C-11.0 WATER QUALITY MONITORING SUMMARY AND ANALYSES

C-11.1 Introduction

In response to the monitoring and reporting requirements of the Fourth Term Municipal Stormwater Permit (R8-2009-0030, NPDES CAS618030) from the Santa Ana Regional Water Quality Control Board (Santa Ana Regional Board), the Permittees have implemented a water quality monitoring and assessment program (Program) that is reported annually in this section of the Unified PEA. This monitoring and reporting program is an extension of the Third Term Permit program developed and submitted by the Permittees to the Regional Board in 2003 and approved by the Executive Officer in August 2005. The program is based on "The Model Monitoring Program for Municipal Separate Storm Sewer Systems (MS4) in Southern California" developed by the Southern California Stormwater Monitoring Coalition (SMC). The SMC is an organization of Southern California municipal stormwater agencies, Los Angeles, San Diego, and Santa Ana Regional Water Boards, the State Water Board, USEPA Region 9, Caltrans, and the Southern California Coastal Water Research Project (SCCWRP).

Background

On October 3, 2013, the Permittees submitted the Report of Waste Discharge (ROWD) to the Santa Ana Regional Board, which included a State of the Environment analysis of stormwater quality issues and priorities in north Orange County under the jurisdiction of the Santa Ana Regional Board. Building on the assessment questions and themes developed for the ROWD State of the Environment submittal, this report presents the results of water quality monitoring conducted in the Santa Ana Region of Orange County between July 1, 2016 and June 30, 2017.

Program Goals

As outlined in the ROWD, the State Water Resources Control Board has provided the following four assessment questions that provide the context for water quality monitoring across the state:

1. Is our water safe to drink?
2. Is it safe to swim in our waters?
3. Is it safe to eat fish and shellfish from our waters?
4. Are our aquatic ecosystems healthy?

The monitoring programs developed for the Santa Ana Region as part of the Program focus on Questions 2 and 4 above, whereas Questions 1 and 3 are evaluated through other regulatory mechanisms and programs.

To help answer these questions, the Santa Ana Regional Board Fourth Term Permit established a series of monitoring program objectives. **Table C-11.1** below depicts the correlation between each monitoring program element and the associated permit objectives.

Table C-11.1: Monitoring Program Goals and their Relationship to the Program Elements

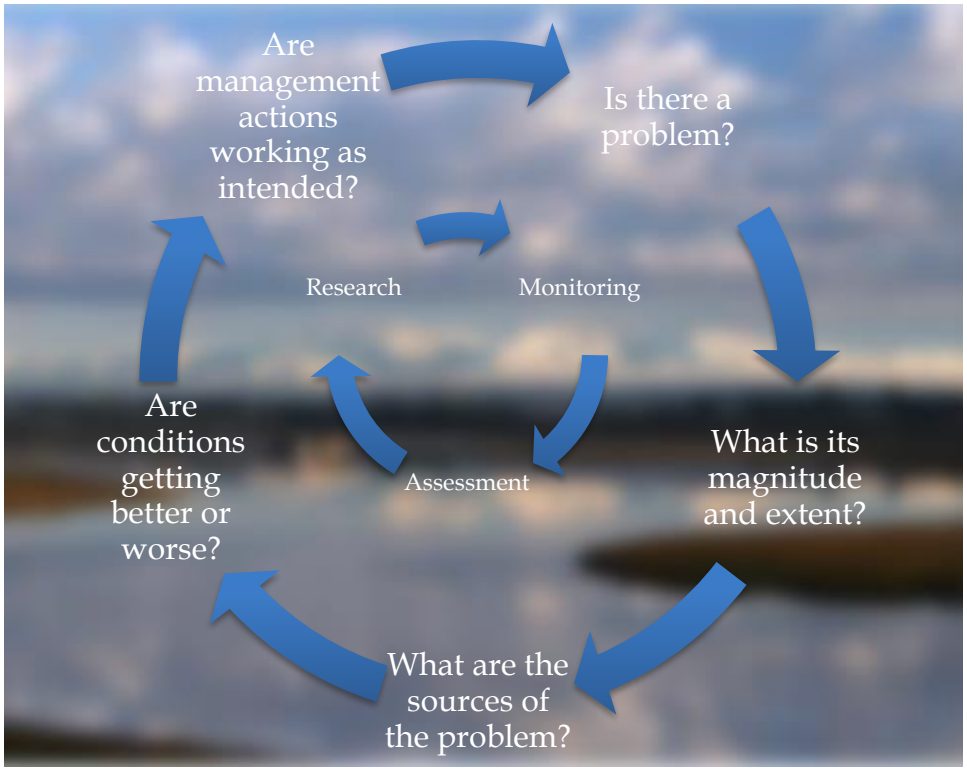
Monitoring Program Objective	Monitoring Program Element				
	Att. C-11-II Long Term Mass Emissions Station Monitoring	Att. C-11-III Estuary / Wetlands Monitoring	Att. C-11-IV Bacteriological / Pathogen Monitoring	Att. C-11-V Urban Stream Bioassessment Monitoring	Att. C-11-VI Dry Weather Monitoring
To develop and support an effective municipal urban runoff pollutant source control program.	X	X	X	X	X
To define water quality status, trends, and pollutants of concern associated with urban runoff and their impact on the beneficial uses of the receiving waters.	X	X	X	X	X
To characterize pollutants associated with urban runoff and to assess the influence of urban land uses on water quality and the beneficial uses of receiving waters.	X	X	X	X	X
To identify significant water quality problems related to urban runoff.	X	X	X	X	X
To identify other sources of pollutants in urban runoff to the maximum extent practicable (e.g., atmospheric deposition, contaminated sediments, other non-point sources, etc.).	X	X			X
To identify and prohibit illicit discharges.					X
To identify those waters, which without additional action to control pollution from urban storm water discharges, cannot reasonably be expected to attain or maintain applicable water quality standards required to sustain the beneficial uses in the Basin Plan (TMDL monitoring).	X	X			
To determine unit loading rates from different urban land use categories.	X				
To determine reference loads and concentrations from un-impacted areas of Orange County including sediment loads from open spaces at the foothills.	X				
To determine runoff concentrations and loads as close as possible to the source (e.g. golf courses, restaurants, etc.).					X
To evaluate the effectiveness of existing urban runoff water quality management programs, including an estimate of pollutant reductions achieved by the structural and nonstructural BMPs implemented by the Permittees. This should include a determination of concentrations and unit loads that are achievable upon BMP implementation.	X	X	X	X	X
To evaluate costs and benefits of proposed municipal storm water quality control programs to the stakeholders, including the public.	X	X	X	X	X

This 2016-17 monitoring assessment presents a summary of results and conclusions for the monitoring year that build upon the ROWD findings and recommendations. As presented in the ROWD State of the Environment report, the Permittees have established the following five assessment questions that drive the implementation and assessment of the environmental monitoring programs as part of the iterative process:

1. Is there a problem?
2. If so, what is the magnitude and extent?
3. What are the sources of the problem?
4. Are conditions getting better or worse?
5. Are management actions working as intended?

The Permittees use these five assessment questions to continuously evaluate their monitoring program framework, design, and priorities for each of the core program elements. Monitoring, assessment, and research programs are implemented and periodically augmented based on the data collected and as new technologies become available. **Figure C-11.1** shows the process graphically.

Figure C-11.1: Monitoring, Assessment, and Research Cycle as Part of the Iterative Process



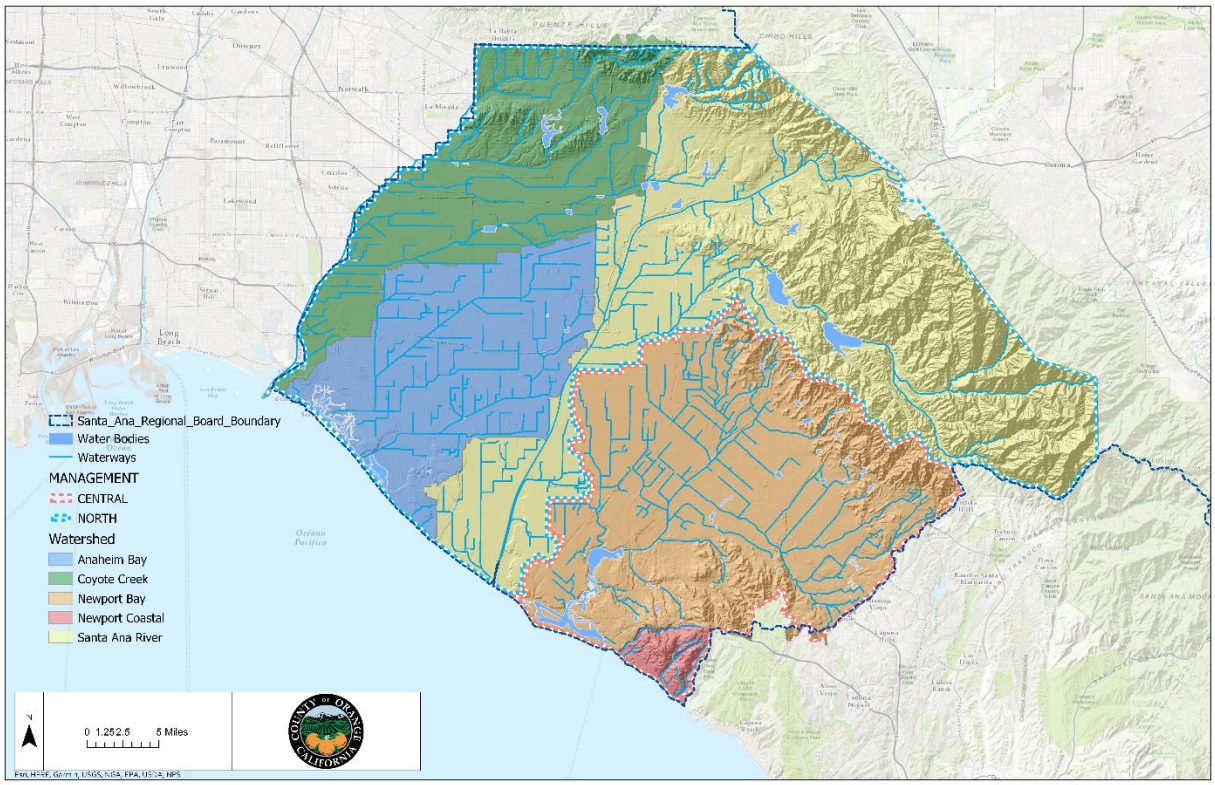
The ROWD established three key themes to help structure the assessment of environmental conditions in the Santa Ana Region Board jurisdiction of Orange County. These assessment themes shown below drive the Permittees assessment strategy as well as the approach for developing new assessment tools are discussed in **Section C-11.4**:

- Theme 1: Focus on priority areas and constituents rather than trying to monitor all constituents, potential issues, and locations.
- Theme 2: Increase the integration of data from a wider range of sources in order to leverage the value and impact of the program's efforts to address the five assessment questions.
- Theme 3: Continue evolving from a strictly discharge-specific approach to a risk prioritization approach that can highlight problem areas and support more flexible monitoring designs that include data adaptive triggers.

