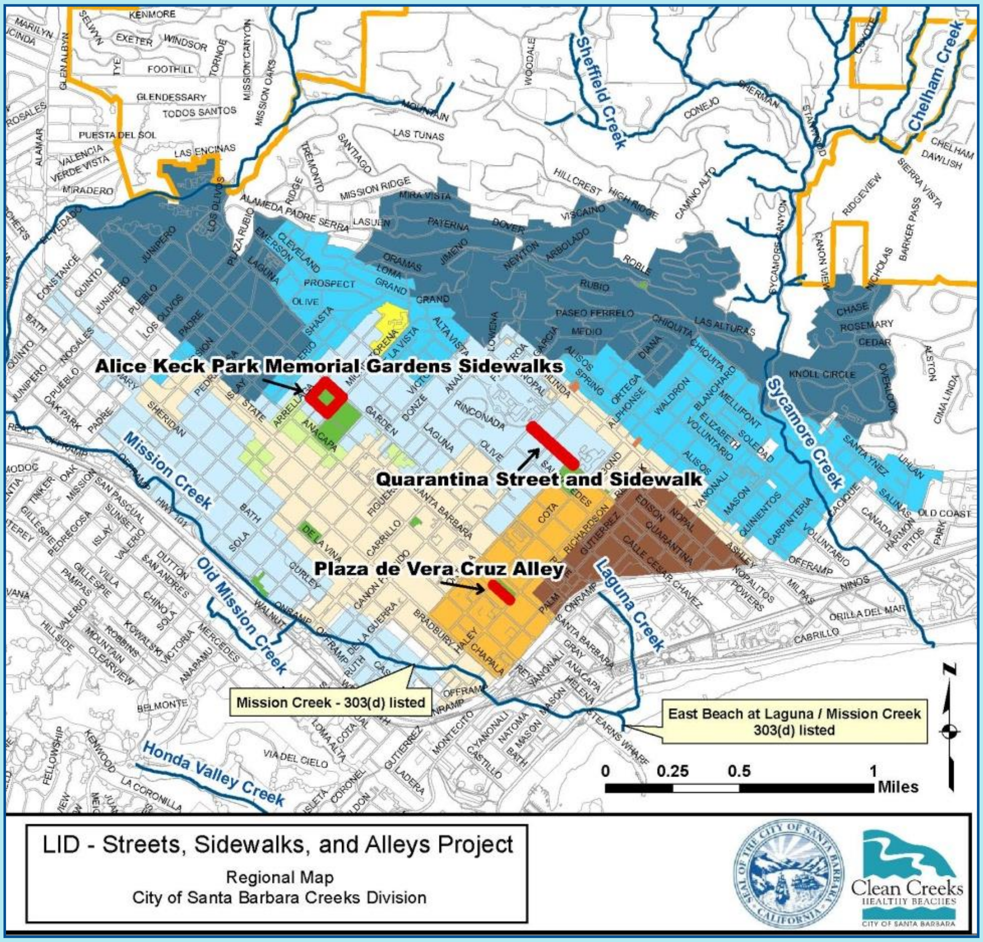
Fiscal Year 2015
Annual Water Quality Report



City of Santa Barbara

Creeks Division

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INTRODUCTION

The following report described sampling and results that were based on the Fiscal Year 2015 Research and Monitoring Plan (Appendix A). The Research Plan is organized around program elements and research questions that have been reviewed by the Creeks Advisory Committee (CAC). The Research and Monitoring Program is adaptive, and as questions are answered or modified, sampling strategies change as well. The program elements and research questions are provided below. Where possible, the report is organized around the research questions. ***The primary purpose of this report is to serve as an internal record of data collection and analysis. Please see the Creeks Division 2001-2006 report for a discussion of methods, information on water quality criteria, and a glossary of monitoring terms.***

WATER QUALITY MONITORING PROGRAM GOALS

The goals of the monitoring program are to:

1. Quantify the levels (concentration, flux, or load) of microbial contamination and chemical pollution in watersheds throughout the city.
2. Evaluate impacts of pollution on beneficial uses of creeks and beaches, including recreation and habitat for aquatic organisms.
3. Evaluate the effectiveness of the City's restoration and water quality treatment projects, which includes collecting baseline data for future projects.
4. Identify sources of contaminants and pollution in creeks and storm drains.
5. Evaluate long-term trends in water quality.
6. Meet monitoring requirements for grants.
7. Meet General Permit monitoring requirements.
8. Investigate 303(d)-listed waterbody impairments.

The underlying motivation behind the monitoring program is to obtain information that the City can use to:

1. Develop strategies for water quality improvement, including prioritization of capital projects and outreach/education programs.
2. Communicate effectively with the public about water quality.

3.

CHANGES FOR FISCAL YEAR 2015

The Research Plan changed substantially in FY14 due to new regulatory requirements in the new Phase II Small MS4 General Permit (Permit) and an increase in the number of water quality and restoration projects requiring sampling. Minor changes were made for FY 15, including:

1. Update Permit Compliance section to include the Performance, Evaluation, and Assessment Identification Plan.
2. Add quarterly sampling for two projects, the Barger Canyon restoration site and the El Estero section of the Mission Lagoon Restoration Project.
3. Increase sampling frequency of Hope and Haley Diversion, as specified in Permit-required Special Studies Plan.
4. Add the use of level loggers in several sites, reflecting the increased focus on infiltration in storm water management.
5. Shift strategy for monitoring Upper Las Positas Project (Golf Course) toward quantifying infiltration and load reduction.
6. Remove general First Flush Monitoring from Storm Monitoring section, based on accumulation of sufficient data. Maintain first flush sampling at infiltration project sites for general pollutants and at additional sites for emerging contaminants detected in FY 14 monitoring.
7. Remove the Arroyo Burro Microbial Source Tracking project from the Source Tracking section due to completion of the project by the University of California, Santa Barbara (UCSB).
8. Add three projects to the Source Tracking section: Wet Weather Human Markers (pending grant funding), Historical FIB Analysis (in partnership with UCSB), and the Microbial Marker Aging Study (conducted by UCSB).

SELECT RESULTS

LONG TERM TRENDS - DROUGHT AND WATER QUALITY

Information on drought and water quality was presented in December 2014 and is updated here, reflecting the additional dry year. Drought has led to a substantial reduction of base flows in creeks in Santa Barbara. Sites that have gone dry occasionally over the past decade have been dry for nearly two years during non-storm conditions. Shallow groundwater, i.e. that which feeds waters to creeks in Santa Barbara via subsurface flow (“interflow”), is also lower than in years past at most sites. Wells within the highly impervious Laguna Creek watershed have shown less response to drought than wells located in Mission Creek and Arroyo Burro watersheds. The dampened response may be due to reduced recharge during past storm events and reduced interflow due to piping of the creek. Changes in hydrology may also effect conductivity of creek flow. In Arroyo Burro, conductivity readings have doubled since the start of the drought.

Drought conditions have continued to result in a reduction in beach warnings, which are based on weekly indicator bacteria tests conducted by Santa Barbara County. During 2012-2015 AB411 seasons (April 1 – October 31, when weekly tests are required by the State), Arroyo Burro Beach, East Beach at Mission Creek, East Beach at Sycamore Creek, and Leadbetter Beach had half as many warnings posted over the past three years, compared to years with normal rainfall amounts. The reduction in warnings is due to fewer storms, lower base flows in creeks, and less frequent lagoon breachings (openings) during dry years. Nearly two decades of indicator bacteria data collected at local beaches shows a significant statistical relationship between the annual rainfall total and the number of beach warnings per year. Due to higher creek flows and larger estuaries, Arroyo Burro Beach and East Beach at Mission Creek show a stronger relationship with rain than Leadbetter Beach and Each Beach at Sycamore Creek. Overall, indicator bacteria concentrations in creeks have not changed during this drought. However, in July 2015, a small monsoonal rain event with air temperatures near 90° F corresponded with the highest indicator bacteria levels the Creeks Division has recorded in creeks during summer months. This event did not produce beach warnings due to closed lagoons.

Bioassessment, which measures the ecological response to water quality and habitat changes, has shown decreased levels of biological integrity at most locations during FY 14; scores are not yet available for FY 15 bioassessment monitoring.

STORM MONITORING

Despite low rainfall, three storms were sampled FY 15. Samples were collected during each storm from six locations in order to determine pre-project concentrations for the Streets, Sidewalks, and Alleys Project. Samples were tested for metals, hydrocarbons, surfactants, nutrients, fecal indicator bacteria, sediment, pesticides (pyrethroids and neonicotinoids), and toxicity. Samples were also collected from the integrator sites (most downstream location above tidal influence) at Arroyo Burro, Mission Creek, Laguna Creek, and Sycamore Creek during one storm; these samples were tested for pesticides.

