**Figure 1.** 2013 Dry Run and First Flush Sites

## Methods

In early September volunteers were trained to follow standardized procedures for field measurements and to collect water samples for laboratory analysis. Following the classroom training, field training was conducted at a local outfall focusing on a demonstration of field measurements and sample collection. This day is known as the Dry Run and is conducted on a weekend day after the classroom training. After the demonstration, teams of volunteers went to their respective sites for area familiarization, took field measurements, and collected water samples. The Dry Run is conducted well ahead of any predicted rain and provides the volunteers with a chance to test equipment at their specific sites and provides water quality information for dry weather runoff. The same analytes that are measured for the First Flush program were measured during the Dry Run. They include: nutrients (nitrate, orthophosphate, urea), bacteria (*E. coli* and enterococcus), metals (copper, lead and zinc), hardness, and total suspended solids. Field measurements were taken for water temperature, pH, electrical conductivity, and transparency.

Conductivity was measured using an Oakton EC Tester; water temperature was measured using a spirit bulb or digital thermometer. Transparency and pH were not measured this year because we mobilized at night and daylight is required for these measurements. Physical observations such as trash, odor, bubbles, scum, and oil sheen were also recorded on the data sheet.

All results (field and lab) are compared to receiving water standards set for particular beneficial uses in a stream, lake, or ocean—they are not meant for end-of-pipe discharges. However, lacking any other effluent standard, they provide some context for the results. Dilution and/or mixing is expected to occur in the receiving waters within a short distance of each outfall. Metal results are compared to the Central Coast Basin Plan's Water Quality Objectives (WQO) for the protection of marine aquatic life. Nitrate, orthophosphate, and total suspended solids results are compared with the Central Coast Ambient Monitoring Program's (CCAMP) attention levels (see Table 1). For all analytes, Minimum Detection Limits (MDL) are noted. The MDL is the minimum concentration that a lab instrument can detect for a given analyte. For sites that have a non-detect listed, it is placed on the graph at half the MDL, however the value is somewhere between zero and the MDL.

**Table 1: Water Quality Objectives (Urea is not listed because it does not have an objective)**

<b>Parameter (reporting units)</b>	<b>Water Quality Criterion</b>	<b>Source of criterion</b>
<b>Copper (ppb)</b>	<b>Not to exceed 30<sup>7</sup></b>	<b>Basin Plan Objective</b>
<b><i>E. coli</i> (MPN/100ml)</b>	<b>Not to exceed 235<sup>1</sup></b>	<b>EPA Ambient Water Quality Criteria</b>
<b>Enterococcus (MPN/100ml)</b>	<b>Not to exceed 104</b>	<b>EPA Ambient Water Quality Criteria</b>
<b>Lead (ppb)</b>	<b>Not to exceed 30<sup>7</sup></b>	<b>Basin Plan Objective</b>
<b>Nitrate as N (ppm)</b>	<b>Not to exceed 2.25<sup>2</sup></b>	<b>Central Coast Water Board</b>
<b>Orthophosphate as P (ppm)</b>	<b>Not to exceed 0.12<sup>3</sup></b>	<b>Central Coast Water Board</b>
<b>pH</b>	<b>Not lower than 6.5 or greater than 8.5</b>	<b>Basin Plan Objectives</b>
<b>Total Suspended Solids (TSS) (ppm)</b>	<b>Not to exceed 500<sup>8</sup></b>	<b>Central Coast Water Board</b>
<b>Transparency (cm)</b>	<b>Not less than 20<sup>4</sup></b>	<b>Central Coast Water Board</b>
<b>Turbidity (NTU)</b>	<b>Not greater than 25<sup>5</sup></b>	<b>Central Coast Water Board</b>
<b>Water Temperature (°C)</b>	<b>Not more than 21<sup>6</sup></b>	<b>Central Coast Water Board</b>
<b>Zinc (ppb)</b>	<b>Not to exceed 200<sup>7</sup></b>	<b>Basin Plan Objective</b>

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

<sup>6</sup> Williamson, "The Establishment of Nutrient Objectives, Sources, Impacts and Best Management Practices for the Pajaro River and Llagas Creek", 1994.

<sup>4</sup> Based on equivalent turbidity guideline value used for 303(d) Listing Guideline Value (Sigler et al., 1985) ([http://www.secchidipin.org/Transparency\\_Tube.htm](http://www.secchidipin.org/Transparency_Tube.htm))

<sup>4</sup> 303(d) Listing guideline value, based on Sigler et al., 1985

<sup>5</sup> Central Coast Ambient Monitoring Program, Pajaro River Watershed Characterization Report 1998, rev 2003.

<sup>6</sup> 303(d) Listing guideline value, based on Moyle, P. 1976. Inland Fisheries of California. Univ. of California Press.

<sup>7</sup> Basin Plan Cold Water Objective for hard water.

<sup>8</sup> Central Coast Ambient Monitoring Program, Salinas River Watershed Characterization Report 1999, rev. 2000.

## **Results/Discussion**

This year, with the beginning of Areas of Special Biological Significance (ASBS) monitoring, Carmel (in Monterey County) opted out of having three of their storm drain outfalls monitored during the First Flush. For that reason the number of monitored sites is 25 for the Dry Run and only 22 for the First Flush. The Carmel sites not monitored during the First Flush were: 4<sup>th</sup> Avenue, 8<sup>th</sup> Avenue and Santa Lucia.

Dry Run samples were collected in Santa Cruz and Monterey Counties on September 7<sup>th</sup>. All sites were visited for the Dry Run but only 11 of the 25 sites had enough flow to be sampled.

Dry Run monitoring results are from a single sample in comparison to First Flush sampling results, which are either one sample (Santa Cruz), or two time series samples separated by 30 minutes (Monterey County, Seaside, Monterey, Pacific Grove, and Carmel), or two time series samples separated by 60 minutes (Capitola and Soquel).

After the Dry Run and leading up to the First Flush event, the coordinators from CWC and MBNMS closely monitored the weather, notifying volunteers of approaching storms. When a storm had the potential to generate enough rainfall for First Flush mobilization, the coordinators placed the volunteers on standby until established criteria were met. Mobilization criteria includes sheeting water on roadways, heavy flow through the storm drain system and conductivity levels less than 1000 micro Siemens ( $\mu\text{S}$ ) and declining.

This year was particularly difficult to anticipate mobilization as the storms that hit the central coast on September 21<sup>st</sup> and October 28<sup>th</sup> both generated much more runoff than was expected. The Coastal Watershed Council was able to mobilize for only the City of Santa Cruz sites on September 21<sup>st</sup> starting just after mid-day, but no sites south of Santa Cruz had enough runoff to mobilize. Another storm occurred on October 28<sup>th</sup>, which allowed for the Seaside, Monterey and Pacific Grove sites to be sampled. This storm was very unusual in that it had much more moisture content than expected and somehow was below the radar which made predictions of storm extent and duration extremely difficult. The third storm to hit the central coast was on November 19<sup>th</sup> and 20<sup>th</sup>. This storm had many squalls that came over the central coast and allowed for sampling of the remaining Capitola and Soquel sites in Santa Cruz County on the afternoon of the 19<sup>th</sup>. The storm continued and allowed for sampling of the Monterey County site in Pajaro late on the 19<sup>th</sup> and the City of Monterey, Carmel-by-the-Sea, and one last Monterey County site in the early hours of the 20<sup>th</sup>.

For 2013, the San Mateo County Resource Conservation District (SMCRCD) decided to not participate in the Dry Run and First Flush due to staffing and budget concerns. The graphs contain the San Mateo County data from past years.

All data is available upon request.

**Table 2: Range of results for Dry Run and First Flush 2013**

<b>Parameter</b>	<b>Dry Run 2013</b>	<b>First Flush 2013</b>
Conductivity	530 - 1730 $\mu$ S	150 - 1040 $\mu$ S
Copper- total	ND - 16 $\mu$ g/L	ND - 248 $\mu$ g/L
Escherichia coli ( <i>E. coli</i> )	<20 - 39,726 MPN/100ml	201 – 148,335 MPN/100ml
Enterococcus	<20 – 22,398 MPN/100ml	<100 – 127,750 MPN/ 100ml
Lead- total	All results were ND	ND - 41 $\mu$ g/L
Nitrate as N	ND - 4.2 mg-N/L	ND – 3.3 mg-N/L
Orthophosphate as P	All results were ND	ND – 4.2 mg-P/L
pH	6.5- 8.0	5.5 – 7.8
Total Suspended Solids (TSS)	ND - 26 mg/L	6 – 319 mg/L
Transparency	6 - >120 cm	8 – 25 cm
Urea	ND - 131 $\mu$ g/L	83 - 2075 $\mu$ g/L
Water temperature	16.0 – 22.3 °C	11.9 – 19.9 °C
Zinc- total	ND - 140 $\mu$ g/L	ND - 665 $\mu$ g/L