Monitoring Activities

During the 2016-17 monitoring period, the Permittees have continued to implement key monitoring programs in accordance with the Fourth Term Permit. The portion of the Santa Ana Regional Board boundary that falls within Orange County is shown in **Figure C-11.2.**

Figure C-11.2: Santa Ana Region Watersheds. This map also depicts the North and Central Watershed Management Areas of Orange County.



Monitoring encompasses four major watersheds; Coyote Creek, Anaheim Bay, Santa Ana River, and Newport Bay. The 2016-17 monitoring year constitutes the eighth year of monitoring under the Fourth Term Permit. Core recommendations and regional trends are presented in the main body of **Section C-11.0.** A detailed summary of the methods used to implement the various monitoring programs, as well as overall procedures for data analysis and reporting in this PEA is included as **Attachment C-11-I**. Individual monitoring program results are included in a number of attachments that provide the data and findings for each program, which is organized as follows:

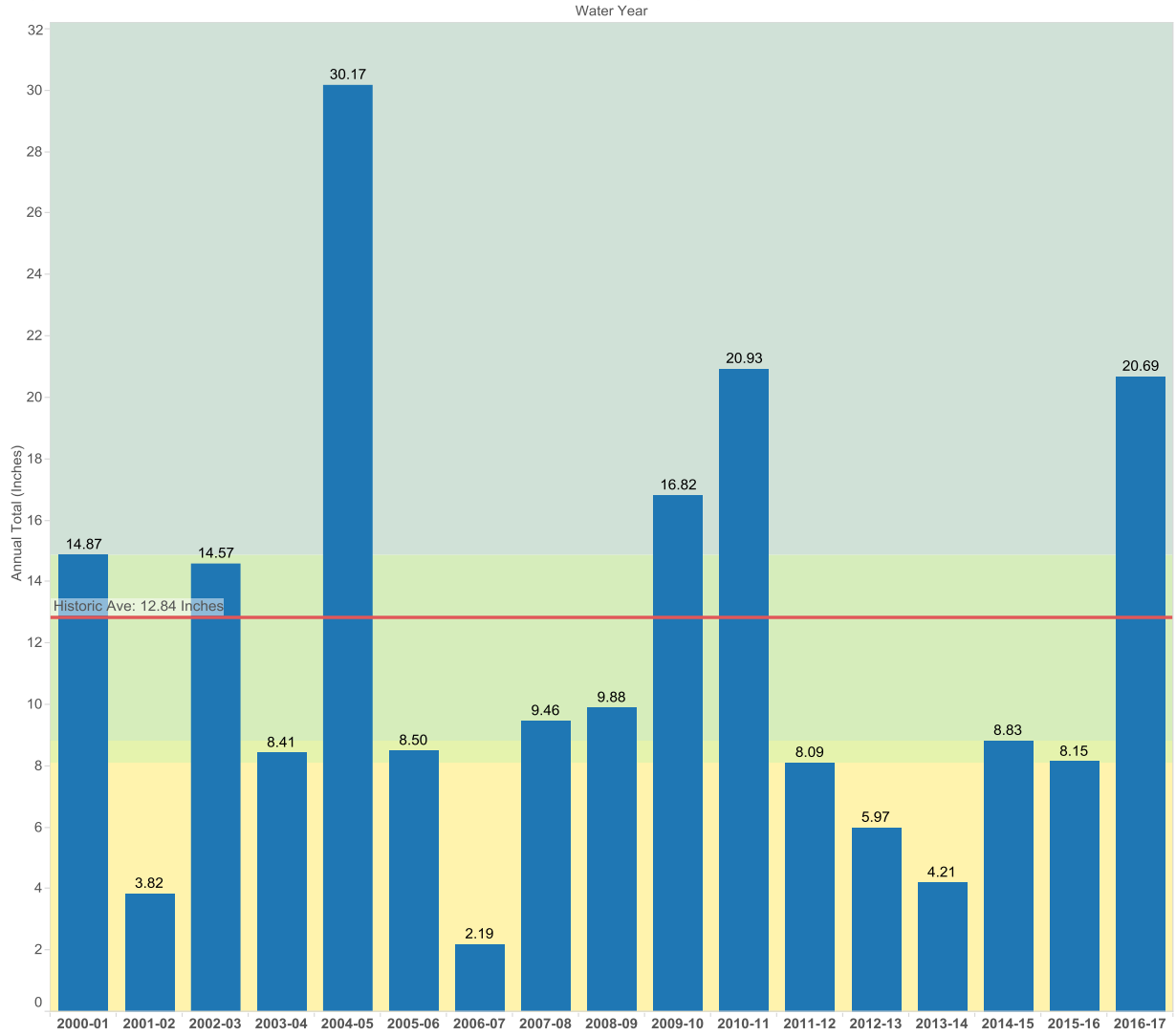
- **Long Term Mass Emissions Monitoring –** Long Term Mass Emissions monitoring was conducted during two semi-annual dry weather monitoring events across the region, along with quarterly events in the Newport Bay watershed. Several storm events were also monitored during the 2016-17 reporting period. The complete assessment for this program is included in **Attachment C-11-II**.
- **Estuary/Wetlands Monitoring –** The Estuary/Wetlands Program was successfully completed during two dry weather monitoring events in northern Orange County watersheds (semi-annual) and quarterly for the Newport Bay watershed. Sampling was also completed during several storm events in 2016-17. The complete assessment for this program is included in **Attachment C-11-III**.
- **Bacteriological/Pathogen Monitoring –** Monitoring was conducted throughout the 2016-17 monitoring year and during the applicable AB411 recreation season period from 2016 (July 1 - October 31, 2016) and 2017 (April 1 to June 30, 2017), with results summarized in **Attachment C-11-IV**.
- **Urban Stream Bioassessment Program –** Four locations were sampled as part of the Southern California Stormwater Monitoring Coalition (SMC) Program, and two as part of the San Gabriel River Regional Monitoring Program (SGRRMP). The complete assessment for this program is included in **Attachment C-11-V**.
- **Dry Weather Reconnaissance Monitoring Program –** Monitoring was conducted from May 1st 2017 to September 30th 2017, which does not precisely align with the 2016-17 PEA reporting period. Sampling was conducted at both targeted (visited five times per season) and random sites (visited three times per season). The complete assessment for this program for 2017 is included in **Attachment C-11-VI**.

The monitoring and reporting program is supported by a quality assurance/quality control (QA/QC) program developed and implemented by the Orange County Stormwater Program. Laboratory analyses are independently validated through quality control check samples in addition to the quality assurance requirements established by USEPA. All analytical laboratories have been certified through the Environmental Laboratory Accreditation Program (ELAP) and follow standard method procedures. The quality assurance program evaluates data for accuracy, precision, and other factors using certified reference materials (for preparing synthetic samples), laboratory control standards for common analyses, duplicate field samples for precision, and equipment/trip blanks. The complete QA/QC report is available in **Attachment C-11-VII**.

Rainfall Events

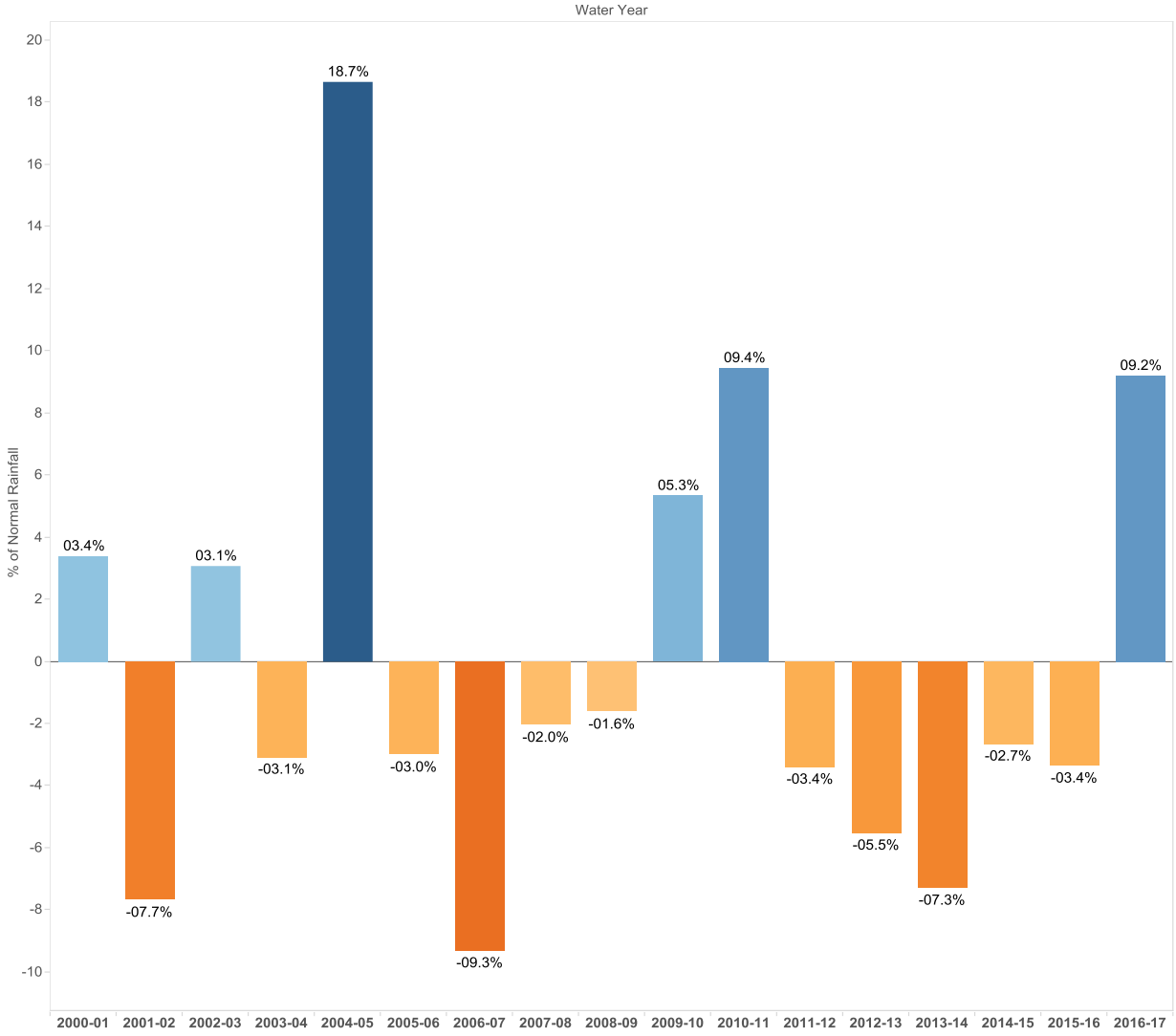
The north Orange County climate is typically dry from May through October, and rainy from late October through April. The 2016-17 water year (July to June) rainfall total, recorded at the Santa Ana rain gage, was 20.69 inches. The water year rainfall totals for the last seventeen years of data is displayed in **Figure C-11.3.**