Results from storm sampling showed high variability in the quality of runoff collected, both across sampling locations and dates. In general, project site samples with comparatively high metals, surfactants, hydrocarbons, and some nutrients also demonstrated the highest toxicity levels. Three of four locations showed significant toxicity in runoff on at least one sample date. Pesticides detected in project sites and integrator stations included imidacloprid and several pyrethroids. As in FY 14, dicloran was found frequently (15 of 16 samples in FY 15). Because dicloran is a fungicide used on agricultural crops and in limited commercial landscaping sites in Santa Barbara County, the dicloran results are still considered tentative. Sumithrin, which was detected frequently in FY 14, was not detected in FY 15. As discussed in June 2015, imidacloprid was detected frequently and is the subject of ongoing research by the Creeks Division.

Upon construction of the Streets, Sidewalks, and Alleys Project, estimates will be made of the amount of pollutants infiltrated, or prevented from reaching the creeks, by using concentration data collected in FY 15 and rainfall/infiltration data collected in FY 16.

IMIDACLOPRID

Previous work by the Creeks Division has shown widespread presence of imidacloprid in urban runoff. The Creeks Division partnered with researchers from the University of California, Santa Barbara (Drs. Lenihan, Mueller, and Means) and the United States Geologic Survey's Pesticide Fate and Transport Group (Dr. Hladik) to apply for funding from California SeaGrant to conduct field sampling, laboratory toxicity tests, and population modeling to understand the potential impacts of the neonicotinoid pesticides on coastal streams and estuaries. The project has been approved by SeaGrant but will not be funded until NOAA receives its FY 2016 budget appropriation from Congress.

PERMIT REQUIREMENTS

Work conducted in support of the Phase II General Permit monitoring requirements included revising and approval of the 303(d) Monitoring Plan/QAPP, chemical testing of outfalls, and participation in a working group to develop modeling and monitoring for the Performance Evaluation Assessment & Improvement Plan.

GRANT REQUIREMENTS

Load reduction calculations and analysis were completed for the LID Parking Lots Project. Sampling was completed for the LID Streets, Sidewalks, and Alleys Project.

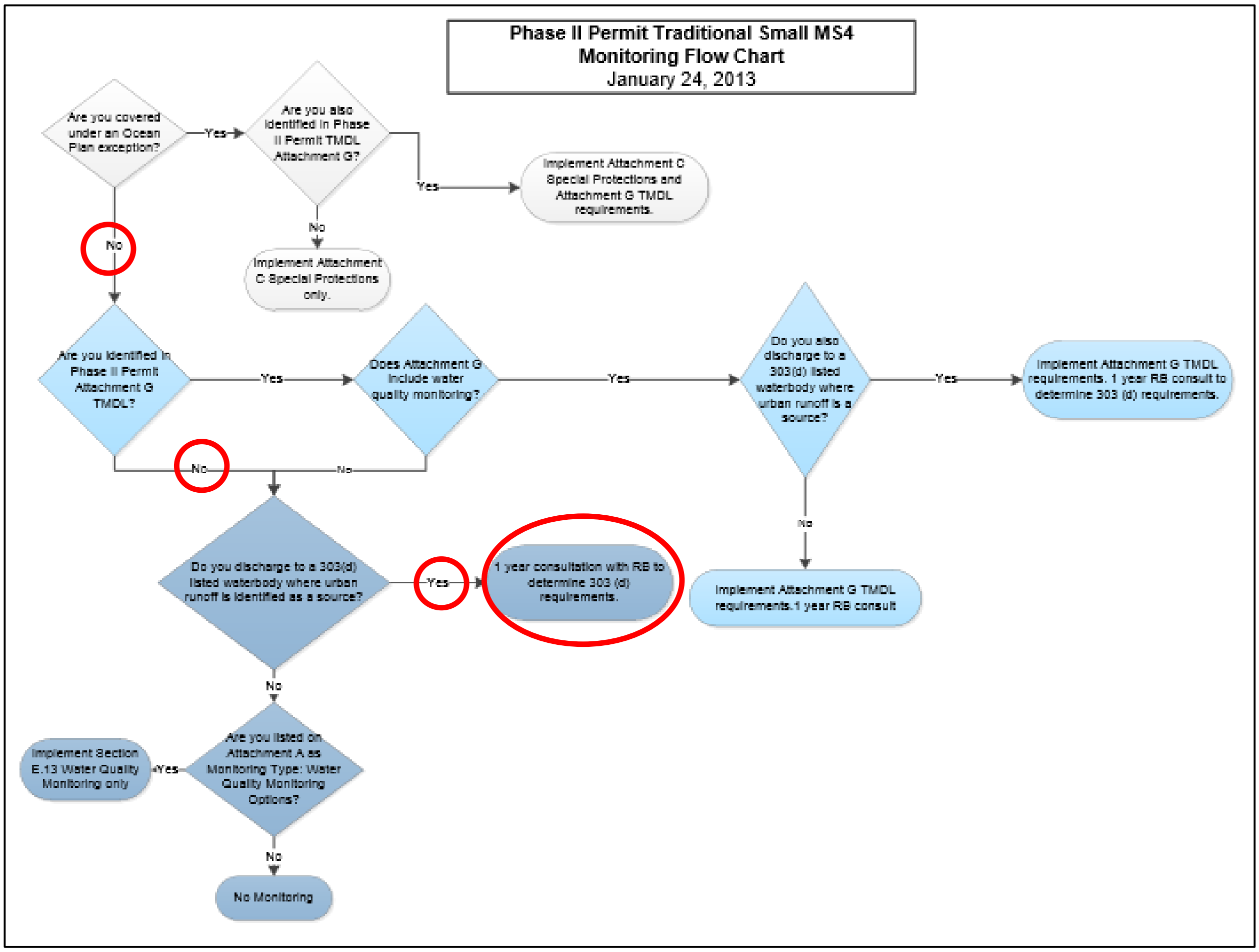
PROGRAM ELEMENTS AND RESEARCH QUESTIONS

GRANT PROJECT MONITORING REQUIREMENTS

1. Parking Lot Storm Water Treatment Demonstration Project
    a. Calculate the load of pollutants infiltrated during 2013-14 rain events at six parking lot sites, based on Event Mean Concentration results from FY 2013 results.
    b. Maintain HOBO data loggers and graph results.
    c. Provide information for grant reporting.
    d. Monitor and report according to approved Monitoring Plan/Quality Assurance Project Plan
2. Streets, Alleys, and Sidewalks LID Project
    a. Submit MP/QAPP, based on previously approved MP/QAPP from Parking Lot Project.
    b. Conduct pre-project runoff monitoring to determine EMCs.
    c. Calculate the load of pollutants infiltrated during 2014-15 rain events at 5 sites, based on Event Mean Concentration results from FY 2015 results.
    d. Maintain HOBO data loggers and graph results.
    e. Provide information for grant reporting.
    f. Monitor and report according to approved Monitoring Plan/Quality Assurance Project Plan

NPDES PERMIT REQUIREMENTS: PHASE II SMALL MS4 GENERAL PERMIT.

Many new requirements are specified in the General Permit. Requirements relevant to the Research and Monitoring Program have been copied from the General Permit and pasted below. The Monitoring section of the General Permit provides a flow chart and narrative description of many different potential monitoring requirements.



The following table shows the 2010 303(d) listings for water bodies in the City of Santa Barbara. Red font indicates that urban runoff is listed as the source of the impairment.

Table 1. 2010 303(d) listings (red font indicates urban runoff as a source)

WATER BODY NAME	POLLUTANT	POLLUTANT CATEGORY	POTENTIAL SOURCES
Arroyo Burro Creek	Escherichia coli (E. coli)	Pathogens	Golf course

