Attachment C-11-III:

Estuary/Wetlands Monitoring

http://ocwatersheds.com/documents/damp/peareports/archived_pea/2014_15_unified_pea

C-11-III.0 ESTUARY/WETLANDS MONITORING

C-11-III.1 Core Monitoring Program

Estuary/Wetlands monitoring is conducted to assess the impact of MS4 discharges on aquatic habitat in estuarine or brackish waters. Monitoring consists of assessments of water for chemistry, physical characteristics, and toxicity, and of benthic sediments for chemistry, toxicity, and infaunal assemblage. The evaluation of Estuary/Wetlands monitoring data includes three distinct elements: benthic community analysis; sediment chemistry and toxicity analysis; and, aquatic chemistry and toxicity analysis. Sampling is conducted for this program during dry and wet weather conditions.

The benthic community analyses and habitat assessment was completed by the Permittees during the September 2014 semi-annual monitoring events for Newport Bay and Huntington Harbour/North County stations. The full 2014-15 sampling results for Estuary/Wetlands monitoring are included as part of the following tables available via the internet link provided https://ocgov.box.com/s/ti74cecpugiarccbbgrc7ljbqmqmr02e:

- **Table C-11-III.1** provides aqueous chemistry data.
- **Table C-11-III.2** provides aqueous toxicity results as well as benthic sediment toxicity.
- **Table C-11-III.3** provides benthic sediment chemistry.

As indicated in the 2013-14 PEA, the 2012-13 SQOs and benthic community analyses monitoring was conducted through the regional Bight '13 program. Due to the requirement of rigorous intercalibration processes and unified QA/QC protocols for all sites under the Bight '13 program, these 2013 results currently remain pending as of the date of the 2014-15 PEA and are expected to be published by SCCWRP in winter or spring 2016. The Permittees continued to participate in the Bight '13 program data analysis as part of regional monitoring efforts.

C-11-III.2 Sediment Quality Objectives

The following describes the general benthic community analyses procedures as well as the available sediment chemistry and toxicity sampling efforts conducted by the Permittees during 2014-15.