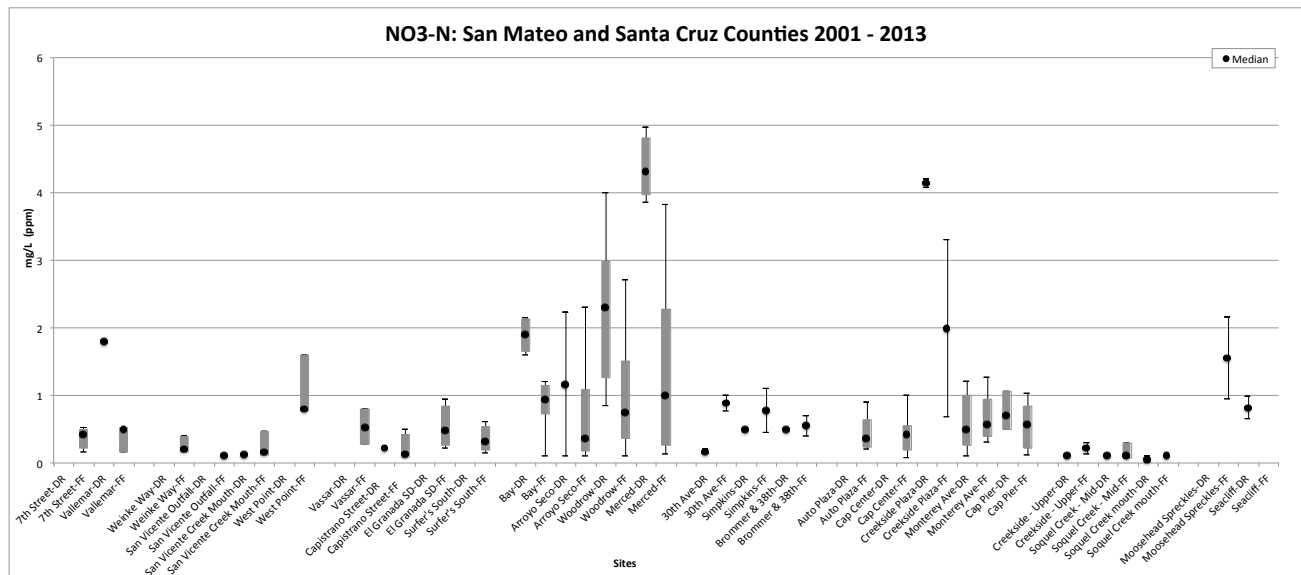
# Nutrients

## Nitrate

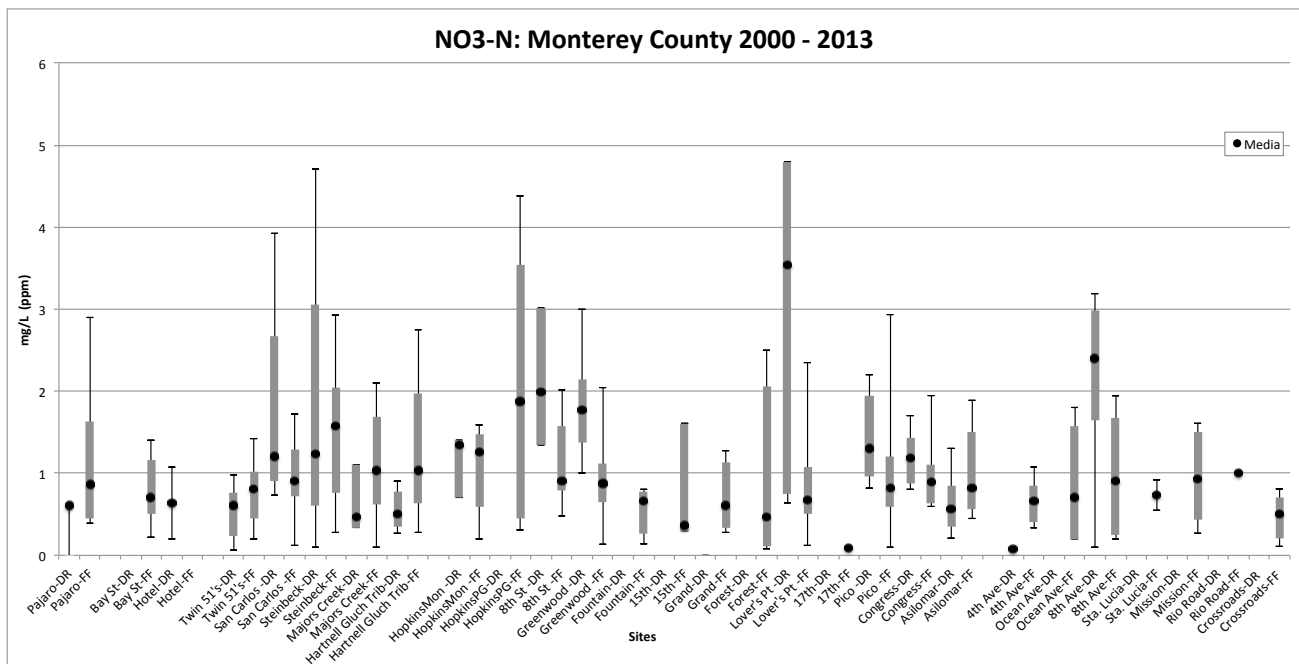
Although nitrate and orthophosphate are needed for plant growth, they are not normally found in elevated concentrations in aquatic systems. Nitrate as with other nutrients, can lead to algal blooms that degrade water quality as those plants die off and consume oxygen in their decomposition. Nitrate sources include runoff from fertilized lawns, agricultural and pasture lands, construction sites and septic/sewer systems. The CCAMP attention level for nitrate as N (NO<sub>3</sub>-N) is 2.25 mg-N/L. The minimum detection limit (MDL) was 0.1 mg-N/L for both the Dry Run and First Flush.

For the **Dry Run**, one of the eleven sites sampled (9%) was above the attention level for nitrate. The highest result was in Santa Cruz (Creskide Plaza) with a value of 4.2 mg-N/L (Figs. 2 and 3). Three sites in Soquel had non-detects: Creskide- Upper, Soquel Creek- Mid, Soquel Creek- Mouth.

During the **First Flush**, one of the twenty-two monitored sites (5%) was above the attention level for nitrate. The highest concentration was in Capitola (Creskide Plaza) with a time series average of 3.3 mg-N/L (Figs. 2 and 3). The only site with a non-detect was in Soquel (Soquel Creek Mouth).



**Figure 2.** Nitrate-N for the Dry Run and time series averages for First Flush in San Mateo and Santa Cruz Counties. Non-detects were given the value of half the Minimum Detection Limit (MDL) but their true value lies between the zero and the MDL. All sites grouped by city from north to south- Montara, Moss Beach, El Granada, Santa Cruz, Capitola, Soquel,



**Figure 3.** Nitrate-N for the Dry Run and time series averages for First Flush in Monterey County. Non-detects were given the value of half the Minimum Detection Limit (MDL) but their true value lies between the zero and the MDL. All sites grouped by city from north to south- Pajaro (Monterey County), Seaside, Monterey, Pacific Grove and Carmel.

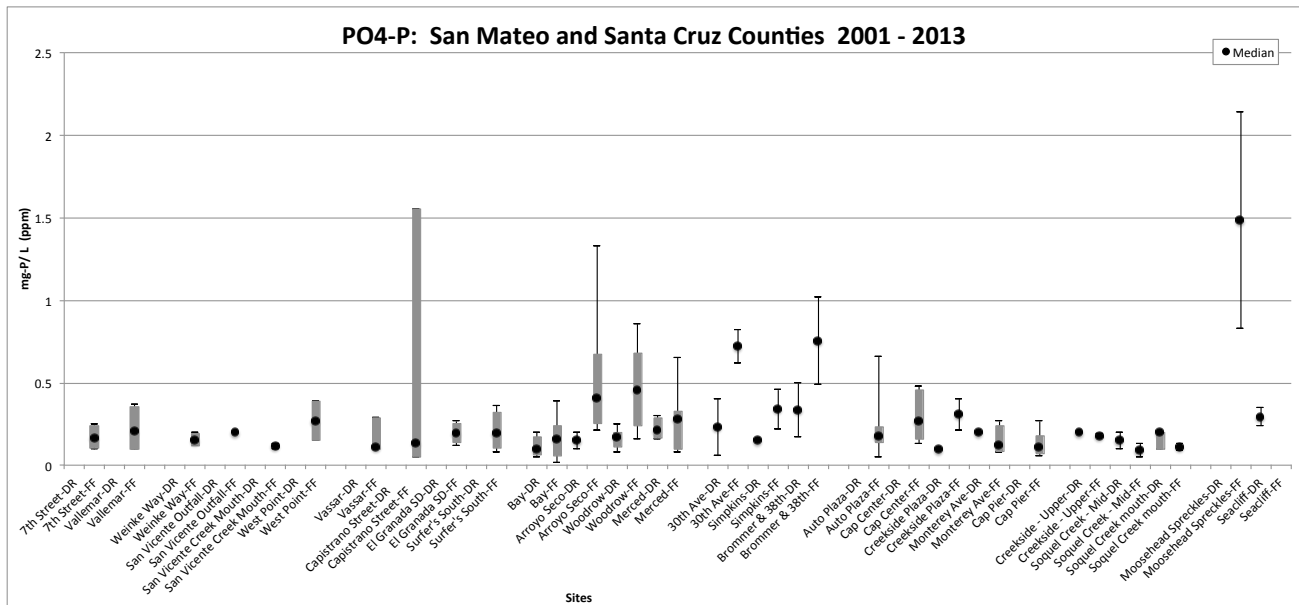
### Orthophosphate

Orthophosphate, like nitrate, is also necessary for plant growth. As with nitrate, orthophosphate can lead to degradation of water as plants grow uncontrolled, complete their life cycle, and decompose, taking up