Arroyo Burro Creek	Escherichia coli (E. coli)	Pathogens	Urban Runoff/Storm Sewers
Arroyo Burro Creek	Escherichia coli (E. coli)	Pathogens	Natural Sources
Arroyo Burro Creek	Fecal Coliform	Pathogens	Golf course activities
Arroyo Burro Creek	Fecal Coliform	Pathogens	Natural Sources
Arroyo Burro Creek	Fecal Coliform	Pathogens	Urban Runoff/Storm Sewers
Mission Creek (Santa Barbara County)	Escherichia coli (E. coli)	Pathogens	Transient encampments
Mission Creek (Santa Barbara County)	Escherichia coli (E. coli)	Pathogens	Urban Runoff/Storm Sewers
Mission Creek (Santa Barbara County)	Escherichia coli (E. coli)	Pathogens	Habitat Modification
Mission Creek (Santa Barbara County)	Escherichia coli (E. coli)	Pathogens	Hydromodification
Mission Creek (Santa Barbara County)	Fecal Coliform	Pathogens	Habitat Modification
Mission Creek (Santa Barbara County)	Fecal Coliform	Pathogens	Transient encampments
Mission Creek (Santa Barbara County)	Fecal Coliform	Pathogens	Hydromodification
Mission Creek (Santa Barbara County)	Fecal Coliform	Pathogens	Urban Runoff/Storm Sewers
Mission Creek (Santa Barbara County)	Low Dissolved Oxygen	Nutrients	Hydromodification
Mission Creek (Santa Barbara County)	Low Dissolved Oxygen	Nutrients	Removal of Riparian Vegetation
Mission Creek (Santa Barbara County)	Low Dissolved Oxygen	Nutrients	Habitat Modification
Mission Creek (Santa Barbara County)	Low Dissolved Oxygen	Nutrients	Source Unknown
Mission Creek (Santa Barbara County)	Unknown Toxicity	Toxicity	Urban Runoff/Storm Sewers
Pacific Ocean at Arroyo Burro Beach	Enterococcus	Pathogens	Source Unknown
Pacific Ocean at Arroyo Burro Beach	Total Coliform	Pathogens	Source Unknown
Pacific Ocean at East Beach – Mission Ck.	Fecal Coliform	Pathogens	Source Unknown
Pacific Ocean at East Beach – Mission Ck.	Total Coliform	Pathogens	Agriculture
Pacific Ocean at East Beach – Mission Ck.	Total Coliform	Pathogens	Unknown Nonpoint Source
Pacific Ocean at East Beach – Mission Ck.	Total Coliform	Pathogens	Urban Runoff/Storm Sewers

Pacific Ocean at East Beach – Mission Ck.	Total Coliform	Pathogens	Nonpoint Source
Pacific Ocean at East Beach – Mission Ck.	Enterococcus	Pathogens	Source Unknown
Pacific Ocean at East Beach – Sycamore Ck.	Enterococcus	Pathogens	Source Unknown
Pacific Ocean at Leadbetter Beach	Total Coliform	Pathogens	Source Unknown
Sycamore Creek	Chloride	Salinity	Source Unknown
Sycamore Creek	Fecal Coliform	Pathogens	Transient encampments
Sycamore Creek	Fecal Coliform	Pathogens	Natural Sources
Sycamore Creek	Fecal Coliform	Pathogens	Urban Runoff/Storm Sewers
Sycamore Creek	Sodium	Salinity	Source Unknown

Note that upon consultation with Regional Board Staff, the Creeks Division may also be required to conduct Receiving Water Monitoring and/or Special Studies, as described in the General Permit.

1. Illicit discharge, detection and elimination.

E.9.a. Outfall Mapping

(i) **Task Description** – Within the second year of the effective date of the permit, the Permittee shall create and maintain an up-to-date and accurate outfall map[15]. The map may be in hard copy and/or electronic form or within a geographic information system (GIS) the development of the outfall map shall include a visual outfall inventory involving a site visit to each outfall. Renewal Permittees that have an existing up-to-date outfall map that includes the minimum requirements specified in Section E.9.a.(ii)(a-e) are not required to re-create the outfall map. This does not exempt Renewal Permittees with an existing outfall map from conducting the field sampling specified in Section E.9.c.

(ii) **Implementation Level** - The outfall map shall at a minimum show:

(a) The location of all outfalls[16] that are operated by the Permittee within the urbanized area, drainage areas, and land use(s) contributing to those outfalls that are operated by the Permittee, and that discharge within the Permittee's jurisdiction to a receiving water. Each mapped outfall shall be located using coordinates obtained from a global positioning system (GPS) and given an individual alphanumeric identifier, which shall be noted on the map. Photographs or an electronic database shall be utilized to provide baseline information and track operation and maintenance needs over time.

(b) The location (and name, where known to the Permittee) of all water bodies receiving direct discharges from those outfall pipes.

(c) Priority areas, including, but not limited to the following:

2.

1) Areas with older infrastructure that are more likely to have illegal connections and a history of sewer overflows or cross-connections
2) Industrial, commercial, or mixed use areas;
3) Areas with a history of past illicit discharges;
4) Areas with a history of illegal dumping;
5) Areas with onsite sewage disposal systems;
6) Areas upstream of sensitive water bodies;
7) Areas that drain to outfalls greater than 36 inches that directly discharge to the ocean; and
8) Other areas that are likely to have illicit discharges

The priority area list shall be updated annually.

(d) Field sampling stations

(e) The permit boundary

Submerged outfalls or other outfalls that may pose a threat to public safety and/or that are inaccessible are not required to be inventoried.

E.9.c. Field Sampling to Detect Illicit Discharges

(i) **Task Description –** Within the second year of the effective date of the permit (e.g. while conducting the outfall inventory under Section E.9.a.), the Permittee shall sample

any outfalls that are flowing or ponding more than 72 hours after the last rain event. The Permittee shall also conduct dry weather sampling (more than 72 hours since the last rain event) of outfalls annually identified as priority areas.

(ii) **Implementation Level –** The Permittee shall:

(a) Conduct monitoring[17] for the following indicator parameters identified in Table 1 to help determine the source of the discharge. Alternatively, the Permittee may select parameters based on local knowledge of pollutants of concern in lieu of sampling for the parameters listed in Table 1. Modifications and associated justifications shall be identified within SMARTS prior to conducting field sampling as specified in Section E.9.c.(i).

Table 1. Indicator Parameters

Indicator Parameters Used to Detect Illicit Discharges					
Parameter	Discharge Types It Can Detect				
	Sewage	Washwater	Tap Water	Industrial or Commercial Liquid Wastes	Laboratory/Analytical Challenges
Ammonia	●	⦿	○	⦿	Can change into other nitrogen forms as the flow travels to the outfall
Color	⦿	⦿	○	⦿	
Conductivity	⦿	⦿	○	⦿	Ineffective in saline waters
Detergents – Surfactants	●	●	○	⦿	Reagent is a hazardous waste
Fluoride*	○	○	●	⦿	Reagent is a hazardous waste Exception for communities that do not fluoridate their tap water
Hardness	⦿	⦿	⦿	⦿	
pH	○	⦿	○	⦿	
Potassium	⦿	○	○	●	May need to use two separate analytical techniques, depending on the concentration
Turbidity	⦿	⦿	○	⦿	

● Can almost always (>80% of samples) distinguish this discharge from clean flow types (e.g., tap water or natural water). For tap water, can distinguish from natural water.
⦿ Can sometimes (>50% of samples) distinguish this discharge from clean flow types depending on regional characteristics, or can be helpful in combination with another parameter
○ Poor indicator. Cannot reliably detect illicit discharges, or cannot detect tap water
N/A: Data are not available to assess the utility of this parameter for this purpose.
Data sources: Pitt (
*Fluoride is a poor indicator when used as a single parameter, but when combined with additional parameters (such as detergents, ammonia and potassium), it can almost always distinguish between sewage and wash water.

(b) Verify that indicator parameters, as specified in Table 2. Action Level Concentrations for Indicator Parameters are not exceeded. Alternatively, the Permittee may tailor Table 2 to align with parameters based on local knowledge of pollutants of concern. Modifications and associated justifications shall be identified within SMARTS prior to conducting field sampling as specified in Section E.9.c.(i).

Table 2. Action Level Concentrations for Indicator Parameters

Indicator Parameter	Action Level Concentration
Ammonia	>= 50 mg/L
Color	>= 500 units
Conductivity	>= 2,000 µS/cm
Hardness	<= 10 mg/L as CaCO3 or >= 2,000 mg/L as CaCO3
pH	<= 5 or >=9
Potassium	>= 20 mg/L
Turbidity	>= 1,000 NTU

(c) Conduct follow up investigations per Section E.9.d. if the action level concentrations are exceeded.

[14] The Permittee shall use the Center for Watershed Protection's guide on Illicit Discharge Detection and Elimination (IDDE): A Guidance Manual for Program Development and Technical Assistance (available at www.cwp.org) or equivalent when developing an IDDE program. Guidance can also be found at: http://cfpub.epa.gov/npdes/stormwater/idde.cfm.
[15] The Permittee may utilize existing forms such as the CWP Outfall Reconnaissance Inventory/Sample Collection Field Sheet while conducting the mapping inventory and Field Sampling as specified below, in Section E.9.c.(http://cfpub.epa.gov/npdes/stormwater/idde.cfm).
[16] Submerged outfalls or other outfalls that may pose a threat to public safety and/or that are inaccessible are not required to be inventoried.

[17] A description of indicator parameter sampling equipment is described in Chapter 12: Indicator Monitoring in the CWP IDDE: Guidance Manual found at: http://www.epa.gov/npdes/pubs/idde_manualwithappendices.pdf. Sampling may be conducted using field test kits.

3. Special Studies

E.13.c. 303(d) Monitoring

All Permittees that discharge to waterbodies listed as impaired on the 303(d)[25] list where urban runoff is listed as the source, shall consult with the Regional Water Board within one year of the effective date of the permit to assess whether monitoring is necessary and if so, determine the monitoring study design and a monitoring implementation schedule. Permittees shall implement monitoring of 303(d) impaired water bodies as specified by the Regional Water Board Executive Officer.