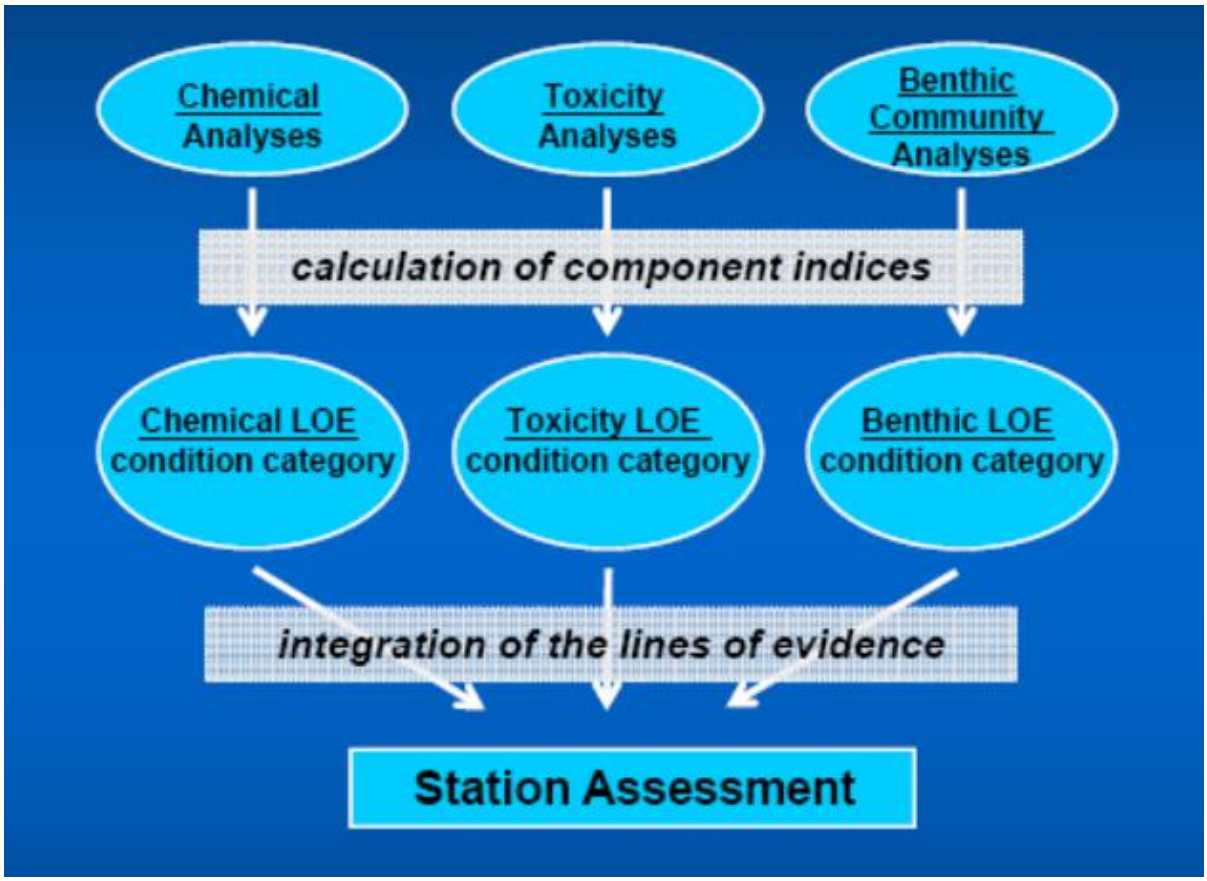
Benthic Community Analyses Approach

Sediment monitoring at the Estuary/Wetlands stations is based on the multiple LOE approach defined in the state's SQOs policy for enclosed bays and estuaries, and includes benthic infaunal community condition, sediment chemistry, and sediment toxicity analyses.

California Water Code section 13393 requires the State Water Board to develop SQOs for toxic pollutants for California's enclosed bays and estuaries. On September 16, 2008, the State Water Board conducted a public hearing and adopted the Water Quality Control Plan for Enclosed Bays and Estuaries – Part 1 Sediment Quality (Plan), containing narrative SQOs and a policy of implementation. The Plan became effective on August 25, 2009.

The State Water Board and SCCWRP have developed a Microsoft Excel based calculation tool which integrates information from each of the three LOEs to produce an overall station assessment of the quality of the sediment habitat at a monitoring location. The following figure presents the overall process used to evaluate the data collected.

Figure C-11-III.1. Assessment Process used to Develop Station Assessment Categories. The following graphic outlines the process that is used to generate the station assessment results based on chemical analyses, toxicity analyses, and benthic community analyses.



The station assessment categories produced are:

- Unimpacted
- Likely Unimpacted
- Possibly Impacted
- Likely Impacted
- Clearly Impacted
- Inconclusive

Table C-11-III.4 breaks down the SQO results for each of the stations monitored in 2014, as well as provides historical results for context. **Figure C-11-III.2** shows a map of the monitored stations and results of the SQO analysis. The table and figure each include overall station assessment scores as well as individual integrated scores for benthic, toxicity, and chemistry analyses conducted at each station. The following stations were monitored in 2014:

- Talbert Marsh at Brookhurst (TBDMAR)
- Bolsa Bay Downstream Tidegates (TGDC05)
- Bolsa Bay Observation Pier (BBOLR)
- Huntington Harbour at Bolsa Chica Channel/Edinger Avenue (HUNBCC)
- Huntington Harbour at Christiana Bay (HUNCRB)
- Huntington Harbor at Warner Avenue (HUNWAR)
- Lower Newport Bay at Harbor Island Reach (LNBHIR)
- Lower Newport Bay at Turning Basin (LNBTUB)
- Upper Newport Bay at Coast Highway Bridge (UNBCHB)
- Upper Newport Bay at Jamboree Road (UNBJAM)
- Upper Newport Bay at North Star Beach (UNBNSB)
- Upper Newport Bay at Santa Ana-Delhi Channel/Irvine Avenue (UNBSDC)
- Lower Newport Bay at Rhine Channel (LNBRIN)

The 2014 samples collected for UNBJAM did not contain organisms to complete the full SQO analysis for this station.