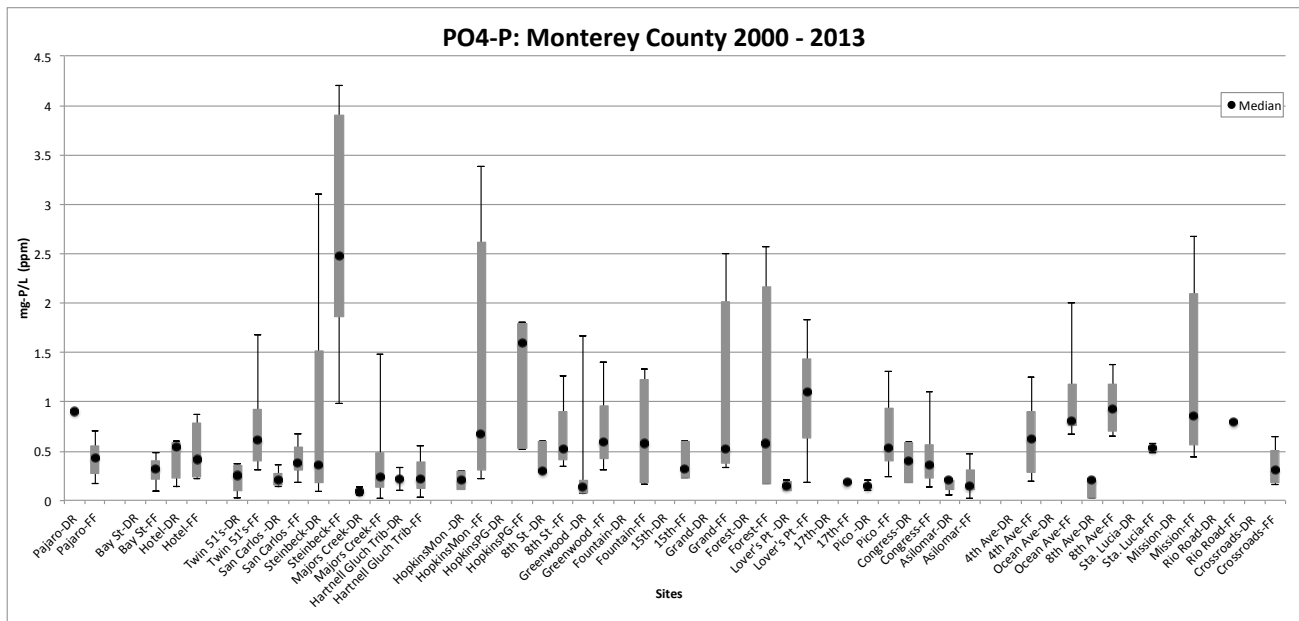
oxygen in the process. Sources of orthophosphate are similar to those for nitrate: leaks in sewer or septic systems, excess fertilizers from urban or agricultural areas, and detergents. The CCAMP attention level for orthophosphate ( $\text{PO}_4\text{-P}$ ) is 0.12 mg-P/L. The MDL was 0.1 mg-P/L for both the Dry Run and First Flush.

For the **Dry Run**, all of the sampled sites had non-detectable levels of orthophosphate.

During the **First Flush**, seventeen sites (77%) monitored were above the attention level for orthophosphate. Monterey (Steinbeck) had the highest average time series concentration for orthophosphate with a result of 4.2 mg-P/L (Figs. 4 and 5). Non-detects were noted for five sites across the region: Capitola (Monterey Avenue and Capitola Pier) and Soquel (Creekside- Upper, Soquel Creek- Mid, Soquel Creek- Mouth).



**Figure 4.** Orthophosphate-P for the Dry Run and time series averages for First Flush in San Mateo and Santa Cruz Counties. Non-detects were given the value of half the Minimum Detection Limit (MDL) but their true value lies between the zero and the MDL. All sites grouped by city from north to south- Montara, Moss Beach, El Granada, Santa Cruz, Capitola, Soquel,



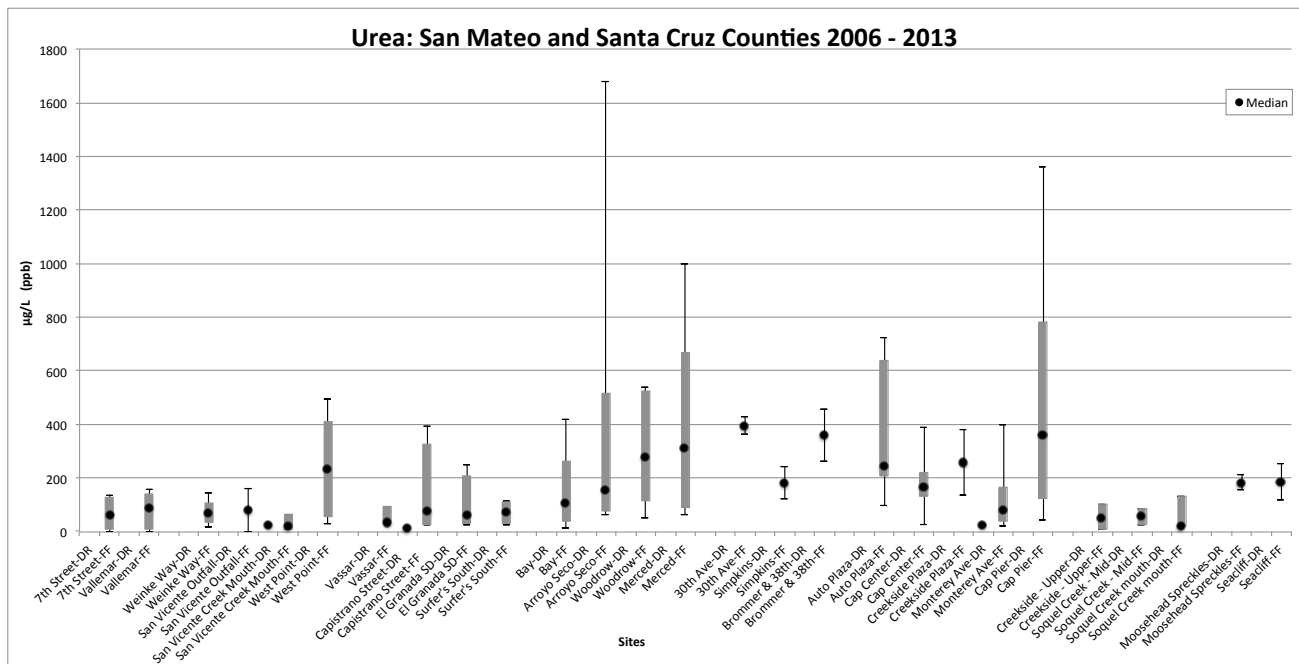
**Figure 5.** Orthophosphate-P for the Dry Run and time series averages for First Flush in Monterey County. Non-detects were given the value of half the Minimum Detection Limit (MDL) but their true value lies between the zero and the MDL. All sites grouped by city from north to south- Pajaro (Monterey County), Seaside, Monterey, Pacific Grove and Carmel.

## Urea

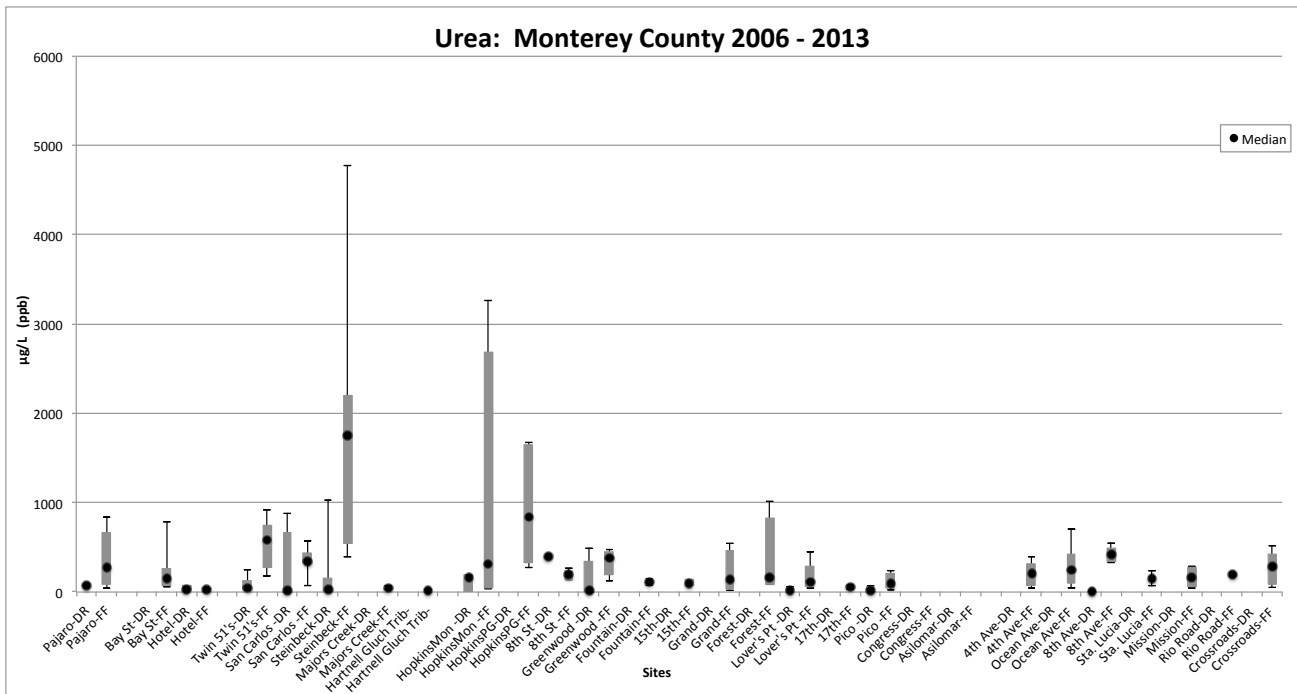
Urea is an organic compound that is soluble in water; therefore it is an excellent fertilizer and is often used for agricultural applications. There are many sources of urea including fire retardants, cigarettes, fertilizers, animal feeds, detergents, and mammalian urine. This was the fifth year that urea was analyzed for this program. While there is no water quality objective for urea, values are noted and compared to previous year's results in order to monitor trends. Urea was only collected during the first time series at all sites. The MDL was 10 µg/L for both the Dry Run and First Flush.