Figure C-11.3: Annual Rainfall Totals at Santa Ana Rain Gage #121.



This marks a break in the recent trend in the previous five years of below average precipitation amounts. The annual percent of normal rainfall was calculated for the Santa Ana precipitation gage by comparing totals to the long term historical average of 12.84 inches. **Figure C-11.4** below highlights the above normal precipitation for the 2016-17 water year.

Figure C-11.4: Annual percent of normal rainfall at Santa Ana Rain Gage #121. This figure characterizs wet and dry water years by comparing the yearly totals to the long-term average. 2016-17 was a wetter than average year.



C-11.2 Discusson of 2016-17 Program Results

This was the eighth complete year of monitoring under the Fourth Term Permit. The following section provides an overview of monitoring and QA/QC results with in-depth reporting on each program available in their respective attachments.

<u>Long-term Mass Emissions Monitoring</u>

Metals samples collected from a combined 112 sampling events from Long Term Mass Emission monitoring sites were assessed by comparing results to the freshwater acute and chronic California Toxics Rule (CTR) criteria (adjusted for water hardness). Acute and chronic exceedances in dry weather conditions for dissolved metals were infrequent (one occurrence) and limited to copper and zinc. Combined acute and chronic wet weather exceedances for dissolved metals were more frequent (68 occurrences, 5% of comparisons to

CTR criteria) and included silver, cadmium, copper, nickel, lead, and zinc. Additionally, total selenium was evaluated against available CTR criterion and exceeded 19 times (26% of comparisons to CTR criteria) in dry weather and eight times in wet weather for both acute and chronic conditions (5% of comparisons to CTR criteria).

Toxicity was evaluated during dry and wet weather conditions by comparing organism response test results (i.e., survival, reproduction, growth) to test controls. Samples were considered toxic if the response was less than (<) 80% when compared to the control sample. Aqueous toxicity was low, and occurred in 5% of dry weather samples and 10% of stormwater-influenced samples. Sediment toxicity was evaluated in 10 day *Hyallela Azteca* survival, with 25% (4 of 16) of samples resulting in <80% effect compared to the control.

Organophosphate pesticides detections in dry weather were infrequent overall, with two detections of Chlorpyrifos, and two of Malathion out of 45 samples evaluated. Chlorpyrifos was detected 10 times (17%), and Malathion five times (8%) in wet weather samples. Pyrethroid compounds were detected more frequently with 11 detections in 24 sampling events (15% of analysis) in dry weather, and 198 detections in 75 wet weather samples (13% of analysis). The most commonly detected wet weather constituents were Bifenthrin (100%), Cyfluthrin (80%), and Cypermethrin (56%) out of 75 samples.

Estuary/Wetlands Monitoring

Benthic community habitat assessments conducted according to the sediment quality objective (SQO) policy in Newport Bay and Huntington Harbor / Bolsa Bay resulted in three stations receiving the *unimpacted* assessment, four *likely unimpacted*, and the remaining five stations *possibly impacted*.

Toxicity was evaluated during dry and wet weather conditions by comparing organism response test results (i.e., survival, reproduction, growth) to test controls. Samples were considered toxic if the response was <80% when compared to the control sample. Dry weather sediment toxicity occurred in 16% of samples (6 of 38 samples) tested on *Eohaustorius estuarius*, while none of the *Mytilus galloprovincialis* tests falling below 80% survival. Aqueous toxicity was low, and occurred only in *Americamysis bahia* growth tests. Three percent of dry weather samples and 12% of wet weather samples fell below 80% survival.

Metals samples collected from a combined 84 sampling events from Estuary/Wetlands monitoring sites were assessed by comparing results to the freshwater acute and chronic California Toxics Rule (CTR) criteria (adjusted for water hardness). For both acute and chronic endpoints, copper was the only metal that exceeded objectives. In dry weather conditions, dissolved copper exceeded acute CTR criteria in 14% of samples and 48% of samples for chronic CTR criteria. Wet weather exceedances for copper were less frequent with one sample above the acute CTR criteria and 34% of samples above chronic CTR criteria.

In dry and wet weather samples, Bifenthrin was the most frequently detected pyrethroid pesticide. Bifenthrin was found in 18% (8 of 44 samples) of dry weather samples, and 49% (19 of 39 samples) of wet weather samples.

Bacteriological/Pathogen Monitoring

Beach water quality during dry weather conditions continues to show limited single sample standard exceedances overall. Results show that coastal monitoring locations exhibit a low exceedance frequency of 3% across all indicator bacteria (*Enterococcus,* fecal coliforms, total coliforms) for the entire 2016-17 year. When analyzed individually, the surfzone sites exhibited a decrease in the number of exceedances from 2015-16. Exceedances in channels occur more frequently than surfzone sites, with a 14% exceedance rate for all indicators. Channel monitoring locations generally exhibited a downward trend in exceedance rate (less exceedances) for the 2015-16 monitoring period, except for a 7% increase at East Costa Mesa Channel (CMCG02). In both coastal and channel monitoring locations *Enterococcus* is the primary contributing factor for single sample standard exceedances.

Urban Stream Bioassessment

Existing trends in bioassessment monitoring continued during the 2017 sampling index period, such that stations located in urban streams scored in the *likely altered* or *very likely altered* condition categories based on their respective California Stream Condition Index (CSCI) scores. The highest scoring site was at the end of the residential area in upper Silverado Canyon, which scored 0.79, equal to the 10th percentile of sites used in the CSCI reference distribution, and is placed in the *possibly altered* condition category.

Dominant trends are highlighted when looking at biotic integrity as a function of habitat quality. Several sub-metrics for physical habitat (phab) assessments as well as the California Rapid Assessment Method (CRAM) demonstrate that urban and heavily engineered channels provide sub-optimal habitat for benthic assemblages. Conversely, stations in areas that are at or near natural condition are provided with beneficial habitat characteristics, such as canopy cover and complex substrate. Cluster analysis clearly groups benthic communities based on geographic location and habitat condition.

Dry Weather Reconnaissance Monitoring

The Principal Permittee worked with the Permittees to select a list of 62 monitoring sites in 2017. Of the 62 sites monitored, a total of 46 were targeted and sampled five times per dry weather season. The remaining 16 random sites were sampled three times during the dry weather season to develop the data set used to calculate statistical tolerance intervals for each constituent. Monitored constituents were grouped into four broad categories (bacteria, nutrients, pesticides, and metals) and analyzed with a water quality index (WQI) that captures the exceedance frequency, exceedance magnitude, and the variety of constituents that exceeded tolerance intervals. The overall average WQI score has remained above 80 for the history of the program, and is used to assess the best and worst performing stations. Across all monitoring stations tolerance interval exceedances for organophosphate pesticides and metals have continued to decline since the inception of the program.

Quality Assurance / Quality Control

The proportion of quality assurance samples submitted this year was 9.8% of the total samples submitted to contract laboratories for constituent analysis. In addition to the contract

laboratories, QA/QC samples for bacteriological constituents are prepared and submitted to the Orange County Public Health Water Quality Laboratory for analysis. In general, the precision and accuracy of various analyses submitted to contract laboratories were within bounds for nutrients, toxicity, general minerals, and fecal indicator bacteria. Future quality assurance investigations are planned to examine an increase in the number of total organic carbon trip blanks and equipment blanks that were above the reporting limit, as well as seawater trace metal accuracies for Silver, Arsenic, Mercury, and Selenium.