Conduct monitoring according to Special Studies Plan, once revisions are approved by Regional Board. Plan includes load reduction monitoring for FIB reduction projects, including:

a. Hope Diviersion
b. Haley Diversion
c. SURF Project
d. Parking Lot LID
e. Streets, Alley, and Sidewalks LID

a. Quality Assurance Project Plan

Where applicable, the Permittee shall prepare, maintain, and implement a Quality Assurance Project Plan (QAPP) in accordance with the Surface Water Ambient Monitoring Program. All monitoring samples shall be collected and analyzed according to the Program QAPP developed for the purpose of compliance with this Order. SWAMP Quality Assurance Program Plan (2008) is available at:

http://www.waterboards.ca.gov/water_issues/programs/swamp/docs/qapp/qaprp082209.pdf

A formatted Microsoft Word document that includes guidelines and boilerplate language for developing the permit QAPP is available at:

http://www.waterboards.ca.gov/water_issues/programs/swamp/tools.shtml#qa

Water quality data shall be uploaded to SMARTS and must conform to California Environmental Data Exchange Network (CEDEN) Minimum Data Templates format. CEDEN Minimum Data Templates are also available at: http://ceden.org/

b. Reporting

(iii) **Reporting** – By the second year Annual Report, the Permittee shall complete and have available a report (50 page maximum) that includes a summary of baseline data collections and discussion of monitoring program results;

By the fifth year Annual Report, the Permittee shall complete and have available a report (50 page maximum) that includes a comparison of data collection to baseline data, and discussion of monitoring program results.

At a minimum, the second and fifth year Annual Reports shall include the following information:

(a) The purpose of the monitoring, brief contextual background and a brief description of the study design and rationale.
(b) Sampling site(s) locations, including latitude and longitude coordinates, water body name and water body segment if applicable. Sampling design, including sampling protocol, time of year, sampling frequency and length of sampling.
(c) Methods used for sample collection: list methods used for sample collection, sample or data collection identification, collection date, and media if applicable.
(d) Results of data collection, including concentration detected, measurement units, and detection limits if applicable.
(e) Quantifiable assessment, analysis and interpretation of data for each monitoring parameter.
(f) Comparison to reference sites (if applicable), guidelines or targets
(g) Discussion of whether data collected addresses the objective(s) or question(s) of study design
(h) Quantifiable discussion of program/study pollutant reduction effectiveness.

c. Water quality data submittal.

Water quality data shall be uploaded to SMARTS and must conform to California Environmental Data Exchange Network (CEDEN) Minimum Data Templates format. CEDEN Minimum Data Templates are also available at: http://ceden.org/

The Creeks Division will review the data submittal requirements and answer the following questions:

- Which data should be submitted to CEDEN?
- Should the existing Creeks WQ Database be modified to support CEDEN submittal?
- Should separate databases be maintained?

4. Monitoring-303(d)

No sampling required as of yet. RB has indicated it will approve of biweekly FIB sampling as in C.1.

5. Performance Evaluation, Assessment, and Identification Plan

General Permit requires quantification of pollutant load reduction by entire stormwater permit. Specific plan to meet this requirement has yet to be finalized. Plan to sample private BMPs to determine load reduction for constituents (hydrocarbons, trash, nutrients, bacteria, TSS, pesticides, herbicides).

b.

C. Restoration and Water Quality Project Assessment-What is the baseline water quality at future restoration, LID, and/or treatment sites, particularly as they relate to project design and assessment of project performance?

WATERSHED ASSESSMENT

Research questions:

1. Is overall water quality, in terms of indicator bacteria and field properties, getting better over time?
2. Are pharmaceutical and personal care products (PPCPs) reaching creeks?
3. Is contaminated groundwater at cleanup sites reaching creeks?
4. What are the background daily cycles of water flow in Santa Barbara creeks? Is there a daily pumping in or removal of water from Arroyo Burro, including San Roque Creek.
5. Are new and emerging contaminants detected in dry weather?
6. Is DO below Basin Plan standards in upper watershed, in pre-dawn, summer conditions?

7. Are high levels of sodium and chloride in Sycamore Creek from natural sources?
8. Is toxicity listing for Mission Creek justified?

STORM MONITORING

Research Questions:

1. Is there algal toxicity in Mission Creek during storm events?
2. What new and emerging contaminants occur in storm runoff?
3. Is runoff from coal tar sealed parking lots and slurry sealed roads more toxic than untreated surfaces?
4. Upper Las Positas (Golf Course)
5. MacKenzie LID
6. Parking Lot LID
7. Streets, Sidewalks and Alleys LID
8. Fish Passage Projects
9. Permit PAEIP – Private BMPs
10. Are human waste markers present in creek flow during wet weather?

RESTORATION AND WATER QUALITY PROJECT ASSESSMENT

Overall Research Questions:

1. What is the baseline water quality at future restoration, LID, and/or treatment sites, particularly as they relate to project design and assessment of project performance?
2. Do Creeks Division treatment projects result in improved water quality, as reflected in pre- and post-project, and/or, upstream to downstream, conditions?
3. Do Low Impact Development (LID)/infiltration projects result in pre-development runoff patterns? What are the loads of pollutants prevented from entering surface water from LID projects?
4. What are the mechanisms of project success?
5. Are installed projects continuing to function correctly?

Projects and Specific Questions

1. Westside SURF and Old Mission Creek Restoration
    a. Is the UV disinfection equipment functioning?
    b. What percentage of flow in Westside Storm Drain is the facility treating?

    c. Have habitat scores and index of biological integrity (IBI) scores in Bohnett Park improved?
2. Arroyo Burro Restoration, including Mesa Creek Daylighting
    a. How does Arroyo Burro Estuary biological integrity compare to other estuaries in the area?
3. Hope and Haley Diversions
    a. Are human waste markers still found in Hope and Haley Storm Drains?
    b. What are the loads of fecal indicator bacteria (FIB) that are diverted to the sanitary sewer by these projects?
4. Upper Las Positas Creek Project Performance (Storm) and Operation (Dry weather)
    a. Do treatment elements (Adams bioswale, East Basin, West Basin) reduce pollutant concentrations during storms?
    b. What is the quality of water discharged during spillover conditions (East Basin, West Basin)?
    c. What are the temporal and spatial patterns of pH, temperature, DO, and conductivity in the East Basin during dry weather?
    d. What is the quality of water released prior to storm events from the East Basin and West Basin (field parameters, FIB, nutrients, metals, hydrocarbons, pesticides, and toxicity)? What are the conditions downstream during releases?
5. McKenzie Park Storm Water Treatment Retrofit (Storm)
    a. Are basins functioning correctly?
    b. Is the design storm fully infiltrated?
    c. What are rainfall, storage, and draw down patterns?
6. Debris Screens (Creek Walks)
    a. Has the installation of catch basin screens lead to decreased trash observed in creeks?
7. Mission Creek Fish Passage (Dissolved Oxygen)
    a. What are the conditions in creek segments where fish spend time waiting for passage conditions (above or below passages)?
8. Mission Lagoon Restoration and Laguna Channel Disinfection
    a. Lagoon Inputs
        i. What are the nutrient and FIB inputs from the El Estero Drain?
        ii. Have human waste signals been eliminated from Laguna Channel inputs? (See Section F)
    b. Lagoon Water Quality
        i. What are the water quality conditions in the lagoon (DO, temperature, turbidity), at the surface and near the bottom?

        ii. How do parameters respond to lagoon breaching and closing?
        iii. How does macro-algae cover and biomass change after the lagoon is closed?
        iv. What is the biological integrity of Laguna Channel sediment? (see Section H)
    c. What is the daily (weekly) condition of the estuary? Lagoon status, color, amount of floating algae?
9. Storm Water Infiltration Retrofit Projects (Prop 84). See Section A.
10. Andre Clark Bird Refuge
    a. What is the cause of stink events?
    b. How is the pilot project performing? Does bioaugmentation help?
    c. What are the sources of nutrients during dry and wet weather?
    d. Can increased microbial degradation of organic material in sediment lead to increased water depth?
    e. What is the sediment quality in relation to dredging costs?
11. Las Positas Creek Restoration Project
    a. What are the flow patterns in dry and wet weather?
12. Upper Arroyo Burro Restoration
    a. Is water being pumped from creek or adjacent groundwater?
    b. What is the historical water quality?
    c. Identify any data gaps.