For the **Dry Run**, only sites in Monterey County were monitored for urea. The highest urea result was in Monterey (Twins) with a concentration of 131 µg/L (Figs. 6 and 7).

During the **First Flush**, urea was only measured during the first time series. Monterey (Steinbeck) had the highest result of 2075 µg/L (Figs. 6 and 7).



**Figure 6.** Urea results for the Dry Run and First Flush in San Mateo and Santa Cruz Counties. Non-detects were given the value of half the Minimum Detection Limit (MDL) but their true value lies between the zero and the MDL. All sites grouped by city from north to south- Montara, Moss Beach, El Granada, Santa Cruz, Capitola, Soquel,



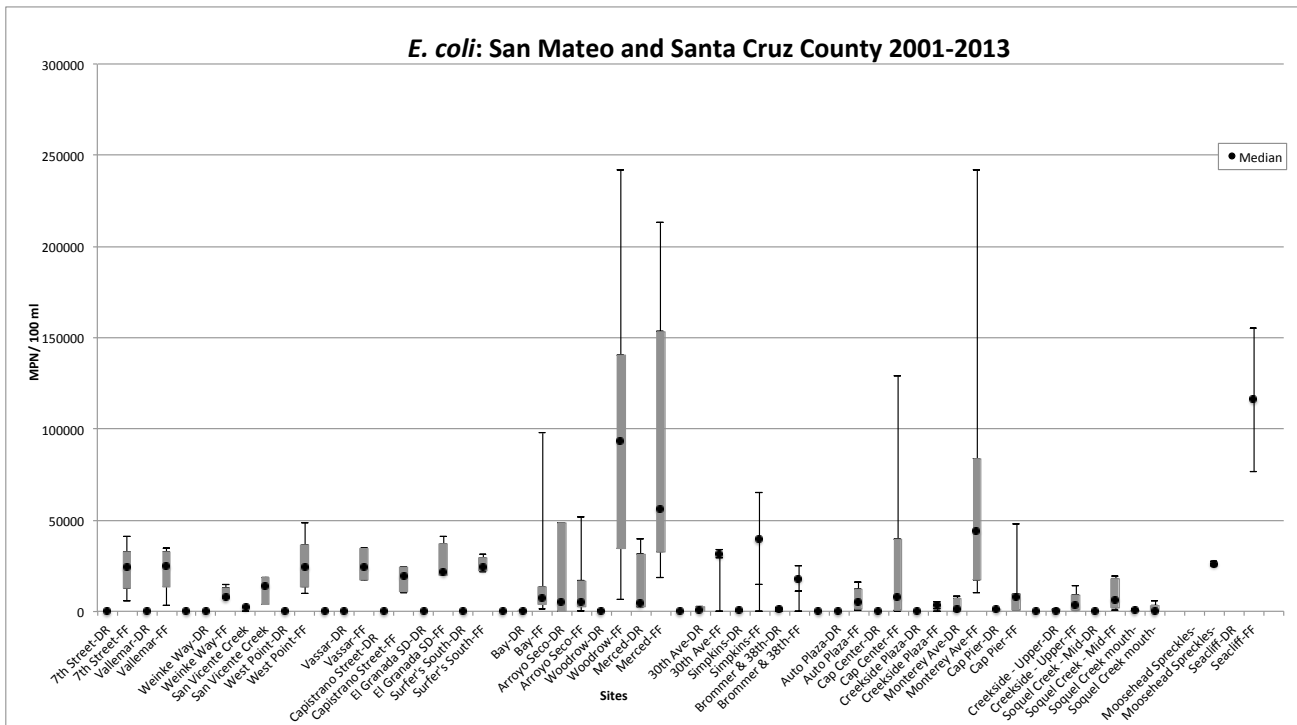
**Figure 7.** Urea results for the Dry Run and First Flush in Monterey County. Non-detects were given the value of half the Minimum Detection Limit (MDL) but their true value lies between the zero and the MDL. All sites grouped by city from north to south- Pajaro (Monterey County), Seaside, Monterey, Pacific Grove and Carmel.

## Bacteria

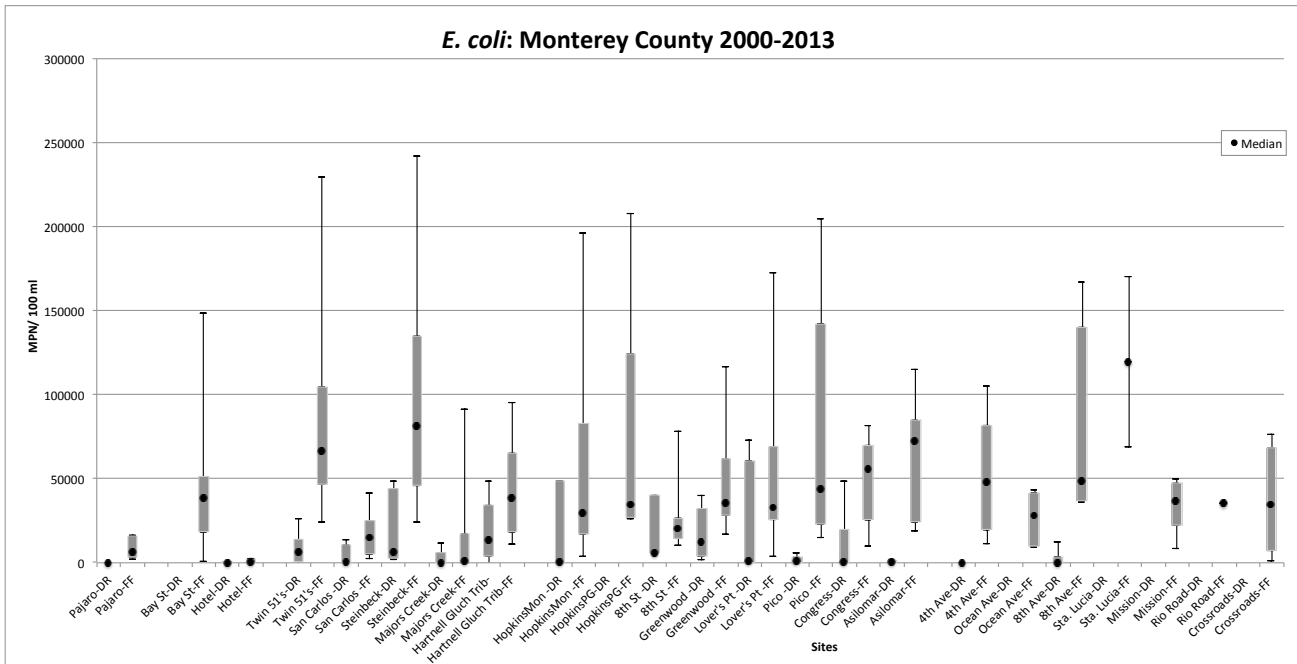
*Escherichia coli* (*E. coli*) and enterococcus are two types of fecal indicator bacteria. *E. coli* and enterococcus, found in the intestines of warm blooded animals, make their way into waterways and the ocean from wildlife populations, through improper domestic animal waste disposal, as well as sewer or septic systems. While these bacteria don't necessarily cause disease in humans, their presence does indicate the potential for other human specific pathogens to be present. The U.S. Environmental Protection Agency water quality criterion for grab samples for *E. coli* is 235 MPN/100 ml and for enterococcus, 104 MPN/100 ml. The MQL for both *E.coli* and enterococcus was 1 MPN/100ml for the Dry Run and 100 MPN/ 100 ml for the First Flush.

For the **Dry Run**, eight of the eleven sites (73%) sampled were above the WQO for *E. coli* and enterococcus. The highest *E. coli* result was 39,726 MPN/100 ml at Pacific Grove (Greenwood Park) (Fig. 8 and 9). The highest enterococcus result was 22,398 MPN/ 100 ml in Monterey (Twins) (Figs. 10 and 11).