C-11.3 Watershed Evaluation and Prioritization

Several components of the monitoring program were evaluated in combination to provide an overview of patterns across the region for the ROWD. The assessment ranked the following constituents as requiring further evaluation:

1. Indicator bacteria, primarily *Enterococcus*
2. Nutrients, primarily inorganic nitrogen and phosphorus
3. Pesticides and toxicity, primarily synthetic pyrethroids
4. Metals/trace elements and toxicity, primarily selenium and copper

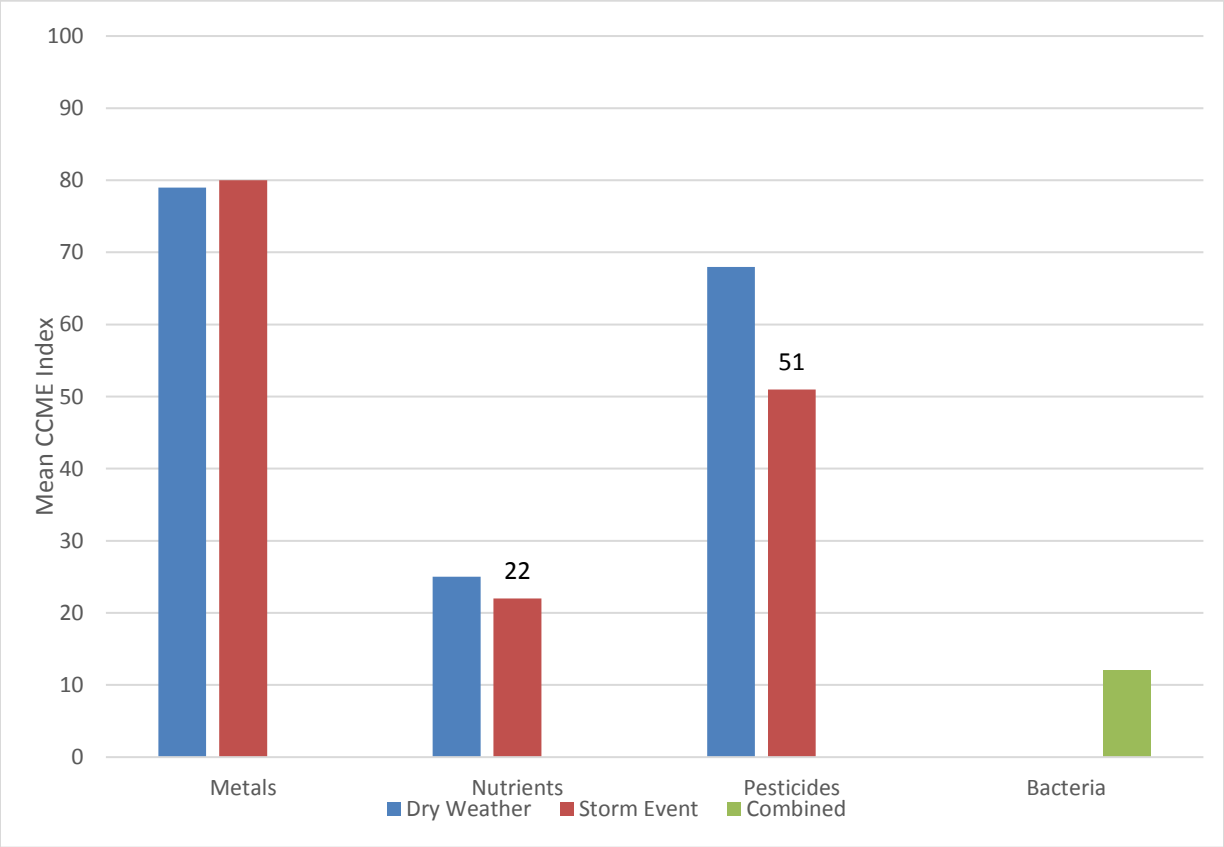
The 2013 ROWD State of the Environment Report was organized into three critical areas of concern: bacterial contamination of swimming beaches, effects of nutrient enrichment, and patterns and trends in toxicity in the region's water bodies. These critical areas of concern were prioritized using a water quality index developed by the Canadian Council of Ministers of the Environment (CCME). A variation of this index has been used by the Central Coast Regional Board to assess watershed health within their Region. The index provides a measure, scored from 0 to 100, of the frequency and magnitude of exceedances that can be tracked over time, with lower scores representing worse conditions and higher scores indicative of better conditions. The scoring can help provide a more effective means of communicating results of water quality monitoring. The index accounts for the number of indicators in each category that exceed standards (such as bacteria or metals), the percentage of individual samples that exceed corresponding standards, and the average magnitude of these exceedances.

Table C-11.2 below provides an overall summary of the ROWD prioritization analysis for various constituents in the Santa Ana Regional Water Board area of Orange County using a dashboard-style table. Each constituent category is separated into dry and wet conditions. Red colors denote persistent and widespread exceedances of water quality objectives for receiving waters, or other widely used targets. Yellow colors indicate occasional exceedances, and green colors represent minimal or no exceedances. **Table C-11.2** can be compared with **Figure C-11.5** below.

Table C-11.2: Overall Summary of Results for the Prioritization Analysis, Santa Ana Regional Board Area. This summary was compiled from available data sets for each constituent dating back to the early to mid-2000s.

	BACTERIA	NUTRIENTS	PESTICIDES	METALS	TOXICITY
CHANNELS					
DRY					
WET					

Figure C-11.5: Overall Water Quality Index for Core Monitoring Constituents in Inland Channels, summarized over the 2003 – 2017 monitoring period. This figure presents the mean CCME index scores in dry weather, wet weather, and/or combined data sets for bacteria, nutrients, metals, and pesticides in the Santa Ana Regional Board area over the 2003-2017 monitoring period.



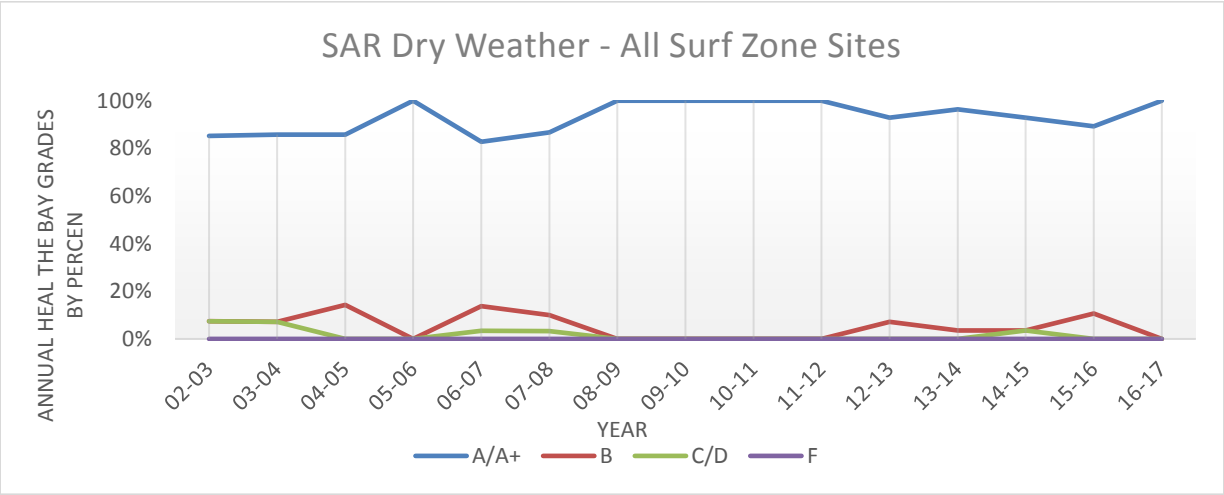
The following sections provide additional analysis and data presentation on a regional scale by constituent.

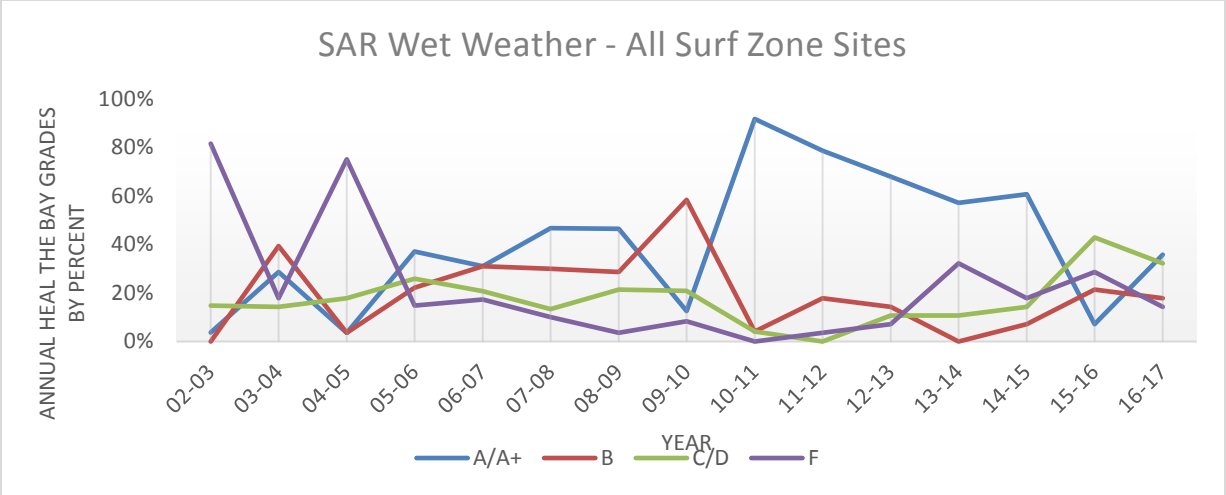
Bacteria

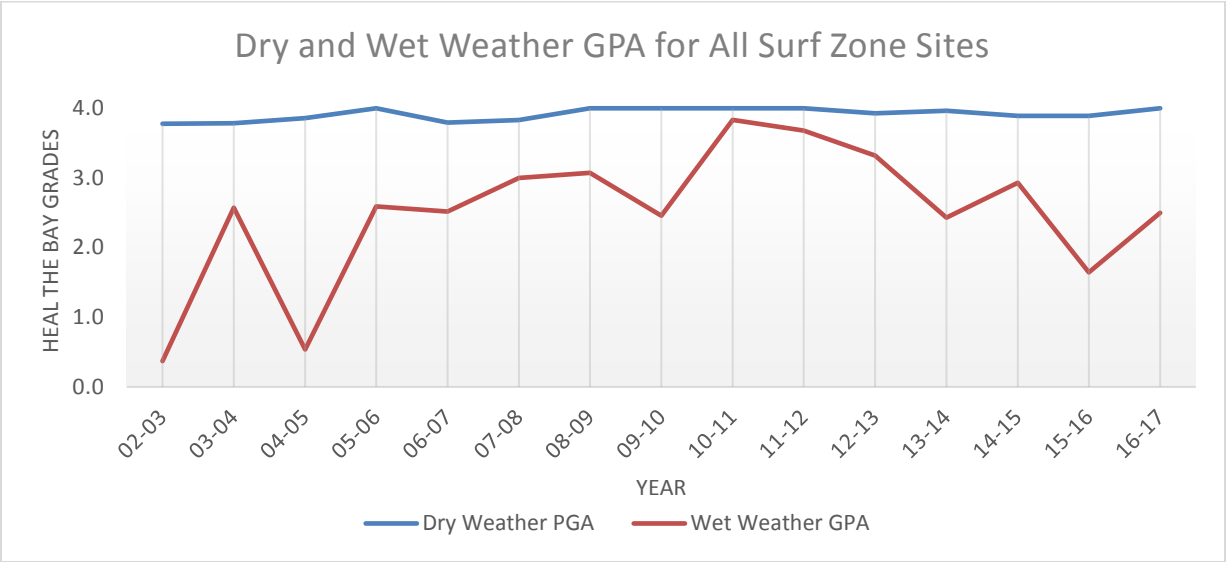
Several years of progress in addressing sources of bacteria through targeted actions implemented by the Permittees has led to a majority of swimming beaches in the Santa Ana Region maintaining an A grade in Heal the Bay's Annual Beach Report Card during dry weather conditions. During wet weather conditions significant challenges remain when stromwater discharges directly to the ocean, and as a result, exceedances of standards increase and beach report card grades become more variable.