Table C-11-III.4. SQO Station Assessment Scores in Tabular Format. The upper table graphic includes Huntington Harbour/North County stations, and the lower table graphic includes Newport Bay stations monitored. The results included overall station assessment, integrated chemistry indicator, integrated toxicity indicator, and integrated benthic indicator for 2014. Historical results are also provided for context.

Huntington Harbour / North County Stations:

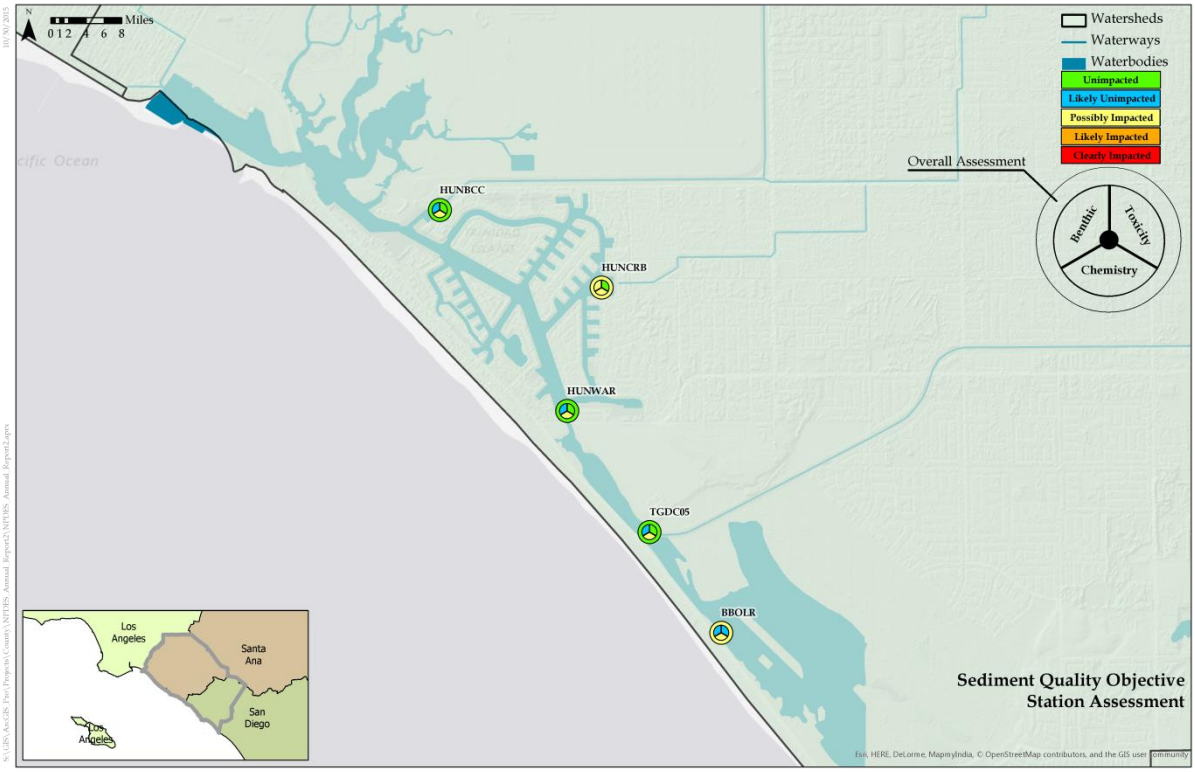
	Station ID	TBTMAR	TGDC05	BBOLR	HUNBCC	HUNCRB	HUNWAR
2009	Station Assessment				Possibly impacted	Likely impacted	Likely unimpacted
2010	Station Assessment	Possibly impacted	Possibly impacted	Likely unimpacted	Likely unimpacted	Likely impacted	Possibly impacted
2011	Station Assessment	Likely impacted		Possibly impacted	Likely impacted	Likely impacted	Likely impacted
2012	Station Assessment	Possibly impacted	Possibly impacted	Possibly impacted	Possibly impacted	Possibly impacted	Possibly impacted
2014	Station Assessment	Unimpacted	Unimpacted	Possibly impacted	Unimpacted	Possibly impacted	Unimpacted
2009	Integrated Chemistry Indicator		Moderate Exposure	Moderate Exposure	Low Exposure	High Exposure	Low Exposure
2010	Integrated Chemistry Indicator		Moderate Exposure	High Exposure	Moderate Exposure	High Exposure	Moderate Exposure
2011	Integrated Chemistry Indicator	Moderate Exposure	Moderate Exposure	Moderate Exposure	Moderate Exposure	Moderate Exposure	Moderate Exposure
2012	Integrated Chemistry Indicator	Moderate Exposure	Moderate Exposure	Moderate Exposure	Moderate Exposure	Moderate Exposure	Moderate Exposure
2014	Integrated Chemistry Indicator	Moderate Exposure	Moderate Exposure	Moderate Exposure	Moderate Exposure	Moderate Exposure	Moderate Exposure
2009	Integrated Toxicity Indicator				Nontoxic	Nontoxic	Nontoxic
2010	Integrated Toxicity Indicator		Nontoxic	Nontoxic	Nontoxic	Nontoxic	Nontoxic
2011	Integrated Toxicity Indicator	Low Toxicity	Low Toxicity	Low Toxicity	Low Toxicity	Low Toxicity	Low Toxicity
2012	Integrated Toxicity Indicator	Nontoxic	Low Toxicity	Low Toxicity	Low Toxicity	Nontoxic	Low Toxicity
2014	Integrated Toxicity Indicator	Nontoxic	Nontoxic	Low Toxicity	Nontoxic	Nontoxic	Nontoxic
2009	Integrated Benthic Indicator				Moderate Disturbance	High Disturbance	High Disturbance
2010	Integrated Benthic Indicator				Moderate Disturbance	High Disturbance	Moderate Disturbance
2011	Integrated Benthic Indicator	High Disturbance		Low Disturbance	Moderate Disturbance	Moderate Disturbance	Moderate Disturbance
2012	Integrated Benthic Indicator	Moderate Disturbance	Low Disturbance	Low Disturbance	Low Disturbance	Moderate Disturbance	Low Disturbance
2014	Integrated Benthic Indicator	Low Disturbance	Low Disturbance	Low Disturbance	Low Disturbance	Moderate Disturbance	Low Disturbance