SOURCE TRACKING/ILLICIT DISCHARGE DETECTION

Research questions:

1. Conduct IDDE investigation per General Permit (Section B).
2. What are the causes of persistent beach warnings that occur?
3. Will Laguna Channel and the East Side Storm Drain show that human waste markers have been eliminated after sewer line repair work is completed? See also Hope and Haley Drains above.
4. Are there pathogens present in Santa Barbara creeks? Are SB beaches suitable for Quantitative Microbial Risk Assessment (QMRA)?
5. How do FIB, host-specific markers and pathogens decay in lagoons?
6. Is RV dumping a consistent problem in Santa Barbara?
    a. What is the scale of RV dumping (time, volume, percent of RVs in town)?
7. How does RV dumping scale to other fecal inputs, e.g. leaking sewers?What is the risk to human health from recreation in creeks and beaches in Santa Barbara?

8. Are human waste markers present in creek flows during wet weather?
9. Historical FIB Data Analysis

CREEKS WALKS/CLEAN UPS

Research Questions:

1. Outfall screening, per guidance in Section B.
2. Can we see anything unusual in lower Arroyo Burro, regarding flow patterns?
3. Is the amount of trash in creeks decreasing over time?
4. Has the installation of catch basin screens lead to decreased trash observed in creeks?

BIOASSESSMENT

Research Questions:

1. How does the biological integrity in our creeks change over time, in response to environmental variation?
2. How does the biological integrity respond to water quality and restoration projects?
3. What is the biological integrity of estuaries in Santa Barbara?
4. What is the biological integrity of Laguna Channel? (In support of Mission Lagoon Restoration Project)

GRANT PROJECT MONITORING REQUIREMENTS

PARKING LOT STORM WATER TREATMENT DEMONSTRATION PROJECT

Results were included in the FY 14 Water Quality Report.

STREETS, ALLEYS, AND SIDEWALKS LID PROJECT

A combined MP/QAPP, based on the previously approved MP/QAPP from Parking Lot Project, was submitted and approved. Three storms were sampled in FY 15 in order to determine EMCs. The load of pollutants in runoff from the sites during the 2014 rain year was been estimated. The load of pollutants infiltrated during 2015-16 rain events will be presented in the FY 16 Annual Report.

Tim Burgess and Chris Clark have maintained HOBO data loggers and will graph results.

OVERVIEW

The data collected under the Streets, Alleys, and Sidewalk LID Project MP/QAPP will allow for an estimate of the pollutant loads infiltrated by the Project during rain events after construction. The City will measure the project's benefits by monitoring the storm water runoff for pollutants and toxicity at each site before construction to determine the pollutant loads associated with each site and establish a baseline condition. A sampling location was identified for each site where storm water runoff can be collected. When possible, samples were be taken throughout the storm and composited for each site. Samples were be tested for hydrocarbons, metals, bacteria, toxicity, TSS, and nutrients. This sampling took place at each of the four sites during three different storms. For each site, the three different storm event results will averaged to determine event mean concentrations (EMC). A median EMC will be calculated for each site. The EMCs will be compared among sites, and if there are significant differences, site-specific EMCs will be used in calculating load reduction. If the EMCs are not different, a City-wide streets, sidewalks, and alleys EMC will be used in calculations.

In addition to the water quality data collected, a monitoring port was installed at each site that extends down to the sub-grade. Water level loggers are used to monitor the depth of water beneath the pavers in the storage area. With these loggers, water levels and percolation rates can be continuously logged throughout storms so that project performance can be monitored.

The desired outcomes of the Project are:

1) Reduce the amount of polluted runoff from the paved areas of the project sites.
2) Allow the captured water to infiltrate into the sub-grade soil.

Data generated under this monitoring plan will be used in calculations that demonstrate the desired outcomes. There will not be any post-project samples collected, because all runoff except for the largest storms will infiltrate through the pavers and will not be available for sample collection.

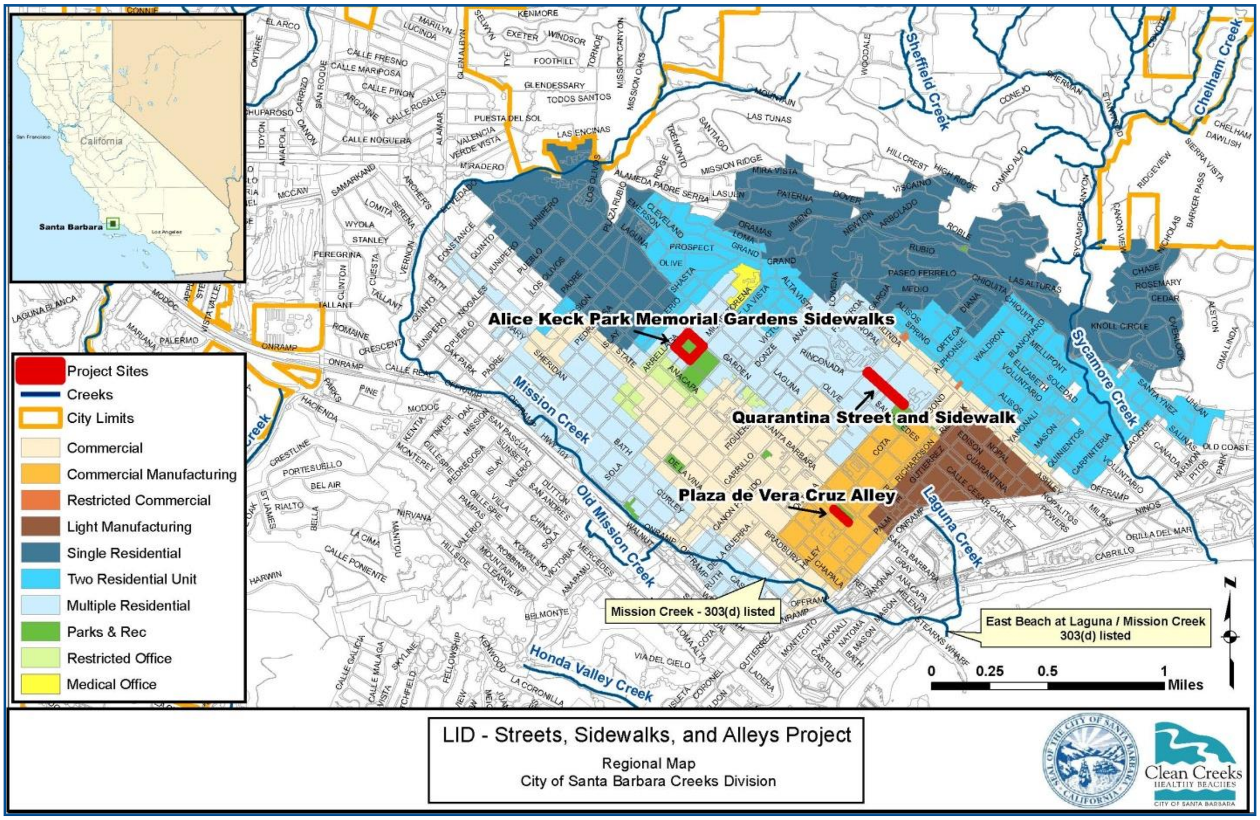


Figure 1. Map of Santa Barbara and Project Site Locations

METHODS

A limited list of constituents was monitored, including key constituents of concern to the City of Santa Barbara, 303(d)-listed constituents. The list of sampling constituents and constituent groups are summarized below (Table 2).

Table 2. Lab Sample Table

Parameter Group	Container	Preservation, Holding Time	Lab Method	Lab Reporting Limit
Fecal Indicator Bacteria	IDEXX Bottle	None, six hours.	Enterolert and Colilert	1 MPN/100 ml
Organic Carbon (Dissolved)	Amber Glass	None, 28 daysLab filters and preserves with HCl.	SM 5310_Doc_B	1 mg/L

Nitrate (as N)	Plastic	None	300_ORGFMS Anions, Ion Chromatography	0.11 mg/L
Total Kjeldahl Nitrogen	Plastic	Sulfuric Acid	351.2 Nitrogen, Total Kjeldahl	0.5 mg/L
Total Nitrogen (Calculated result from NO2+NO3+TKN)	Plastic	Sulfuric Acid	Total Nitrogen	0.05 mg/L
Total Phosphorus (as P)	Plastic	Sulfuric Acid	365.3 Phosphorus, Total	0.05 mg/L
Total Petroleum Hydrocarbons - Diesel	Amber Glass	None, 28 days	8015B_DRO Diesel Range Organics (DRO) (GC)	0.5 mg/L
Total Suspended solids	Plastic	None, 7 days	2540D Solids, Total Suspended (TSS)	1 mg/L Default RL = 10 mg/L; need minimum 1L sample aliquot to achieve 1 mg/L
Total Metals Arsenic Cadmium Chromium Copper Iron Lead Manganese Mercury Nickel Silver Sodium Zinc	Plastic	Nitric Acid, 180 days for all except mercury (28 days)	6010B Metals (ICP) all except: 7470A Mercury (CVAA)	0.02 mg/L for all except 0.0002 mg/L for mercury and 0.05 for aluminum

Surfactants	Plastic, 48 hours	None, 48 hours	5540C Methylene Blue Active Substances (MBAS)	0.1 mg/L
Pesticides Neonicotinoids Pyrethroids	 Amber Glass Amber Glass	 None, 7 days None, 7 days	HPLC MS MS Pesticide Scan NCI-SIM	 5 ng/L 5 ng/L
Toxicity	1 gallon cube	None, 36 hours	% Survival Fathead Minnow	0

*If available, Basin Plan objectives for receiving waters will be used for data interpretation in Final Report.