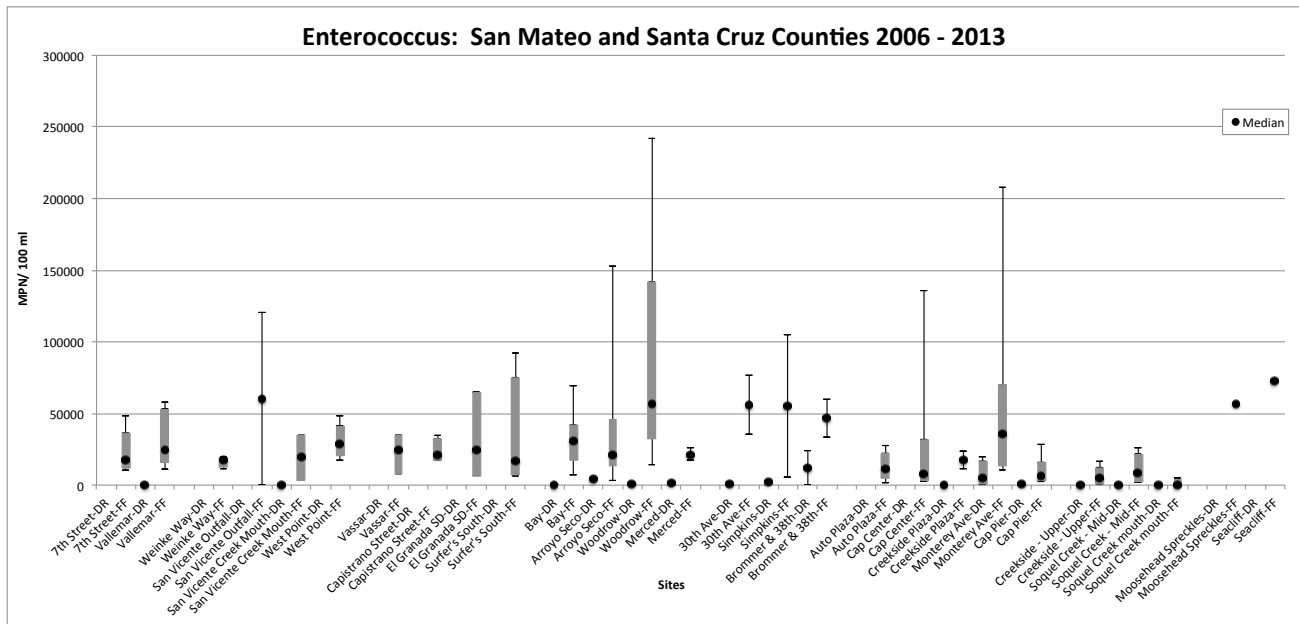
During the **First Flush** both types of bacteria were present in all cities and at all sites. Twenty-one of the twenty-two sites monitored (95%) were above the WQO for *E.coli* and enterococcus. The highest average result for *E.coli* was 148,335 MPN/100 ml in Seaside (Bay Street) (Figs. 8 and 9), and the highest average result for enterococcus was 127,750 MPN/100 ml in Pacific Grove (Lovers) (Figs. 10 and 11).



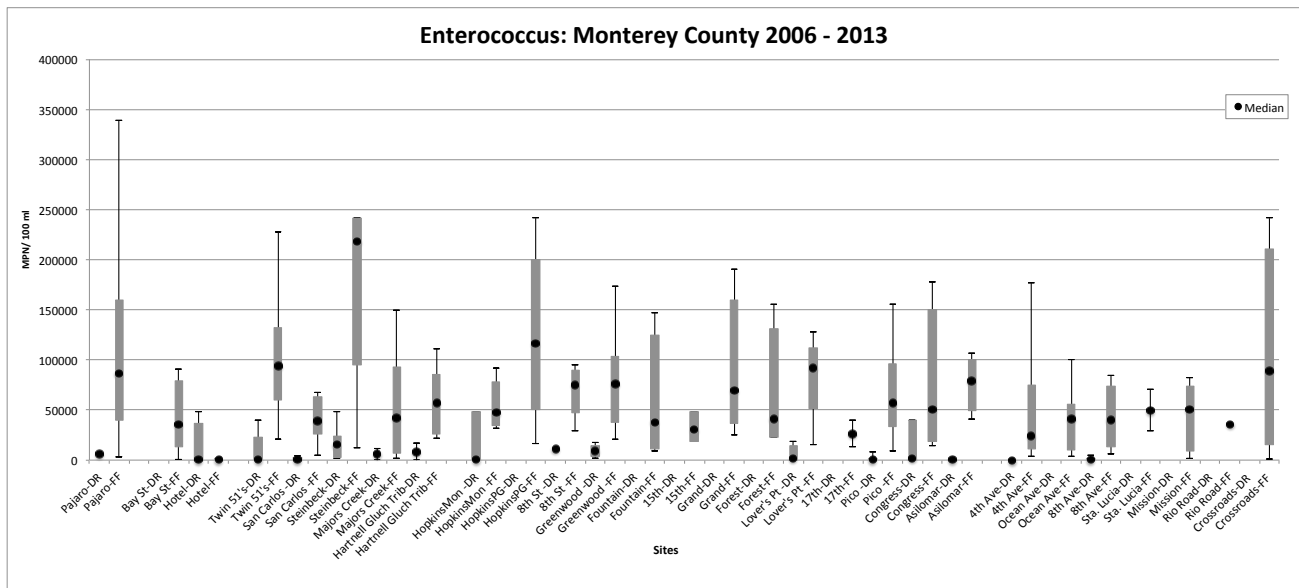
**Figure 8.** *E. coli* results for the Dry Run and time series averages for First Flush in San Mateo and Santa Cruz Counties. All sites grouped by city from north to south- Montara, Moss Beach, El Granada, Santa Cruz, Capitola, Soquel,



**Figure 9.** *E. coli* results for the Dry Run and time series averages for First Flush in Monterey County. All sites grouped by city from north to south- Pajaro (Monterey County), Seaside, Monterey, Pacific Grove and Carmel.



**Figure 10.** Results for enterococcus for the Dry Run and time series averages for First Flush in San Mateo and Santa Cruz Counties. All sites grouped by city from north to south- Montara, Moss Beach, El Granada, Santa Cruz, Capitola, Soquel,



**Figure 11.** Results for enterococcus for the Dry Run and time series averages for First Flush in Monterey County. Non-detects were given the value of half the Minimum Detection Limit (MDL) but their true value lies between the zero and the MDL. All sites grouped by city from north to south- Pajaro (Monterey County), Seaside, Monterey, Pacific Grove and Carmel.

## Metals

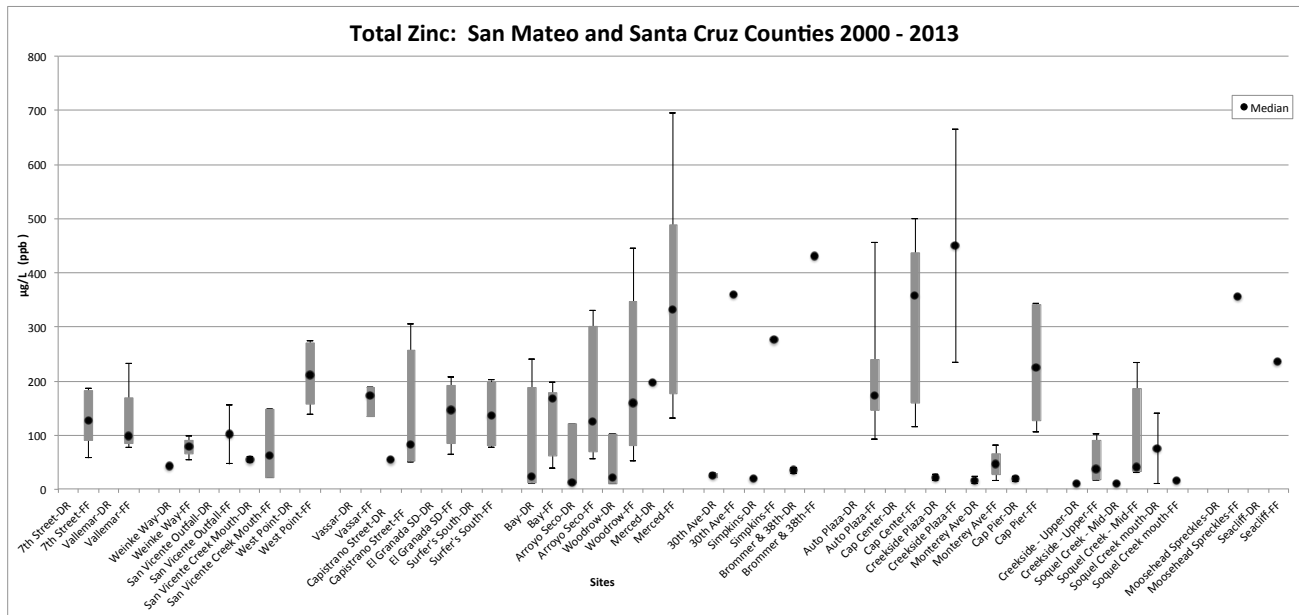
Storm water runoff in coastal urban areas is known to contain trace metals from sources such as automobile brake pads, tires and industrial waste. Very low concentrations in the marine environment can cause reduced reproduction, developmental deformities, and mortality. For the Dry Run and First Flush, samples were analyzed for total zinc (Zn), total copper (Cu), and total lead (Pb).

## Zinc

The Basin Plan WQO for Zn is <200 µg/L; and the MDL for zinc was 50 µg/L for the Dry Run and 10 µg/L for the First Flush.