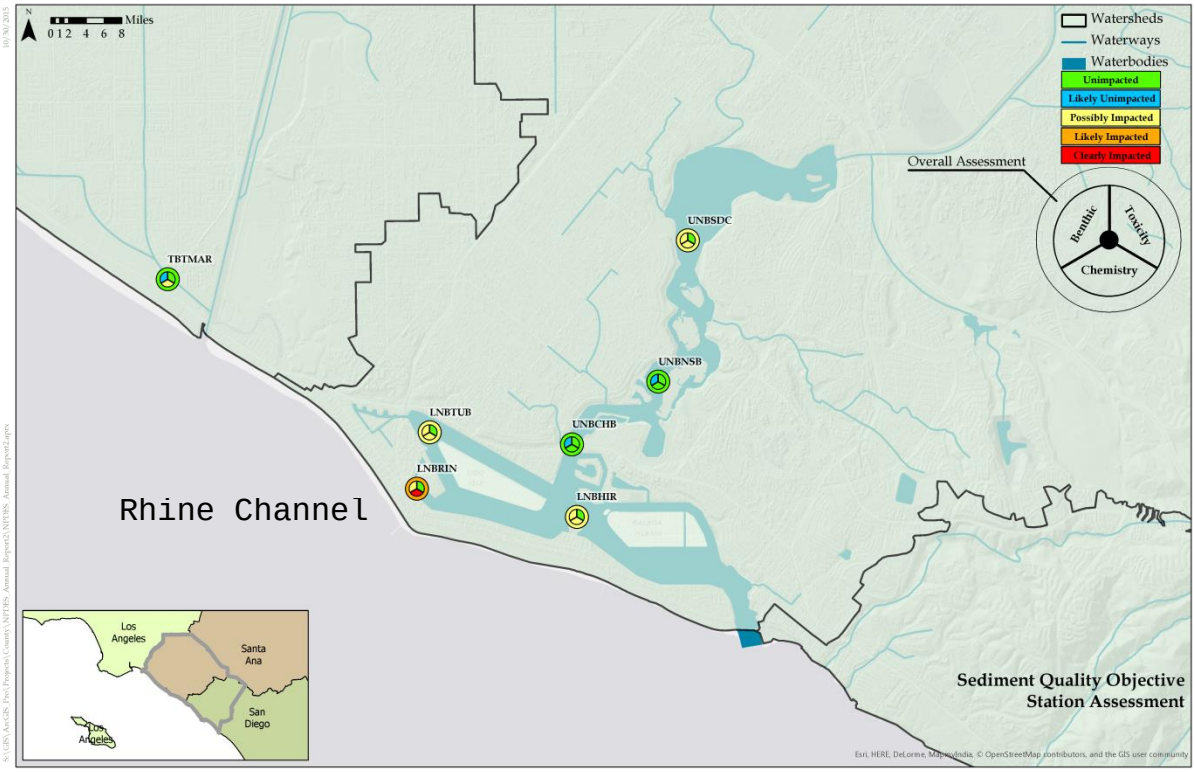
Newport Bay Stations:

Rhine Channel

	Station ID	LNBHIR	LNBTUB	UNBCHB	UNBJAM	UNBNSB	UNBSDC	LNBRIN
2009	Station Assessment	Possibly impacted	Possibly impacted	Likely unimpacted	Likely impacted	Possibly impacted	Clearly impacted	
2010	Station Assessment	Possibly impacted	Likely impacted	Possibly impacted	Possibly impacted	Possibly impacted	Likely impacted	
2011	Station Assessment	Possibly impacted	Likely impacted	Unimpacted	Possibly impacted	Likely unimpacted	Possibly impacted	Likely impacted
2012	Station Assessment	Possibly impacted	Possibly impacted	Unimpacted		Possibly impacted	Possibly impacted	
2014	Station Assessment	Possibly impacted	Possibly impacted	Unimpacted	Not Reported	Unimpacted	Possibly impacted	Likely impacted
2009	Integrated Chemistry Indicator	Moderate Exposure	High Exposure	Moderate Exposure	Moderate Exposure	Moderate Exposure	Moderate Exposure	
2010	Integrated Chemistry Indicator	Moderate Exposure	Moderate Exposure	Moderate Exposure	Moderate Exposure	Moderate Exposure	High Exposure	
2011	Integrated Chemistry Indicator	Moderate Exposure	High Exposure	Moderate Exposure	Moderate Exposure	Moderate Exposure	Moderate Exposure	High Exposure
2012	Integrated Chemistry Indicator	Moderate Exposure	Moderate Exposure	Moderate Exposure	Moderate Exposure	Moderate Exposure	Moderate Exposure	
2014	Integrated Chemistry Indicator	Moderate Exposure	Moderate Exposure	Low Exposure	Moderate Exposure	Low Exposure	Moderate Exposure	High Exposure
2009	Integrated Toxicity Indicator	Nontoxic	Nontoxic	Moderate Toxicity	High Toxicity	High Toxicity	High Toxicity	
2010	Integrated Toxicity Indicator	Moderate Toxicity	Nontoxic	Low Toxicity	Nontoxic	Nontoxic	Low Toxicity	
2011	Integrated Toxicity Indicator	Low Toxicity	Nontoxic	Nontoxic	Nontoxic	Low Toxicity	Nontoxic	Low Toxicity
2012	Integrated Toxicity Indicator	Low Toxicity	Nontoxic	Nontoxic	Nontoxic	Nontoxic	Nontoxic	
2014	Integrated Toxicity Indicator	Nontoxic	Nontoxic	Nontoxic	Nontoxic	Nontoxic	Nontoxic	Nontoxic
2009	Integrated Benthic Indicator	High Disturbance	High Disturbance	Reference	High Disturbance	Low Disturbance	High Disturbance	
2010	Integrated Benthic Indicator	Low Disturbance	Moderate Disturbance	Low Disturbance	High Disturbance	Moderate Disturbance	High Disturbance	
2011	Integrated Benthic Indicator	Low Disturbance	Moderate Disturbance	Low Disturbance	High Disturbance	Reference	Moderate Disturbance	Moderate Disturbance
2012	Integrated Benthic Indicator	Low Disturbance	High Disturbance	Low Disturbance		Moderate Disturbance	Moderate Disturbance	
2014	Integrated Benthic Indicator	Moderate Disturbance	Moderate Disturbance	Low Disturbance	Not Reported	Low Disturbance	Moderate Disturbance	Moderate Disturbance