As indicated in **Figure C-11.6**, a comparison of ocean water quality during dry weather and wet weather conditions can be made by aggregating Heal the Bay's Annual Beach Report Card grades at all 28 surf zone monitoring locations to provide a yearly grade point average (GPA). The results indicate consistently good ocean water quality during dry weather conditions and a trend that reflects an overall improvement in bacteriological water quality during wet weather conditions.

Figure C-11.6: Annual Heal the Bay Report Card Grades for Dry Weather and Wet Weather Conditions. Also included are the cumulative Grade Point Averages (GPA) for Dry and Wet Weather Conditions for all Surf Zone Sites (third chart down).

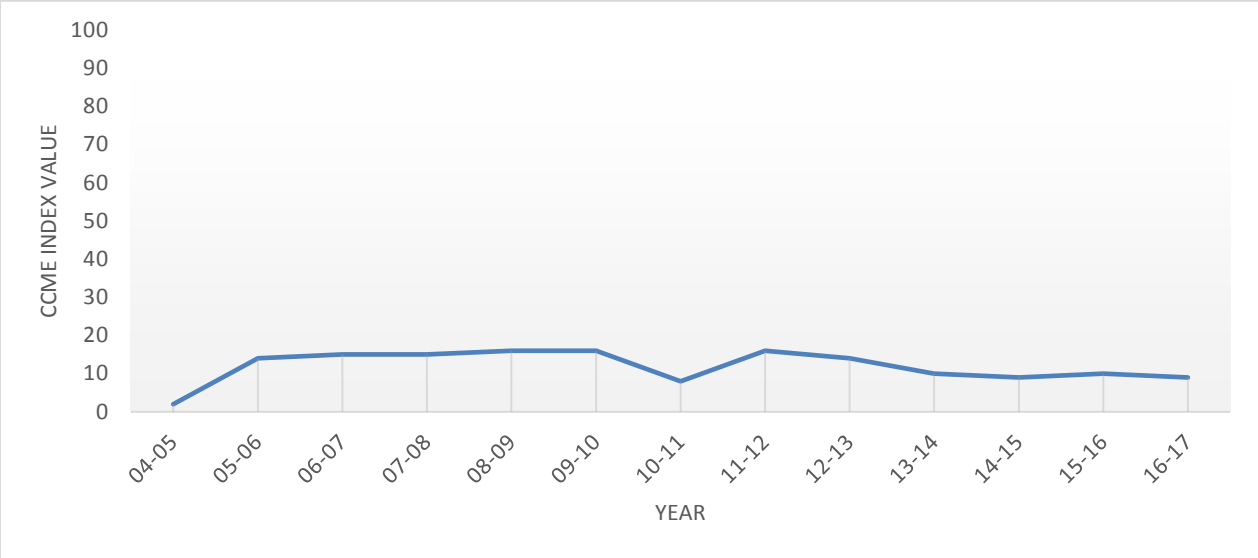






Challenges remain for indicator bacteria in the inland channels during both wet and dry weather. **Figure C-11.7** shows that CCME bacterial indicator index scores for inland channels during both wet and dry weather conditions remain low, meaning poor conditions, since 2005.

Figure C-11.7: Overall Index of the Extent to which Bacteria meet Thresholds in Channels, for both Dry and Wet Weather Conditions.



The following section describes additional information related to the regional shoreline monitoring program for northern Orange County.

Regional Beach Water QualityMonitoring Program

On July 1, 2012, the Permittees entered into a unified regional shoreline monitoring program under the Fourth Term MS4 Permit. Participants in this unified regional program include the Permittees, Orange County Health Care Agency, and Orange County Sanitation District. This unified program has facilitated regional collaboration, created a sustainable monitoring program for public health protection purposes, improved consistency in field and laboratory procedures to improve data comparability and prioritization abilities, and effectively leveraged resources and technical capabilities amongst the agencies involved. Each of these benefits is consistent with the monitoring and assessment approach themes described in **Section C-11.2**. **Attachment C-11-IV** includes 2016-17 regional data for the northern Orange County coastline from Seal Beach to the El Moro station near Crystal Cove State Beach.

The 2016 Annual Ocean, Harbor & Bay Water Quality Report was prepared by Orange County Health Care Agency and recently published in September of 2017 (see http://ocbeachinfo.com/download/). The report provides an updated analysis of bacteriological water quality data for Orange County's recreational waters countywide and includes data on sewage spills and related ocean, harbor and bay water closures. All surf zone recreational water monitoring locations in the region met compliance with dry weather AB411 bacteriological standards at least 90% of the time during the 10-year period from 2005 to 2016.

Progress in Assessing Epidemiological Risks during Wet Weather

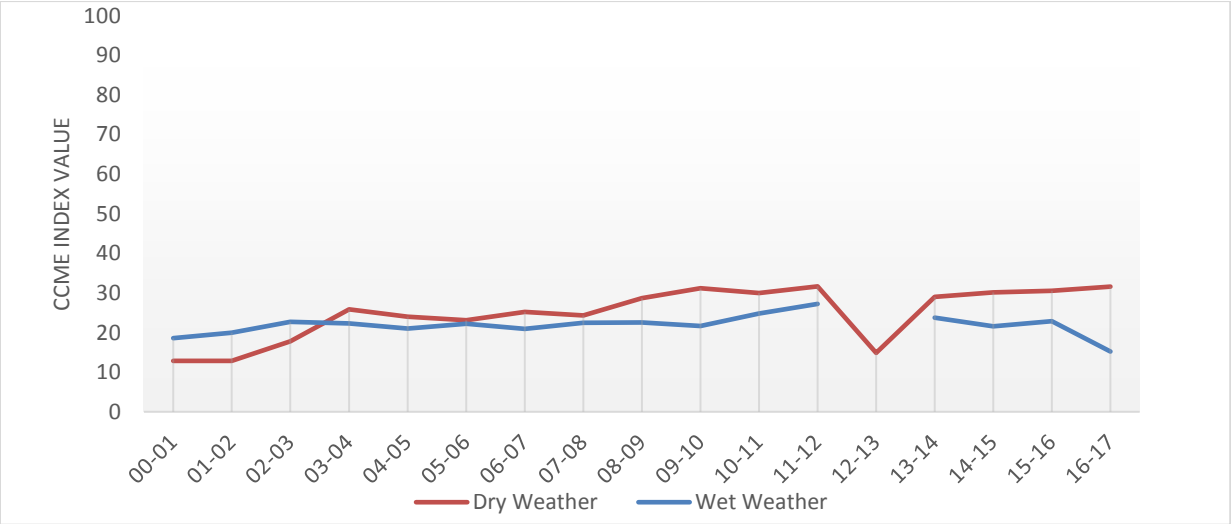
SCCWRP and its member agencies have completed a three-year epidemiological study examining the health impacts to surfers from entering the coastal surf zone during and just after rain events in September 2016. SCCWRP has published a news article and the Surfer Health Study report at the following link: http://sccwrp.org/homepage/news/16-09-12/Surfer_rainfall_study_helps_focus_water-quality_discussion.aspx. Based on an evaluation of two popular surfing locations during the winters of 2013-14 and 2014-15, the rate at which surfers contracted gastrointestinal illness was less than the illness rate predicted by the federal USEPA guidelines issued in 2012. The results of the Surfer Health Study have elicited further discussion on its public policy implications, and the Permittees will continue to track how the science and regulatory initiatives evolve relating to wet weather bacteria and pathogen risks.

Nutrients

Elevated nutrient levels are found in both urban and undeveloped areas, making it a complex regional challenge. Visual evidence of nutrient impacts is often manifested by the presence of macroalgae.

Many Permittee BMPs such as water conservation programs, LID, and public education for improved landscape maintenance practices target sources of nutrients. However, nonpoint source runoff and diffuse loading of nutrients, such as leaching from upland soils and intrusions from shallow groundwater, have increasingly become more significant sources. In addition, the complex internal recycling of nutrients in creeks, streams, and other systems can contribute an additional source of loading. **Figure C-11.8** below demonstrates that water quality index scores for nutrients (total nitrogen and total phosphorus) are consistently low (poor conditions) over time at channel sites.

Figure C-11.8: Overall Index of the Extent to which Nutrients (Total Nitrogen and Total Phosphorus) meet Thresholds in Channels for both Dry and Wet Weather Conditions.



The following sections document additional programs and studies conducted in 2016-17.