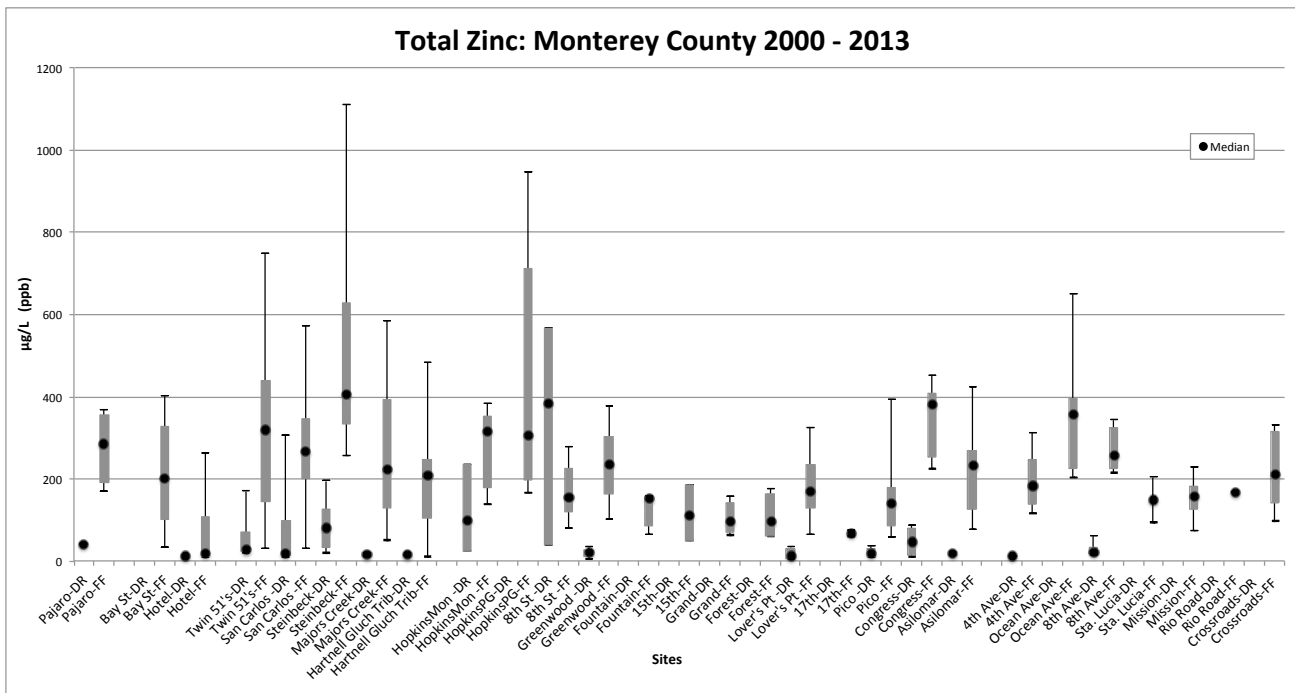
For the **Dry Run**, zinc concentrations were all below the WQO (Figs. 12 and 13).

For the **First Flush**, thirteen of the twenty-two sites (59%) were above the WQO for zinc. The highest average zinc concentration was 665 µg/L in Capitola (Creekside Plaza) (Figs. 12 and 13).



**Figure 12.** Total zinc results for all sites for Dry Run and time series averages for First Flush in San Mateo and Santa Cruz Counties. Non-detects were given the value of half the Minimum Detection Limit (MDL) but their true value lies between the zero and the MDL. All sites grouped by city from north to south- Montara, Moss Beach, El Granada, Santa Cruz, Capitola, Soquel,





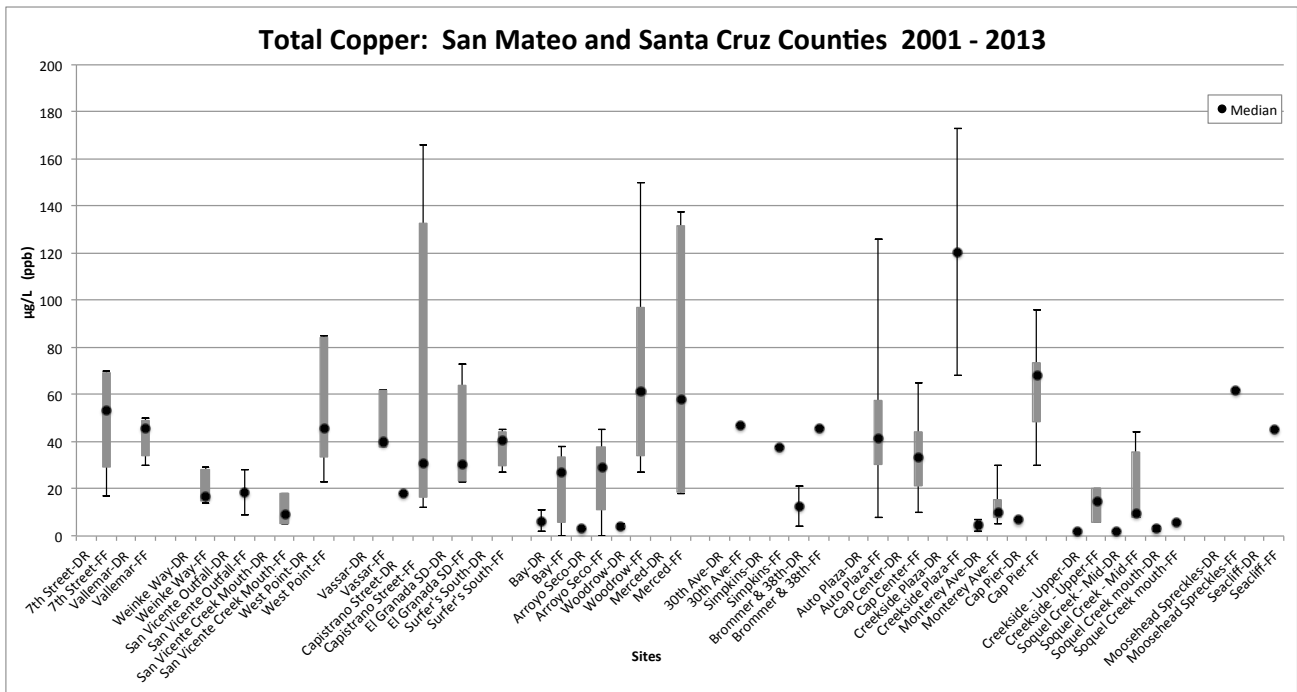
**Figure 13.** Total zinc results for all sites for Dry Run and time series averages for First Flush in Monterey County. Non-detects were given the value of half the Minimum Detection Limit (MDL) but their true value lies between the zero and the MDL. All sites grouped by city from north to south- Pajaro (Monterey County), Seaside, Monterey, Pacific Grove and Carmel.

**Copper**

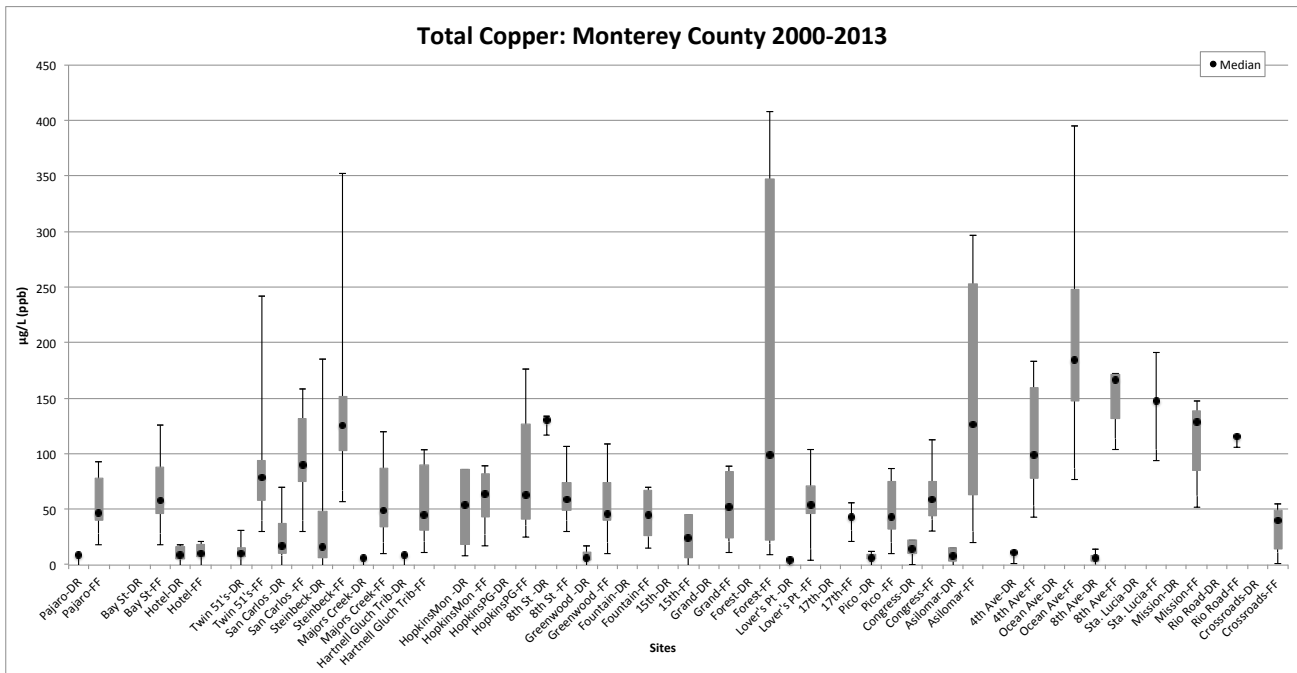
The Basin Plan WQO established for total Cu is 30 µg/L; the MDL for copper was 4.0 µg/L for the Dry Run and 10 µg/L for the First Flush.