Figure C-11-III.2. SQO Station Assessment Scores in Graphic Format. The following graphics portrays overall assessment scores (outer circle), as well as individual benthic, toxicity, and chemistry scores for each station monitored. Map area is divided into two areas similar to **Table C-11-III.4**.





Overall SQO assessment of sites in areas that are minimally influenced by tidal exchange, such as LNBRIN, tended toward the Likely Impacted category. LNBRIN also contained the highest mercury and copper concentrations in sediment of the Estuary / Wetlands stations monitored across the Santa Ana Region. Conversely, sites with good tidal exchange, such as UNBNSB and UNBCHB, had assessment categories in the unimpacted range.

Sediment Chemistry and Toxicity Analysis by the Permittees

Sediment chemistry and toxicity testing is a key part of the SQO assessment and represents an integrated approach to measuring pollutant effects on aquatic species. As an overall indicator of the presence of toxic pollutants present in sediments that may or may not be detected as individual chemical constituents, toxicity provides a cumulative perspective of conditions.

Additional sediment chemistry and toxicity samples are incorporated into the monitoring program from harbors, estuary, and wetland sites beyond the SQO monitoring in September 2014. Samples are normally collected in the spring/early summer time period following storm season and in the fall. The data from the samples is used for evaluating toxicity during dry weather conditions as well as measuring the aggregated effects of toxicants accumulated in sediments over the period of the storm season.

The following sediment toxicity data was compiled during the SQO assessment in September 2014 and the subsequent semi-annual (Huntington Harbour/North County) and/or quarterly (Newport Bay) monitoring events:

- Levels of toxicity in the 10-day *Eohaustorius* survival test overall from the 2014-15 monitoring events ranged from 67% to 99% survival compared to the control sample, with an overall average of 92% survival amongst the samples analyzed. In total, one of the 38 samples collected fell below the <80% effect range (a sample is considered toxic if there is an 80% or less survival compared to a control sample for the same test organism), which was measured at 67% survival at LNBHIR in January 2015. The three other samples collected in 2014-15 from this station were above 80% survival.
- *Mytilus* fertilization is conducted during the September 2014 monitoring event along with the SQO analysis, with the exception of the LNBRIN station, which is only monitored for *Eohaustorius*. Levels of toxicity for *Mytilus* fertilization ranged from 84% to 101% compared to the control sample, with an overall average of 94%. None of the *Mytilus* fertilization tests fell below the <80% effect range for fertilization during the September 2014 monitoring event.