Assessing Regional Nutrient Concentrations

Nutrient levels in inland receiving waters have a wide range of concentrations. Inorganic nitrogen and total phosphorus levels are significantly different between sites and between seasons as shown spatially in **Figures C-11.9** (total inorganic nitrogen) and **C-11.8** (total phosphorus), respectively. The statistical breakdown of the nutrient data collected in the receiving water monitoring programs used to create these figures is included as **Table C-11.3** and **Table C-11.4** and are available at the following link: https://ocgov.box.com/v/2016-17-SAR-PEA-C-11-Datasets

Figure C-11.9: Mean Total Inorganic Nitrogen (mg/L) in Inland Surface Waters during Dry and Wet Weather Conditions, 2016-17

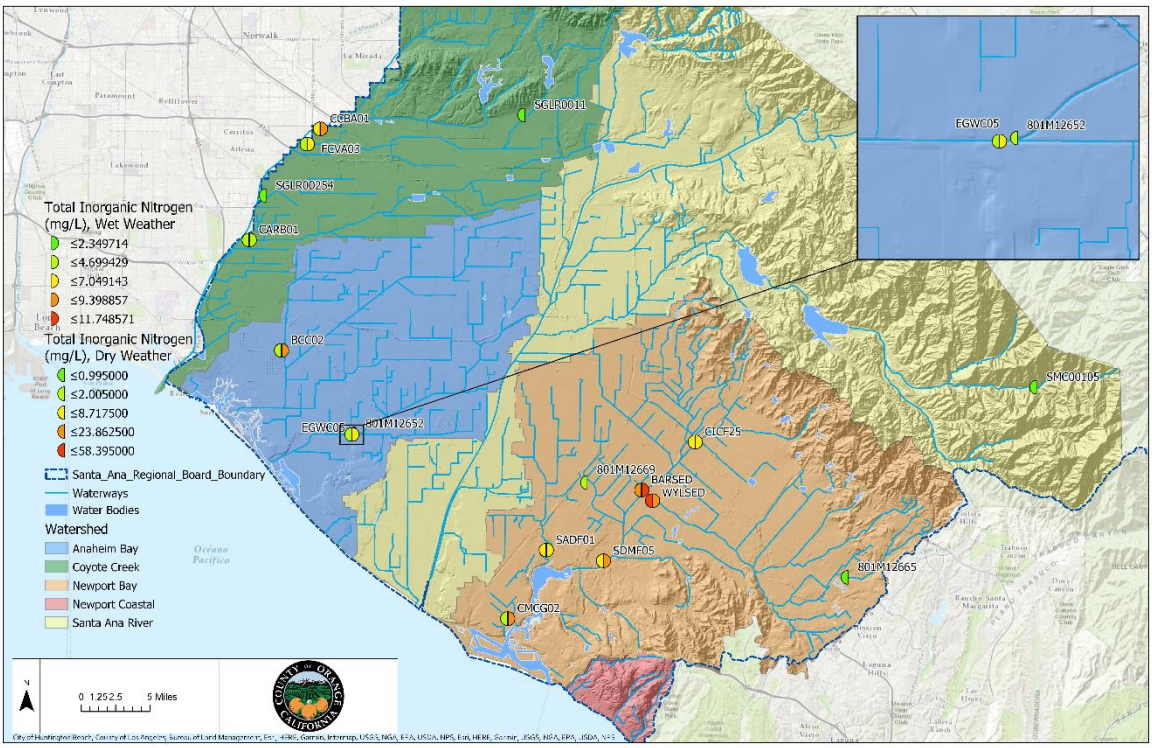
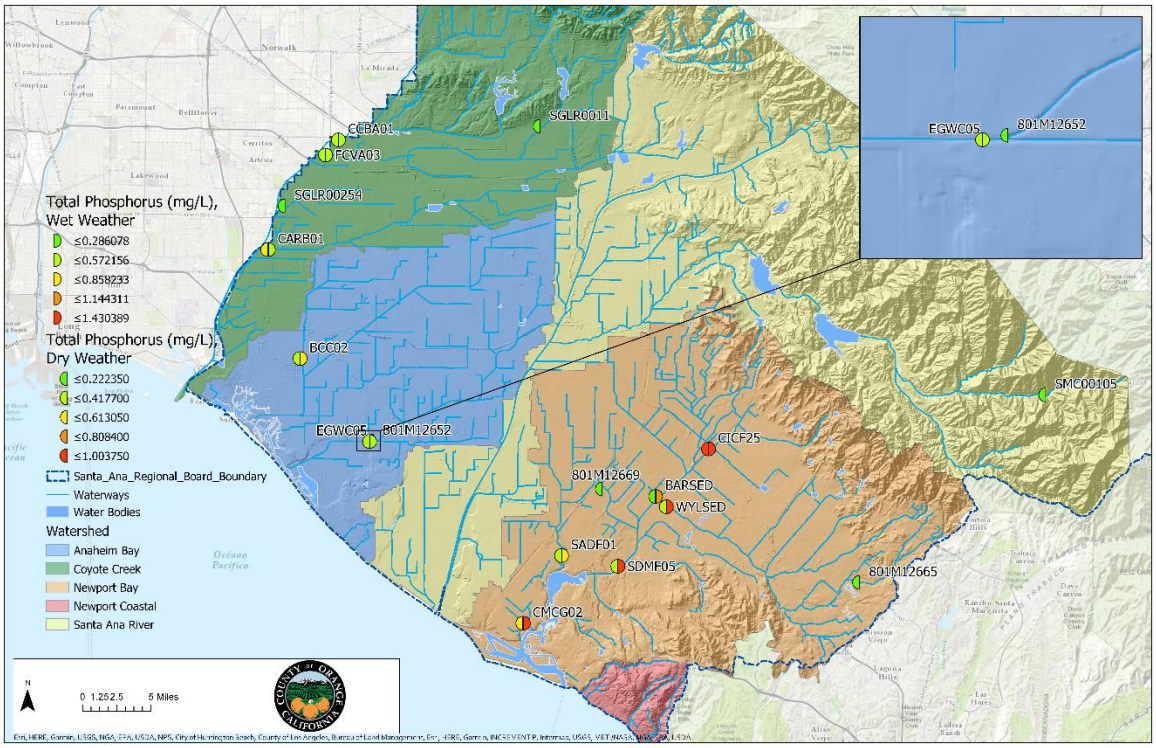


Figure C-11.10: Total Phosphorus Concentrations (mg/L) in Inland Surface Waters during Dry and Wet Weather Conditions, 2016-17.



Inorganic nitrogen levels are highest in the Newport Bay watershed. Inorganic nitrogen concentrations at Peters Canyon Wash at Barranca Parkway (BARSED) and San Diego Creek at Harvard Avenue (WYLSED) contained the highest mean concentrations of Long Term Mass Emissions sites at 23.86 and 58.39 mg/L during dry weather, respectively. The mean concentrations for stormwater-influenced samples at BARSED and WYLSED were 11.75 and 7.4 mg/L, respectively. These two stations are the only Long Term Mass Emissions sites to see substantial (i.e. greater than 50%) total inorganic nitrogen concentration reductions in storm conditions. The majority of other Long Term Mass Emissions sites have increased mean total inorganic nitrogen concentrations in stormwater-influenced samples compared to dry weather conditions. This suggests that groundwater exfiltration in the area of BARSED and WYLSED represents the predominant source of inorganic nitrogen in the watershed during dry weather. As discussed in the 2015-16 PEA, this portion of central Irvine contains a shallow groundwater basin in the former "Swamp of the Frogs" area with both natural and agricultural inputs of nitrogen in the groundwater table that can impact surface waters.

The mean dry weather total inorganic nitrogen was 5.61 mg/L for San Diego Creek at Campus Drive (SDMF05), which is substantially less than BARSED and WYLSED. The operation of the Natural Treatment System which diverts, treats, and discharges runoff back into San Diego Creek upstream of the SDMF05 station has been demonstrated to reduce nitrate as N concentrations and mean daily flow rates in this area (see **Attachment C-11-II.2**).

Mean total phosphorus concentrations at Long Term Mass Emissions stations ranged from 0.027 to 1.0 mg/L in dry weather and 0.34 to 1.43 mg/L during 2016-17 storm events. The highest mean concentrations detected for dry weather were at the Central Irvine Channel and Costa Mesa Channel station for wet weather.