For the **Dry Run**, copper concentrations were all below the WQO. Five sites had non-detects: Santa Cruz (Bay, Woodrow), Capitola (Creekside Plaza), Soquel (Creekside- Upper, Soquel Creek- Mid) (Figs. 14 and 15).

During the **First Flush**, sixteen of the twenty-two monitored sites (73%) were above the WQO. The highest copper concentration was in Carmel (Ocean Avenue) with an average of 248 µg/L (Figs. 14 and 15). One site had a non-detect: Soquel (Soquel Creek- Mouth).



**Figure 14.** Total copper results for the Dry Run and time series averages for First Flush in San Mateo and Santa Cruz Counties. Non-detects were given the value of half the Minimum Detection Limit (MDL) but their true value lies between the zero and the MDL. All sites grouped by city from north to south- Montara, Moss Beach, El Granada, Santa Cruz, Capitola, Soquel,



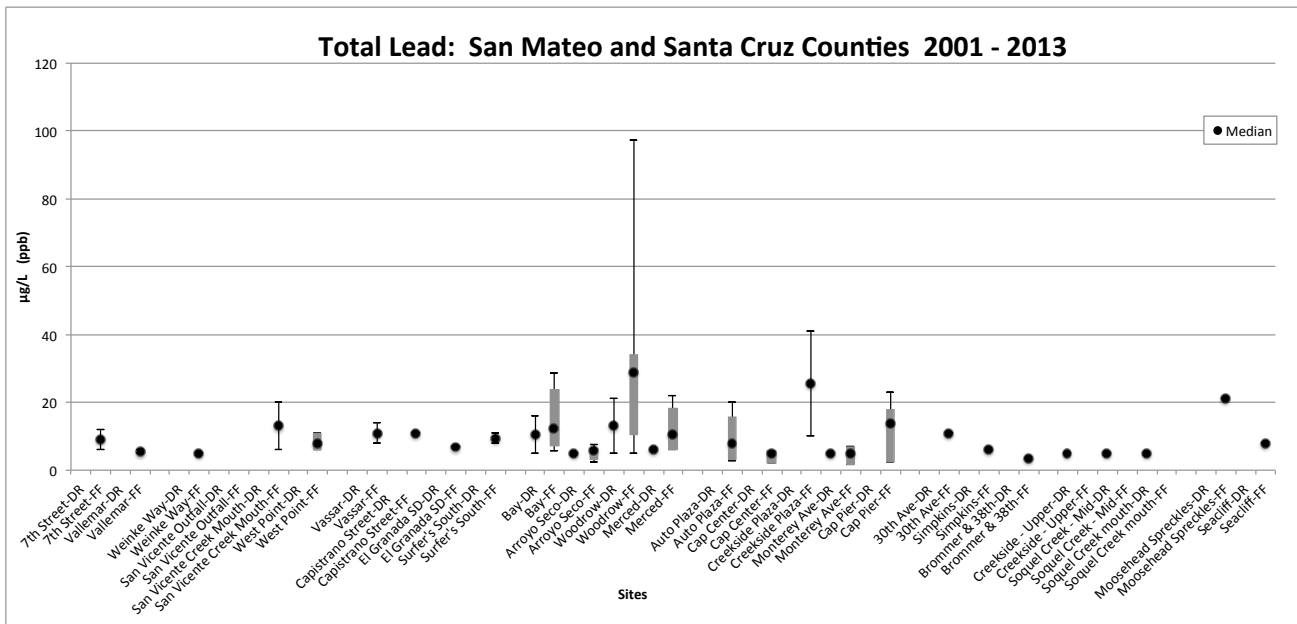
**Figure 15.** Total copper results for the Dry Run and time series averages for First Flush in Monterey County. Non-detects were given the value of half the Minimum Detection Limit (MDL) but their true value lies between the zero and the MDL. All sites grouped by city from north to south- Pajaro (Monterey County), Seaside, Monterey, Pacific Grove and Carmel.

## Lead

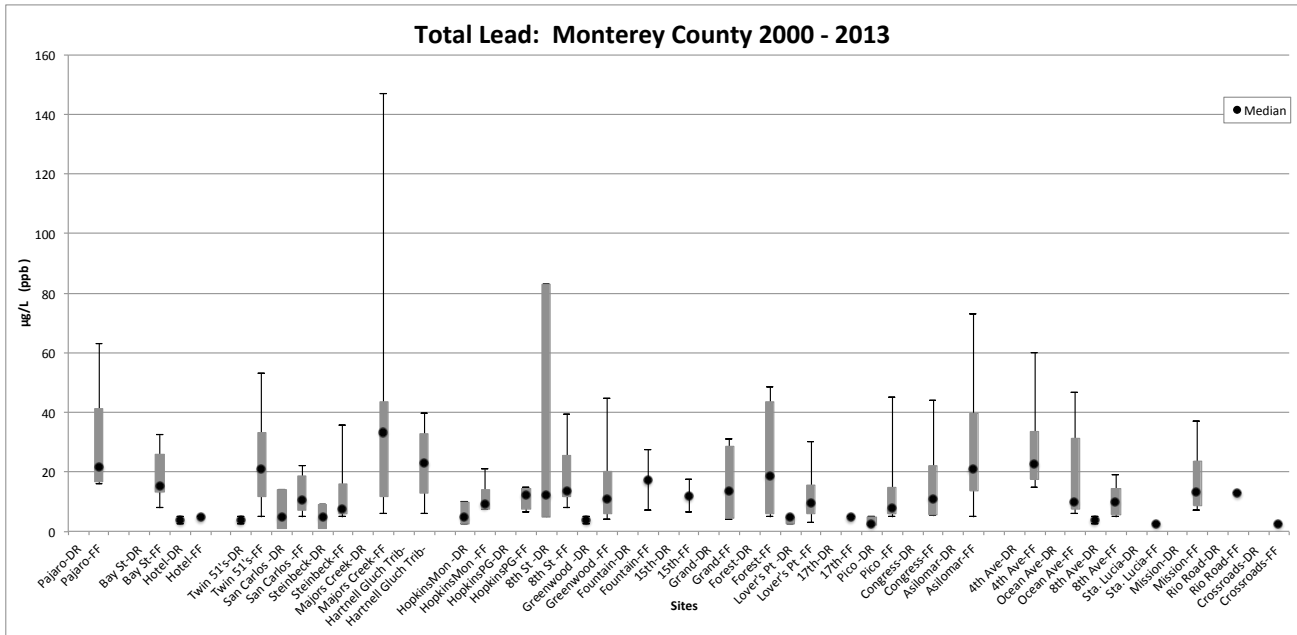
The Basin Plan WQO for total lead (Pb) is 30 µg/L. The MDL for lead was 5 µg/L for both the Dry Run and First Flush.

For the **Dry Run**, all sites had non-detects for lead (Figs 16 and 17).

For the **First Flush**, two of the twenty-two monitored sites (9%) were above the WQO. The highest result was 41 µg/L in Capitola (Creekside Plaza). Six sites had non-detects: Capitola (Monterey Avenue), Soquel (Creekside- Upper, Soquel Creek- Mid, Soquel Creek- Mouth), Monterey (Steinbeck), and Monterey County (Crossroads) (Figs. 16 and 17).



**Figure 16.** Total lead results for all sites for Dry Run and time series averages for First Flush in San Mateo and Santa Cruz Counties. Non-detects were given the value of half the Minimum Detection Limit (MDL) but their true value lies between the zero and the MDL. All sites grouped by city from north to south- Montara, Moss Beach, El Granada, Santa Cruz, Capitola, Soquel,



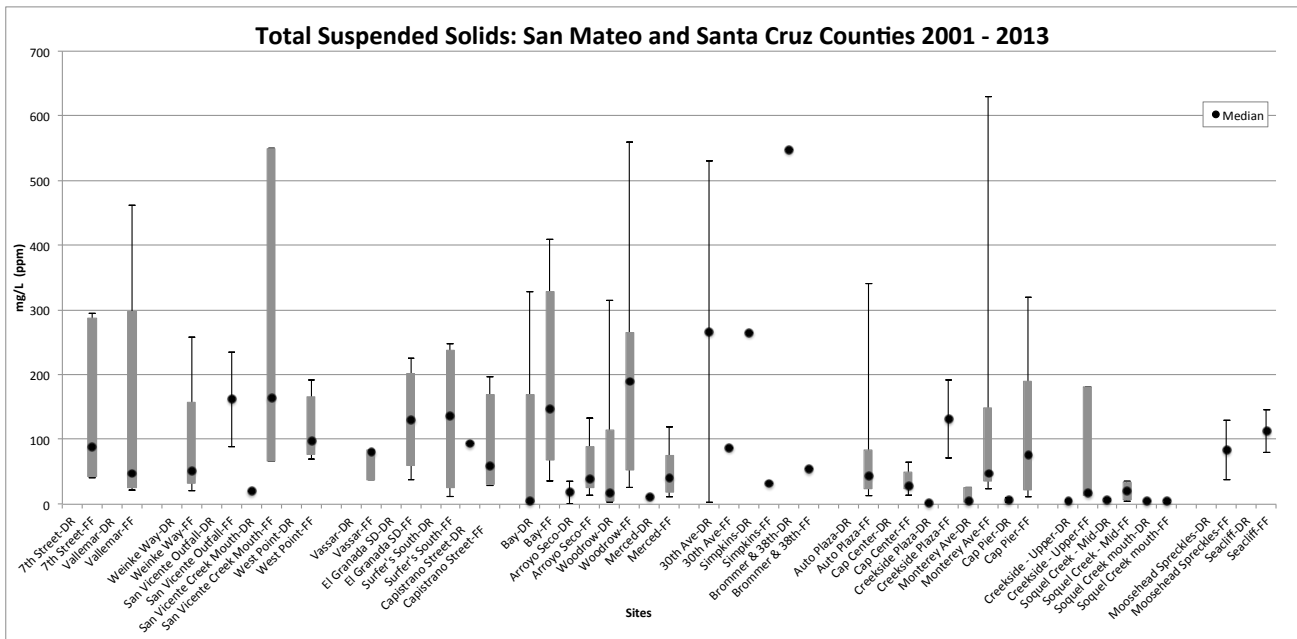
**Figure 17.** Total lead results for all sites for Dry Run and time series averages for First Flush in Monterey County. Non-detects were given the value of half the Minimum Detection Limit (MDL) but their true value lies between the zero and the MDL. All sites grouped by city from north to south- Pajaro (Monterey County), Seaside, Monterey, Pacific Grove and Carmel.