Sediment chemistry samples collected during the sediment toxicty monitoring events are analyzed for multiple pesticide and polychrolinated biphenyl (PCB) compounds. In particular, the presence of the pyrethroid pesticides and survival rates for *Eohaustorius* are evaluated. Synthetic pyrethroid pesticides analyses were historically added to the

monitoring program as an additional study by the Permittees to supplement the core monitoring elements due to their potential relationship to sediment toxicity. The results from the 2014-15 monitoring show overall a low occurrence of sediment toxicity (1 in 38 *Eohastorius* samples) as well as infrequent detections of pyrethroid compounds (as well as other pesticides and PCBs) in sediment. The one sample that exhibited toxicity at LNBHIR in January 2015 was non-detect for analyzed pesticides and PCB compounds. The following summarizes the constituents detected in sediment chemistry for each station monitored in 2014-15:

- Organochlorine pesticides and PCB Arochlors were not detected in any of the sediment samples collected.
- PCB Congeners were detected in two samples, which were both collected in June 2015: BBOLR (two detections) and LNBTUB (multiple detections).
- Pyrethroid pesticides were detected in three samples collected from two stations: LNBRIN (one detection in June 2015) and UNBJAM (two detections each in January and June 2015).

C-11-III.3 Aquatic Chemistry and Toxicity Analysis

The Estuary/Wetlands monitoring included both aquatic chemistry sampling and aquatic toxicity testing (with marine test organisms). As indicated above, **Table C-11-III.1** presents the aqueous chemistry results and **Table C-11-III.2** presents the aqueous toxicity results. Data presented includes both dry and wet weather sampling events.

Dry weather monitoring is generally conducted quarterly at Newport Bay stations and semi-annually at Huntington Harbour/Bolsa Bay/Talbert Marsh stations. Stormwater monitoring of the Estuary / Wetlands sites are generally paired with Long Term Mass Emissions sampling when feasible; however, limited storm events of sizable rain amounts occurred in 2014-15. Stormwater-influenced samples were collected at various stations during three storm events. The below average rain year coupled with smaller sized storms limited monitoring opportunities for harbor and estuary sites, affecting the total amount of aquatic chemistry and toxicity samples collected in wet weather.

Attachment C-11-II (Long Term Mass Emissions) includes tabular and graphical summaries of the exceedances of acute and chronic CTR criteria for dissolved metals samples collected in the marine (seawater) environment. The only trace element to exceed acute or chronic CTR criteria for Estuary / Wetlands sampling was dissolved copper during 2014-15 as follows:

- The comparison of data with the acute CTR criterion shows that 5 of the 49 (10%) grab samples collected during dry weather contained dissolved copper at a concentration which exceeds the CTR acute toxicity criterion (4.8 µg/L) for seawater. The stations with exceedances include BBOLR (2 of 3 samples), TGDC05 (1 of 3 samples), and UNBJAM (2 of 6 samples). For stormwater-influenced conditions, a total of 1 of 25 samples collected exceeded the CTR acute criterion for copper (LNBTUB, 1 of 2 wet weather samples).

- Comparisons of sampling data to the chronic CTR criterion show more frequent exceedances for dissolved copper. Samples from the Huntington Harbour/Bolsa Bay complex exceeded the dissolved copper CTR chronic criterion in 9 of 14 samples (64%) collected during dry weather and 6 of 9 (67%) stormwater-influenced samples. No exceedances of CTR acute criterion for dissolved copper were observed in the four samples collected at Talbert Marsh. Samples from Newport Bay exceeded the dissolved copper chronic CTR criterion 11 of 31 times (35%) during dry weather. Stormwater-influenced samples from Newport Bay exceeded the CTR chronic criterion in 10 of 15 storm samples (67%).