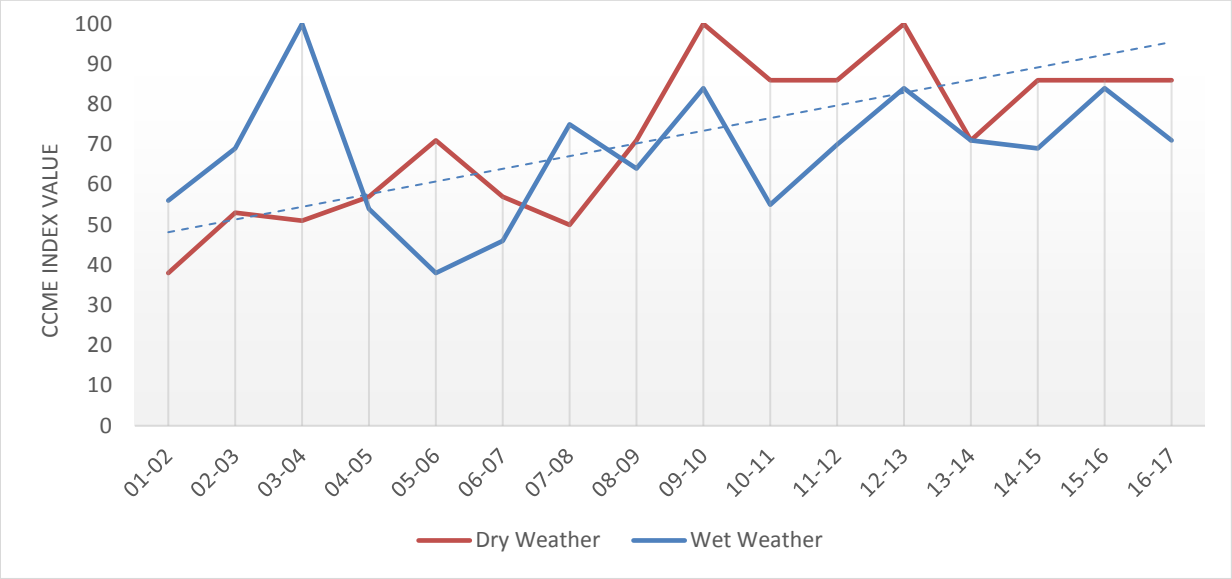
Toxicity Sources from Pesticides

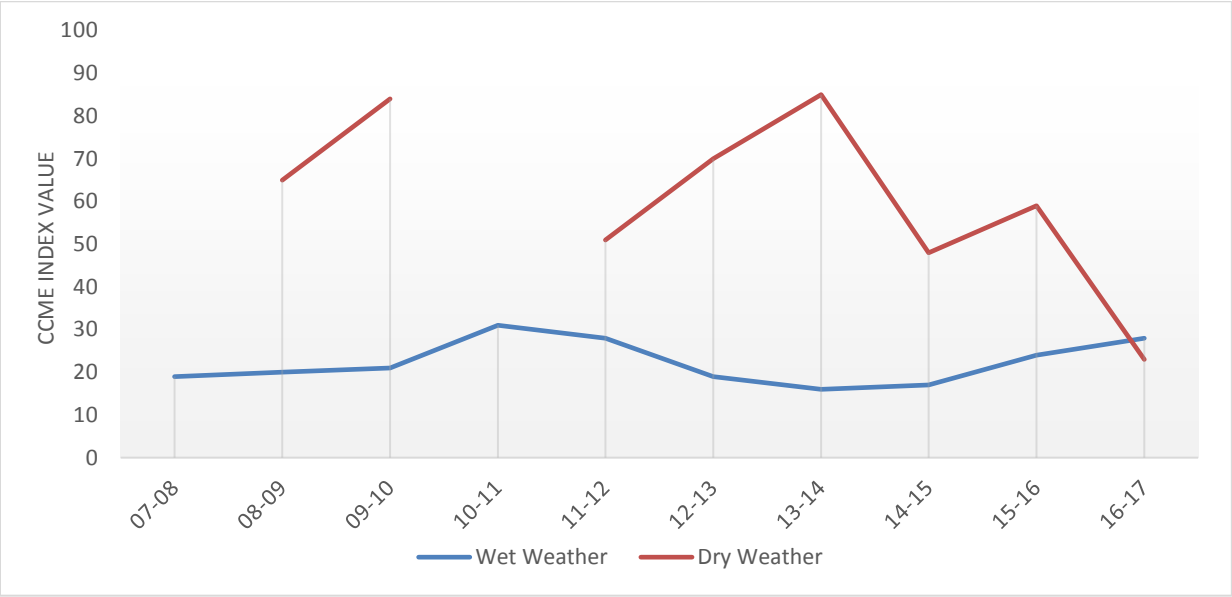
Aquatic and sediment toxicity has been attributed to the use and passive discharge of pesticides into the MS4. Tracking pesticide sources is a challenge as retail pesticide sales and usage is widespread and not fully documented. In addition, classes and amounts of pesticide compounds used in the environment evolve over time. An example would be the observed shift in usage from organophosphate pesticides to pyrethroid pesticides and other emerging pesticide compounds (fipronil and neonicitinoid pesticide classes).

The Permittees have incorporated pesticide monitoring into their core program elements. **Figure C-11.11** below demonstrates trends over time for organophosphate and pyrethroid pesticides in both dry and wet weather. The upper figure shows that water quality index values are improving overall in dry weather.

There are occasional detections of organophosphate pesticides in receiving waters in both dry and wet weather, mostly for Malathion. However, these detections generally occur to a much lower degree than pyrethroid pesticides, hence the lower overall water quality index scores for pyrethroids versus organophosphate pesticides in the two charts associated with **Figure C-11.11**. Pyrethroid pesticide water quality index scores have been variable in recent monitoring years in dry weather, and additional sampling data and statistical analysis is needed to fully understand potential trends. Additional discussion on this topic is included in **Section C-11.4**.

Figure C-11.11: Overall Water Quality Index of the Extent to which Organophosphate (Top) and Pyrethroid Pesticides (Bottom) meet Regulatory Standards in Dry and Wet Weather Conditions.



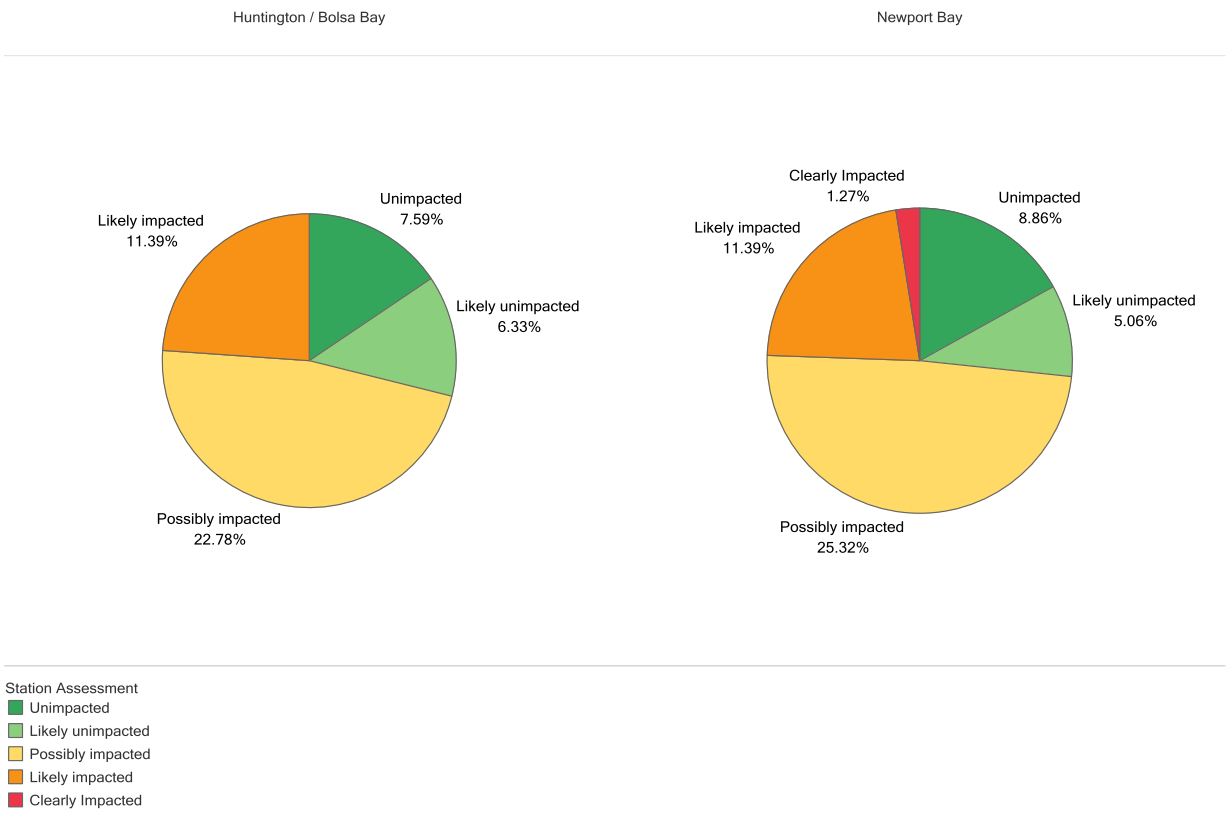


Progress in Identifying Toxicants to Benthic Sediment Species and other Aquatic Organisms

Sediment quality objective (SQO) sampling, which includes a combination of chemical analyses, toxicity analyses, and benthic community analyses, has been ongoing since 2009. Monitoring is performed during the summer dry weather semi-annual monitoring events for Newport Bay and Huntington Harbor / Bolsa Bay stations. **Figure C-11.12** Presents the cumulative results of benthic habitat assessments from 2009-2017 based on the multiple lines of evidence (LOE) approach defined in the SQO policy. The Huntington Bay / Bolsa Bay complex and Newport Bay show a similar percentage of sites receiving assessment categories

of either *likely unimpacted* or *unimpacted* (13.92%). The majority of assessments fall into the *possibly impacted* category, in which there may be impacts to aquatic life in sediment, but the level of impact is uncertain due to disagreement among the lines of evidence. The majority of station assessments demonstrate degraded benthic community with little or no toxicity and low chemical concentrations, suggesting the need for more information on benthic habitat characteristics, sediment effects, or other physical stressors.

Figure C-11.12: Cumulative SQO Station Assessment results.



Progress in Evaluating Toxicity Testing Methods and Procedures

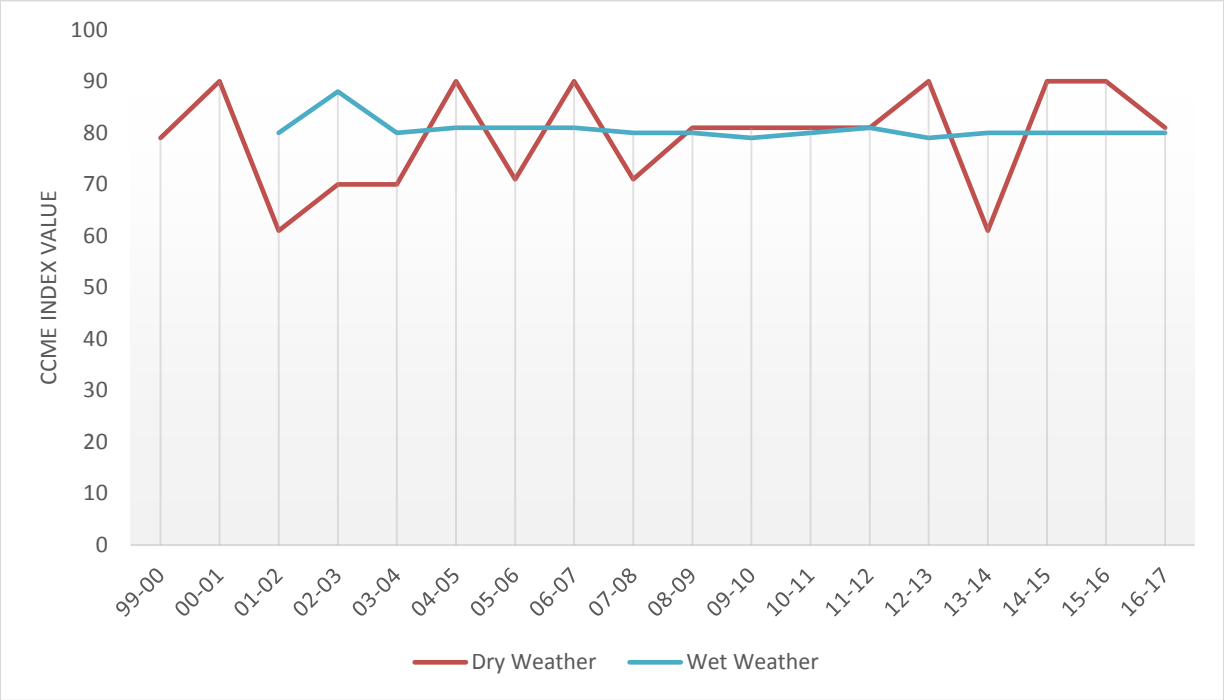
The Permittees have participated in the SMC Toxicity Intercalibration Study throughout 2015-16. The Permittees, along with other SMC member agencies, commissioned this intercalibration study to quantify toxicity sample testing comparability amongst various participating laboratories. The toxicity intercalibration study aimed to assess variability amongst testing laboratories, identify potential improvements in laboratory methods and procedures, and improve comparability and consistency. The SMC, with project oversight by SCCWRP, conducted exercises to characterize and ultimately minimize inter-laboratory variability for testing marine and freshwater species, and to develop a manual to provide guidelines for testing precision and sensitivity. Based on the results of the initial study, the SMC developed a proposal to conduct another round of toxicity intercalibration studies to develop quality assurance guidance for the *Ceriodaphnia dubia* reproduction test. The draft white paper for the results of the intercalibration study are available at the following link (http://socalsmc.org/wp-content/uploads/2017/08/SMC-Toxicity-paper_FinalDraft-09192017.pdf). The SMC has not proceeded with the next phase of intercalibration study at