**Total Suspended Solids (TSS)**

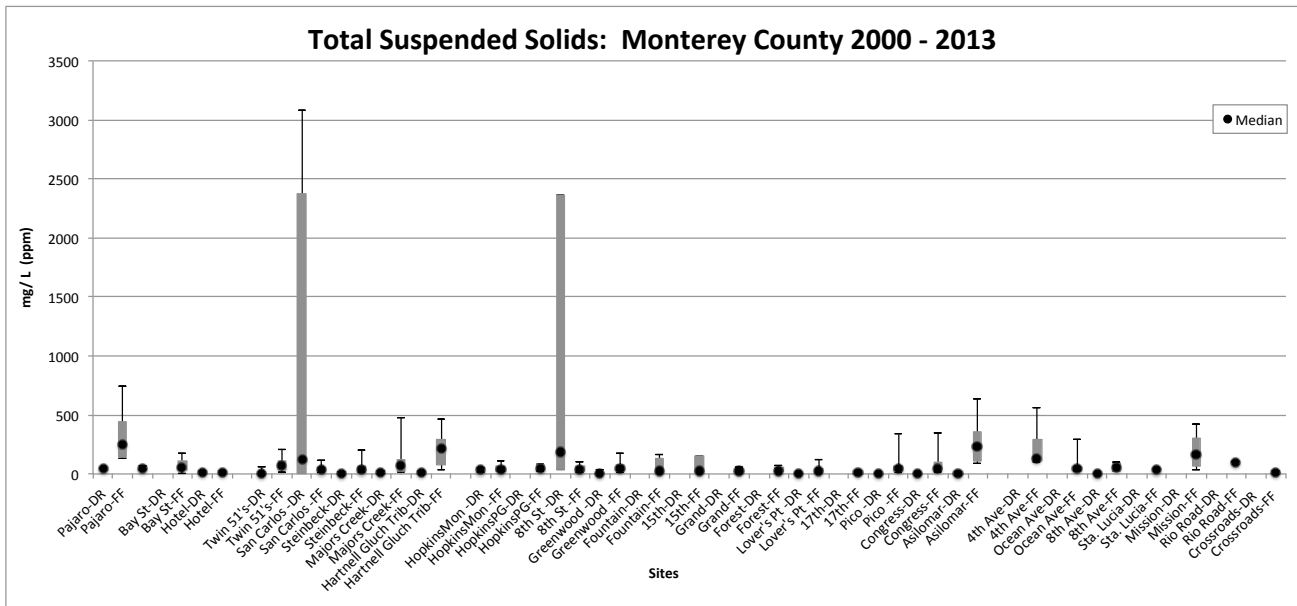
TSS are particulate matter in water that attract charged particles which can often be pesticides and metals. TSS can additionally impact the environment through sedimentation and reduction in the ability of marine organisms to respire. Some sources of TSS are construction sites with improper sediment control, bank erosion from rivers or streams, runoff from agricultural fields, and over irrigation in urban areas. The attention level for TSS is 500 mg/L, with an MDL of 5 mg/L for both the Dry Run and First Flush.

For the **Dry Run**, none of the sites were above the WQO. Four sites had non detects: Capitola (Creekside Plaza), Soquel (Soquel Creek Mouth), Pacific Grove (Pico), Carmel (8<sup>th</sup> Avenue) (Figs. 18 and 19).

For the **First Flush**, none of the sites were above the WQO (Figs. 18 and 19).



**Figure 18.** TSS results for all sites for Dry Run and time series averages for First Flush in San Mateo and Santa Cruz Counties. Non-detects were given the value of half the Minimum Detection Limit (MDL) but their true value lies between the zero and the MDL. All sites grouped by city from north to south- Montara, Moss Beach, El Granada, Santa Cruz, Capitola,



**Figure 19.** TSS results for all sites for Dry Run and time series averages for First Flush in Monterey County. Non-detects were given the value of half the Minimum Detection Limit (MDL) but their true value lies between the zero and the MDL. All sites grouped by city from north to south- Pajaro (Monterey County), Seaside, Monterey, Pacific Grove and Carmel.

At each site during the Dry Run and First Flush 2013, volunteers recorded the presence of trash, sewage (smelled), oil sheen, and bubbles and/or scum (Table 3).

**Table 3: Visual Observations**

	Trash-DR	Trash-FF	Oil Sheen-DR	Oil Sheen-FF	Smells of Sewage-DR	Smells of Sewage-FF	Scum and /or Bubbles-DR	Scum and/or Bubbles-FF
Bay Street (Santa Cruz)								X
Arroyo Seco (Santa Cruz)		X						
Woodrow (Santa Cruz)	X	X						
Merced (Santa Cruz)								
Auto Plaza (Capitola)								X
Capitola Center (Capitola)						X		X
Creekside Plaza		X						
Monterey Ave (Capitola)								
Capitola Pier (Capitola)								X
Creekside- Upper (Soquel)		X	X					X
Soquel Creek- Mid (Soquel)			X			X		X
Soquel Creek Mouth (Capitola)				X				X
Pajaro (Monterey County)		X				X		X
Bay Street (Seaside)		X		X		X		
Twins (Monterey)	X	X				X		X
San Carlos (Monterey)								X
Steinbeck (Monterey)		X				X		
8 <sup>th</sup> Street (Pacific Grove)								
Greenwood Park (Pacific Grove)	X	X						X
Lovers (Pacific Grove)								X
Pico (Pacific Grove)		X						X
4 <sup>th</sup> Avenue (Carmel)								
Ocean Avenue (Carmel)		X						X
8 <sup>th</sup> Avenue (Carmel)	X							
Santa Lucia (Carmel)								
Rio Road (Carmel)								
Crossroads (Monterey County)		X						X

## Conclusion

For the past fourteen years, the Dry Run and First Flush have provided Central California coastal area residents and municipalities with valuable information about the quality of water running from the storm drains to the ocean. Results from this and other Dry Run/First Flush events provide managers and researchers with pollutant concentrations during two critical times: late season dry weather and the initial flushing events when the most polluted water is expected. Results from the 2013 events show that:

- Nitrate concentrations are generally higher during the dry weather monitoring, yet still below the attention level. Nitrate concentrations were below the attention level for all but one site (the same site) during the Dry Run and First Flush.
- For the first time in Dry Run/ First Flush history, the Dry Run results for orthophosphate were all below the WQO. However, orthophosphate results continue to be above the action level for many sites during the First Flush. In Monterey County 100% of the sites were over the attention level and in Santa Cruz County 55% of sites were over the attention level.
- Copper concentrations appear to be consistently higher at sites in the southern half of the Monterey Bay region. In Monterey County, 91% of the sites were above the attention level for copper while 55% of the sites were in Santa Cruz County.
- Zinc concentrations appear to be consistently higher at sites in the southern half of the Monterey Bay region. For sites in Santa Cruz County, zinc results were over the WQO at 45% of sites and in Monterey County were over the WQO at 73% of sites.
- Lead concentrations were below the WQO during dry weather events at all sites and over the WQO at 2 sites for wet weather.
- As in previous years, *E. coli* and enterococcus results during First Flush were all above the WQO. In 2013, 73% of the sites exceeded the WQO for both *E. coli* and enterococcus during dry weather and 95% during wet weather.

First Flush data helps us to better understand what *our* pollutants of concern are over a very large area and help to identify where concentrations are highest. Our hope is that this informs the placement of target projects and Best Management Practices (BMPs) to address those specific contaminants. First Flush does not necessarily inform us as to whether our efforts are improving water quality; that requires a different monitoring design but can use the information provided by the First Flush event to prioritize problem watersheds. Local cities have used First Flush information and addressed pollutant concentrations by cleaning out storm drains prior to the rains, installing dry weather diversions and CDS units (litter/debris removal systems) as well as identifying opportunities to slow down runoff through vegetation and permeable surfaces. By addressing these issues on a watershed level more water quality improvements may be accomplished.