The following figures show the sampling location at each project site. One sampling site was been selected at each site in the Project area (Figure 1). Each site was selected to provide runoff that is inclusive of or representative of runoff from the retrofit, while excluding runoff that will not be infiltrated by the Project. Sampling sites were observed during dry weather, and in some cases prepared for sampling by digging out areas to place sample vessels for runoff collection. The sample locations have been documented with GPS coordinates (Table 3) and are mapped below.

One sampling site has been selected at each site in the Project area (Figure 1). Each site has been selected to provide runoff that is inclusive of or representative of runoff from the project, while excluding runoff that will not be infiltrated by the Project. Sampling sites were observed during dry weather, and in some cases prepared for sampling by digging out areas to place sample vessels for runoff collection. The sample locations have been documented with GPS coordinates (Table 1) and are shown as red stars (Figures 2-4).

Based on field conditions, the program may be modified by the project team during the sampling event to provide for field safety and make the collection accurate and thorough. Any changes made to the plan will be documented within the field notebooks and added to this Monitoring Plan as Appendices.

At each sampling site, a monitoring port will be installed during project construction. Upon project completion, a HOBO Water Level Logger will be deployed in each monitoring port during rainstorms to record water level changes below the pavers.

Table 3. Sampling Locations. NAD 83 datum used for GPS coordinates

Site Name	Sample Site Code	Sample Site Specific Location	Comments	Latitude	Longitude
Plaza de Vera Cruz Alley Project Site			GPS Location of each end of project site	34.4193 34.4185	-119.6950 -119.6938
Plaza de Vera Cruz Alley Monitoring Port				34.4187	-119.6941
Plaza de Vera Cruz Alley Runoff Sample Site	LIDVeraCru	Where runoff flows off of alley.		34.4186	-119.6940
Alice Keck Park Memorial Gardens Sidewalk Project Site			GPS Location of each corner of project site	34.4302 34.4293 34.4284 34.4292	-119.7062 -119.7050 -119.7060 -119.7072
Alice Keck Park Memorial Gardens Sidewalk Monitoring Ports				34.4297 34.4287	-119.7055 -119.7057
Alice Keck Park Memorial Gardens Sidewalk Sample Sites	LIDAliceKe	Where runoff discharges off of sidewalk into gutter, and where runoff discharges off of a concrete sidewalk in adjacent Alameda Park		34.4290 34.4275	-119.7054 -119.7047
700 block of N. Quarantina St. Project Site			GPS Location of each end of project site	34.4270 34.4259	-119.6913 -119.6898
700 block of N. Quarantina St. Monitoring Port				34.4265	-119.6907
700 block of N. Quarantina St. Runoff Sample Site	LIDQuarS	Runoff collected from sidewalk runoff and street runoff into gutter.		34.4264	-119.6904
800 block of N. Quarantina St. Project Site			GPS Location of each end of project site	34.4279 34.4270	-119.6926 -119.6915
800 block of N. Quarantina St. Monitoring Port				34.4273	-119.6919
800 block of N. Quarantina St. Runoff Sample Site	LIDQuarN	Runoff collected from sidewalk runoff and street runoff into gutter.		34.4263	-119.6904

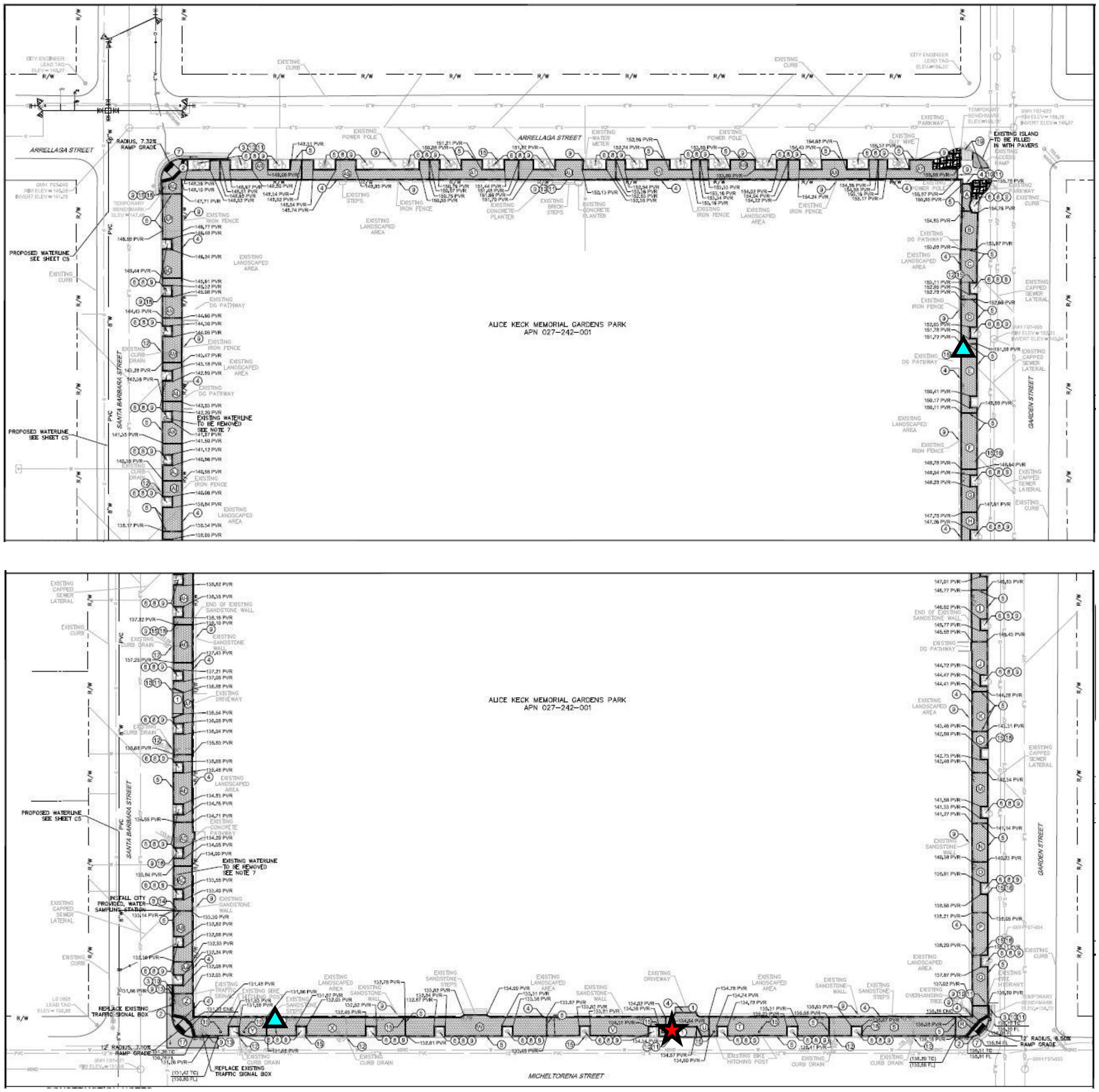


Figure 2. Alice Keck Park Memorial Gardens Sidewalks site with monitoring ports (blue triangles) and pre-project stormwater sampling locations (red star).