Organophosphate and pyrethroid pesticides were also sampled as part of the monitoring efforts. The following summarizes the findings observed:

- A total of 2 of 75 (3%) samples collected during dry and wet weather conditions contained detectable organophosphate pesticides. One sample containing 14 ng/L of Malathion was collected from HUNBCC on February 23, 2015 as part of a storm monitoring event. The other sample with detections was collected from LNBHIR on June 4, 2015 during dry weather conditions. This LNBHIR sample contained detections of 11 organophosphate pesticides; however, further evaluation of this sample through the QA/QC process indicated that it was likely switched with a synthetic QA/QC sample with these compounds added and the actual field sample was non-detect for organophosphate pesticides. Therefore, it is likely that only 1 of 75 field samples (1%) contained detectable organophosphate pesticides for this program.
- A total of 9 of 16 (56%) stormwater-influenced samples collected from Huntington Harbour/North County stations contained detectable pyrethroid pesticides. Bifenthrin was detected in each of these 9 samples with detections ranging from 2 to 2.6 ng/L (detection limit is <2 ng/L). Other compounds detected included cyfluthrin (3 samples), cypermethrin (1 sample), deltamethrin (2 samples), esfenvalerate (1 sample), L-cyhalothrin (3 samples), and permethrin (1 sample).

Aquatic toxicity was evaluated on dry weather samples using four toxicity tests with two marine organisms: the purple sea urchin (*Stronglyocentrotus purpuratus*) fertilization test, and the mysid shrimp (*Americamysis bahia*) 48 hour survival test, 7 day survival, and growth tests. Samples were collected from Newport Bay, Huntington Harbour/Bolsa Bay, and Talbert Marsh in September 2014; Newport Bay in January 2015 and March 2015; and Newport Bay, Huntington Harbour/Bolsa Bay and Talbert Marsh in June 2015. A summary of the toxicity organism responses statistics during dry weather and storm events is summarized in the tables below.

Table C-11-III.4. Summary of Dry Weather Toxicity Results and Statistics. None of the 144 aqueous tests (0%) were found to have toxicity. Mean and Min refer, respectively, to the mean of all test results and the minimum result in any single test. The Total column indicates the number of toxic sample results out of the total number of tests conducted.

Dry Weather Toxicity Test Statistics	Mean	Min	Toxic
Americamysis bahia Growth test	121%	87%	0 of 36
Americamysis bahia 7 Day Survival test	101%	93%	0 of 36
Americamysis bahia 48 Hour Survival test	100%	97%	0 of 36
Strongylocentrotus purpuratus Fertilization test	100%	97%	0 of 36

A total of 36 dry weather samples were collected year round resulting in 144 toxicity tests conducted using the four different tests/organisms. None of these tests exhibited toxicity < 80% effect range.

Table C-11-III.5. Summary of Wet Weather Toxicity Results and Statistics. A total of one of the 88 aqueous tests (0%) was found to have toxicity. Mean and Min refer, respectively, to the mean of all test results and the minimum result in any single test. The Total column indicates the number of toxic sample results out of the total number of tests conducted.

Wet Weather Toxicity Test Statistics	Mean	Min	Toxic
Americamysis bahia Growth test	222%	70%	1 of 22
Americamysis bahia 7 Day Survival test	102%	95%	0 of 22
Americamysis bahia 48 Hour Survival test	102%	93%	0 of 22
Strongylocentrotus purpuratus Fertilization test	100%	98%	0 of 22

Of the 88 toxicity tests conducted on stormwater samples, one *Americamysis bahia* growth test sample from LNBHIR from December 3, 2014 was considered toxic at 70% effect. The integrated results of toxicity during dry and wet weather are included with **Attachment C-11-II**.

C-11-III.4 Regional Monitoring Program

Water quality monitoring efforts for 2014-15 focused on the core Estuary/Wetlands monitoring. No regional monitoring activities were conducted except for follow up participation in the Bight '13 program data analysis, as mentioned in **Section C-11-III.1** above.

C-11-III.5 Special Studies

No special studies were conducted during 2014-15. The Permittees do conduct additional synthetic pyrethroid pesticide sampling in sediments as part of an effort to better understand potential sediment toxicity effects. The results of this effort are summarized and discussed in the *Sediment Chemistry and Toxicity Analysis* section above.