this time, but have created a fact sheet outlining a follow up study available at the following link (http://socalsmc.org/wp-content/uploads/2017/08/SMC-Toxicity-Intercalibration-Fact-Sheet_V3.pdf). Should a study proceed in the future, the Permittees, and their contract laboratory for toxicity testing, plan to support these efforts, which is consistent with Theme 2 of the monitoring and assessment approach discussed in **Section C-11.2**. Additional information is included in **Section C-11.4**.

Toxicity Sources from Trace Metals

Trace metals are evaluated as potential sources of toxicity. However, studies by the Permittees have indicated that metals, with exception of some instances of elevated dissolved copper, are at relatively low exceedance frequencies and do not appear to contribute to aquatic toxicity in freshwater. **Figure C-11.13** below demonstrates that water quality index scores for metals are relatively high (better conditions) in channels and embayments and have remained steady since 2003. The index includes the number of metals that exceed standards each year, the percentage of individual samples that exceed standards, and the average magnitude of any such exceedances.

Figure C-11.13: Overall Water Quality Index of the Extent to which Metals meet Regulatory Standards in Dry and Wet Weather Conditions.



C-11.4 Progress Updates and Changes in the Monitoring and Assessment Program

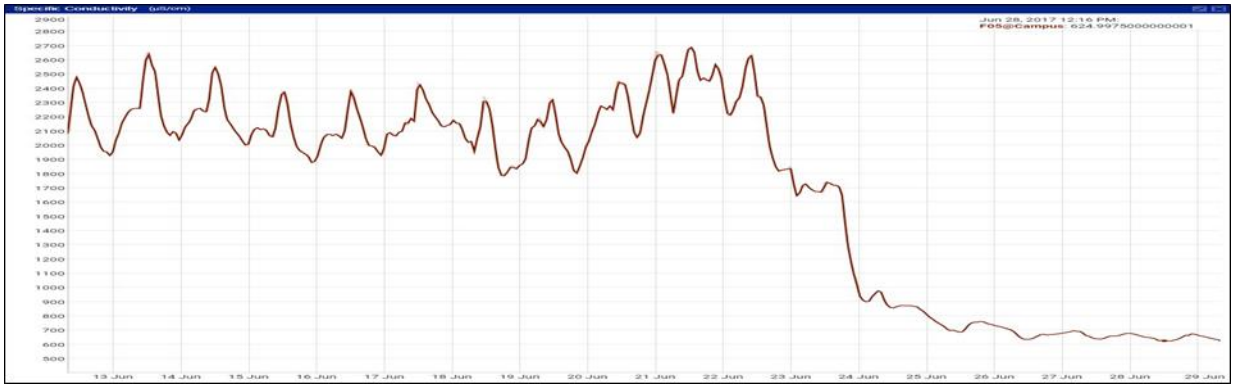
The assessment of environmental conditions in the Santa Ana Region are continually evaluated using the framework described in Section C-11.1 and evaluated against the three assessment themes established by the ROWD State of the Environment Report. This section outlines the progress the Permittees have made in updating and evaluating the monitoring and assessment program and identifies how they correspond the assessment themes outlined in the ROWD.

Progress Updates

Themes 1, 2, and 3:

- The ROWD State of the Environment and subsequent PEAs incorporate the use of a water quality index (based on the CCME index) to assess water quality data and establish priorities in monitoring and program management. The Permittees continued to use and enhance this assessment tool, incorporating it into many of the core monitoring program elements for the 2016-17 PEA, such as for the Dry Weather Reconnaissance Monitoring Program. The Permittees continue to work with the SMC on a project to explore development of a regional water quality index that could be used on a broad scale to interpret large amounts of complex water quality data.
- Order No. R8-2009-0030 was anticipated to have been replaced by the Fifth Term MS4 Permit during the 2016-17 reporting period. However, the adoption of the Fifth Term Permit for north Orange County by the Santa Ana Regional Board remains pending. In anticipation of the next Order, the Permittees are working on integration of the MS4 and TMDL monitoring programs into one comprehensive Monitoring and Assessment Program for the region.
- The Permittees have continued to research the applicability of microbial source tracking tools with human and animal genetic markers, particularly on special studies or source investigation activities.
- In the fall of 2016, the principal Permittee successfully tested real time in situ water quality monitoring probes installed at Santa Ana Delhi channel and San Diego Creek at Campus Drive. This water quality probe provides real time continuous data for conductivity, salinity, pH, oxidation-reduction potential (ORP), optical dissolved oxygen (ODO), turbidity (NTU), temperature, barometric pressure, water level, and total dissolved/suspended solids that is accessible at any time via a web based portal. Data collected at the San Diego Creek Mass Emissions monitoring station alerted staff to a drop in conductivity throughout the summer as seen in **Figure C-11.14**. Upon investigation, staff discovered that the upstream flow contribution had shifted to being primarily originating from Sand Canyon Channel watershed, and were able to pinpoint the source to wetlands in William R. Mason regional park. After successful deployment at the Santa Ana Delhi and San Diego Creek monitoring locations the Permittees have expanded the potential use of real time water quality probes across all monitoring programs.

Figure C-11.14: Real time conductivity data from SDMF05 Mass Emissions Program monitoring station.



Themes 1 and 2:

- The SMC has developed new protocols for bioassessment monitoring as part of the second 5 year regional study discussed in **Attachment C-II-V**. The Permittees have implemented these new monitoring and assessment protocols in 2016-17, including the continuation of examining sediment toxicity in conjunction with the presence of pyrethroids and fipronil in sediment. The Permittees will continue to actively engage in the regional bioassessment monitoring program in 2017-18.
- Working with the Santa Ana Regional Board, SCCWRP, and other agencies, the Permittees have voluntarily participated in a causal assessment of a section of San Diego Creek between Jeffrey Road and Culver Drive in the City of Irvine. This process began in 2014-15 and continued in 2016-17. The goal is to develop the capacity to perform causal assessments while attempting to identify the primary stressors resulting in low bioassessment scores historically found in this reach. SCCWRP has started the development of a framework for rapid, screening level evaluation of stressors to reduce the level of effort and time required to conduct a causal assessment. The Permittees plan to continue their participation in these efforts.

<u>Recommendations for Changes in the Monitoring and Assessment Program</u>

Themes 1 and 2:

As indicated in **Section C-11.3**, toxicity intercalibration studies funded by the SMC and coordinated by SCCWRP identified potential concerns with the results of *Ceriodaphnia dubia* testing, particularly related to the reproduction test. As a result, the SMC proposed a third round of toxicity intercalibration study to identify laboratory quality assurance practices that will improve comparability of the *Ceriodaphnia dubia* reproduction test. The work would have been to identify test conditions and procedures that will minimize instances of toxicity when laboratory dilution water, prepared in accordance with standardize guidance and expected to be nontoxic, is tested by multiple laboratories. Improving the comparability of test results for samples expected to be nontoxic would improve confidence in the use and interpretation of the *Ceriodaphnia dubia* data (both current and historical) for monitoring purposes and regulatory actions.

On July 26, 2017, the Permittees issued a letter to the Executive Officer for the Santa Ana Regional Board requesting that *Ceriodaphnia dubia* testing through the Mass Emissions program be suspended in exchange for funding the Orange County Permittees' portion of the third toxicity calibration study proposed by the SMC. The SMC subsequently decided to forego the third round of toxicity intercalibration study at this time, and the issue remains unresolved. Alternatively, the Permittees plan to evaluate other potential organisms for toxicity testing as a substitute for *Ceriodaphnia dubia*. Based on these findings, the Permittees would recommend the following change to the monitoring and assessment program:

- Allow for the substitution of *Ceriodaphnia dubia* testing with alternative and equivalent test organisms to collect more reliable water quality data and provide more effective toxicity testing resources.

Themes 1 and 3:

Organophosphate pesticides were detected at very low frequencies in 2017 for the Dry Weather Reconnaissance Monitoring Program, similar to prior monitoring years. As discussed in **Section C-11.3**, this finding is consistent with the shift away from the regional use of organophosphate pesticides to newer pesticide treatments such as pyrethroids and other compounds. Based on these findings, and unless otherwise needed to support specific source investigation activities, the sampling and analysis of organophosphate pesticides for this program is inefficient and ineffective for identifying illegal discharges related to these constituents. Therefore, the Permittees would recommend the following change to the monitoring and assessment program:

- Remove organophosphate pesticides from the Dry Weather Reconnaissance Monitoring Program for outfalls and develop replacement sampling alternatives to collect more useful water quality data. For example, the substitution of organophosphate pesticides testing with pyrethroid pesticide constituents could be evaluated for the Dry Weather Monitoring Program, since pyrethroids are currently in greater use by the public and have been detected in stormwater samples in the receiving waters programs.