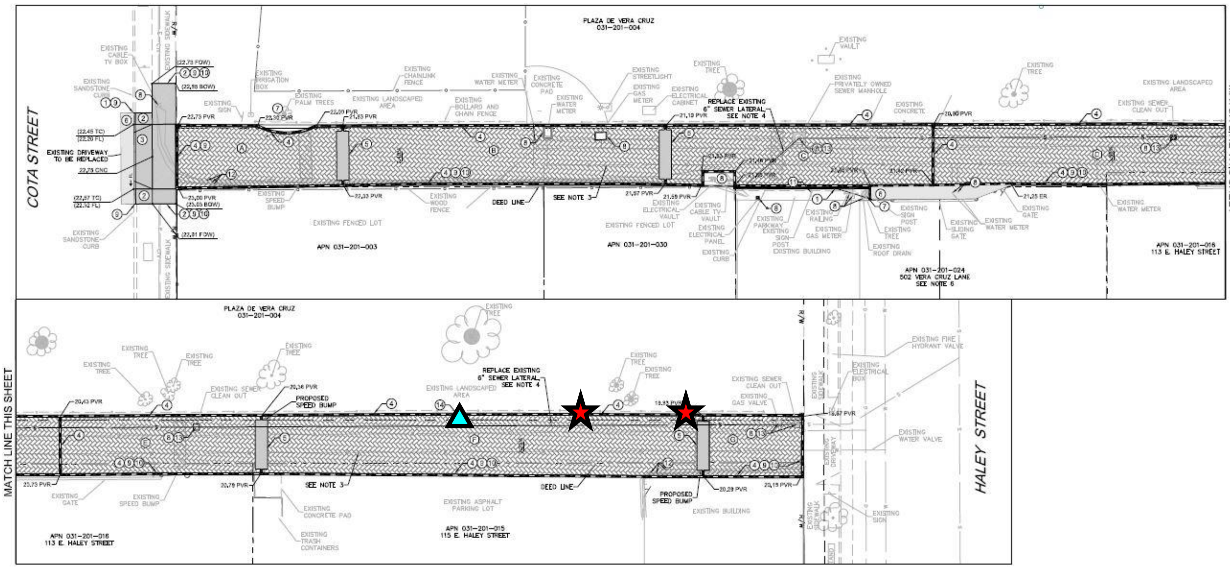


Figure 3. Vera Cruz Park (blue triangle) and pre-project stormwater sampling location (red star).

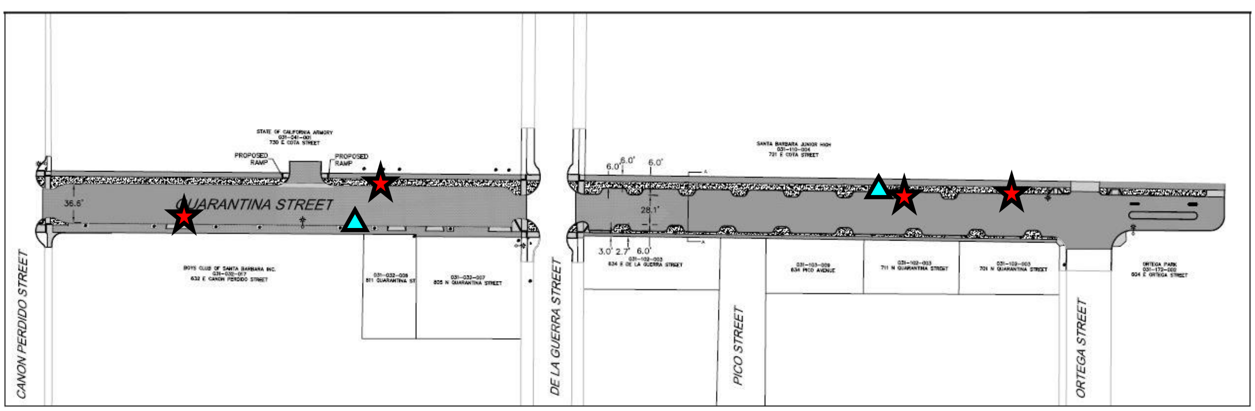


Figure 4. 800 and 700 blocks of N. Quarantina Street with sampling ports (blue triangles) and pre-project stormwater sampling locations (red stars).

Despite below-average rainfall, samples were collected during three storms (Table 4). Rainfall patterns show that the storms were representative of rainfall throughout the year (Figure 5). Due to small storms and rapidly changing forecasts, only one storm was able to be sampled as a composite, and rather than three time points, the composite included two time points.

Table 4. Summary of Sampled Storms

Storm Number, Total Rainfall in Storm	Date	Grab or Composite	Time(s) samples collected for composite	In. rainfall at each sample time point
1, 2"	12/3/2014	Composite	7:20 am – 10:00 am 11:30 am – 1:00 pm	0.4" 1.5"
2, 0.6"	2/7/2015	Grab	12:15 pm -1:15 pm	0.25"
3, 0.3"	4/7/2015	Grab	12:30 pm – 1:00 pm	0.1"

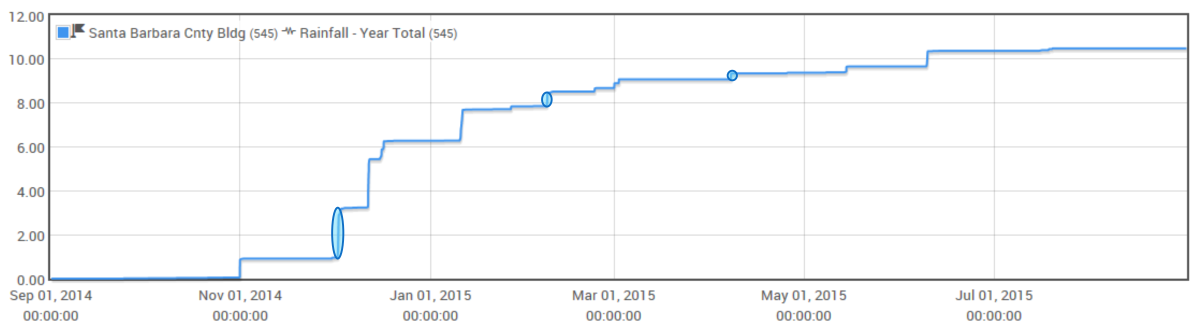


Figure 5. Total rain accumulation in Water Year 2012-2013. Blue ovals indicate sampled events.

Storms 1 (the second storm of the year) was collected as a composite of two time points at each site. Storms 2 and 3, both later season, small storms, were collected as grab samples at each site (Figure 6**Error! Reference source not found.**).

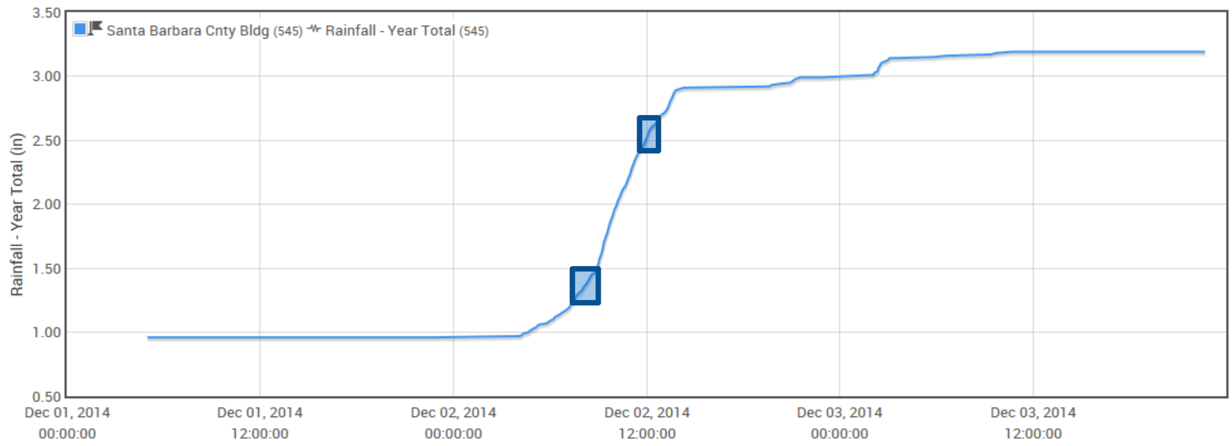


Figure 6. Total rainfall and sample collection windows during Storm 1.

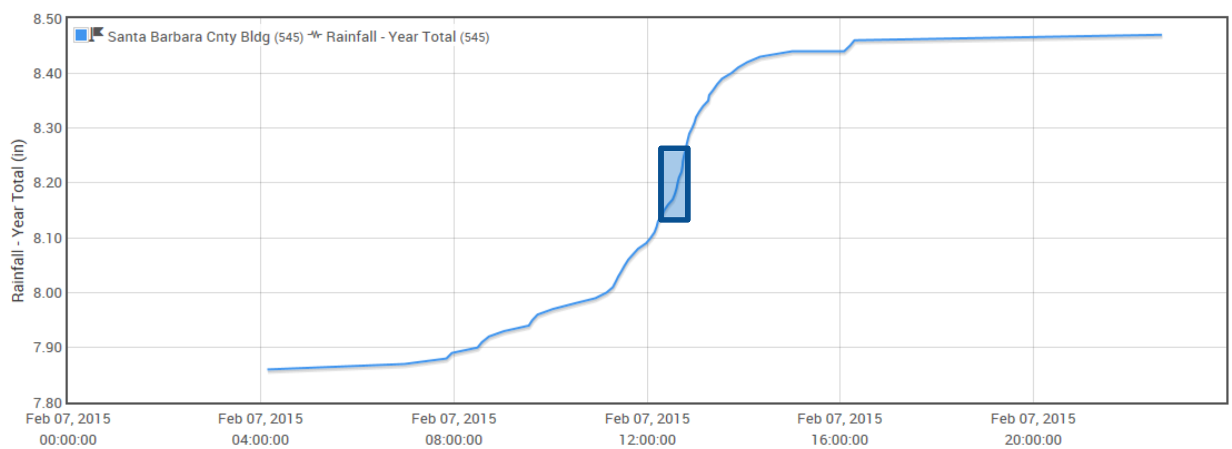


Figure 7. Total rainfall and sampling window during Storm 2.

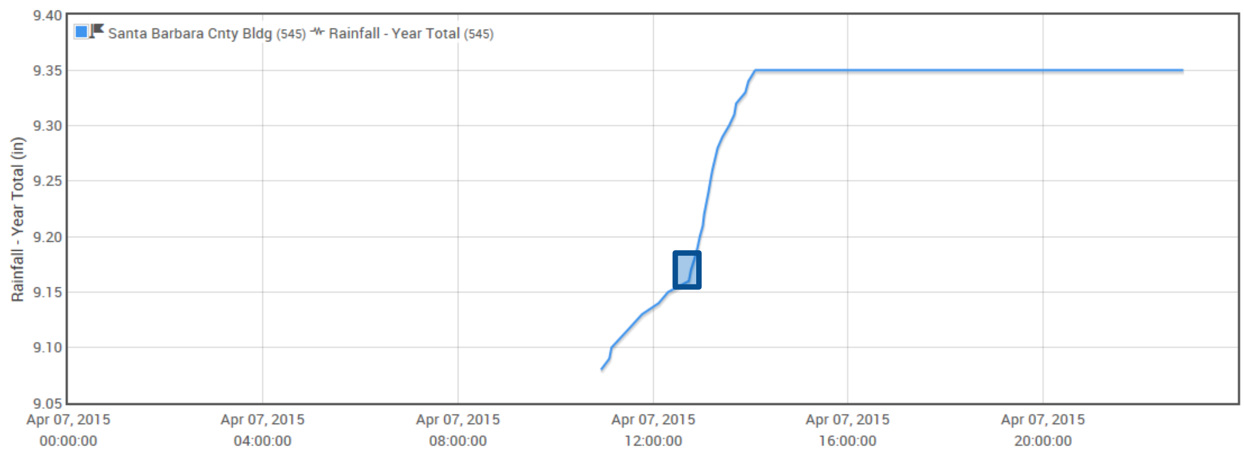


Figure 8. Total rainfall and sampling window during Storm 3.

RESULTS

A summary of results is presented here. Detailed results will be presented in the FY 2016 Report.

- High metals, surfactants, hydrocarbons, and some nutrients were found in some locations at some times; these correlated roughly with the highest toxicity levels.
- Three out of four locations were locations toxic (significantly different from control) on at least one day. Some sites were extremely toxic (0% survival).
- Imidacloprid and some pyrethroids were detected in many samples.
- Dicloran was found in 15 of 16 samples, also found in half of the samples in FY 14.
    - Dicloran was Included with pyrethroids, but is not actually a pyrethroid; we did no request it to be tesed.
    - Dicloran is a fungicide used on crops and in limited commercial landscaping sites in SB County.
    - Results do not make sense, lab says they are good.
    - Consider results tentative.

- Sumithrin not detected in FY 15.

GENERAL PERMIT REQUIREMENTS

MONITORING

Monitoring was conducted according to agreements with the Regional Board. Detailed results will be presented in the FY 2016 Report.

WATERSHED ASSESSMENT

LONG TERM TRENDS AND IMPACT OF DROUGHT

This is updated from previous report, showing the effects of yet another year of low rainfall.

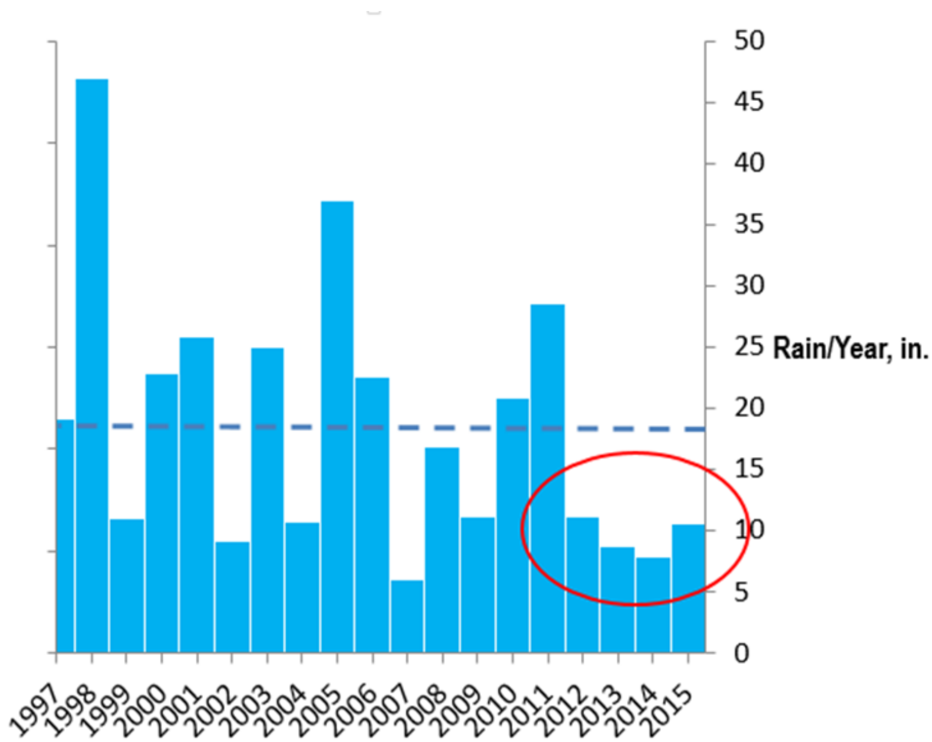


Figure 9. Annual rainfall 1997-2016 at El Estero in Santa Barbara showing four straight years of approximately half of average annual rainfall.

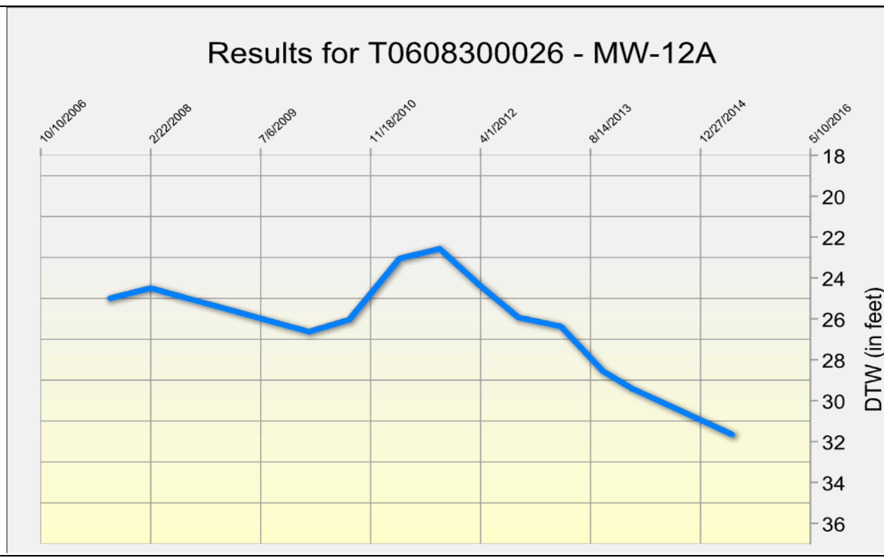
SUMMARY OF IMPACTS TO CREEKS

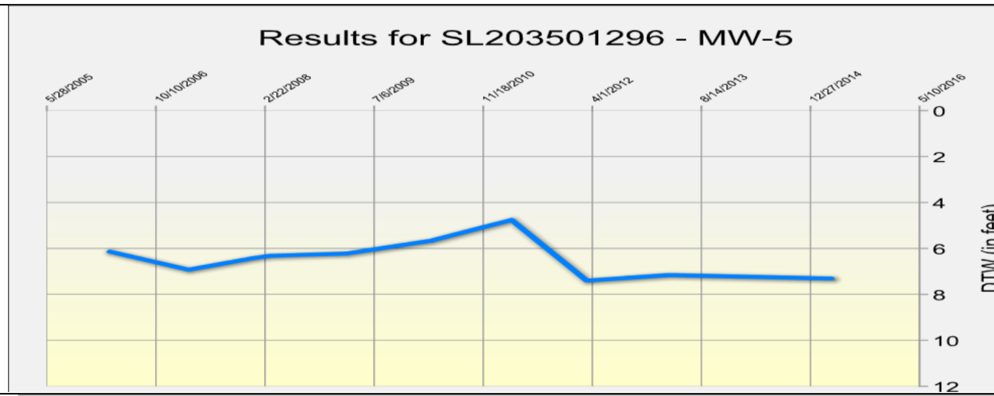
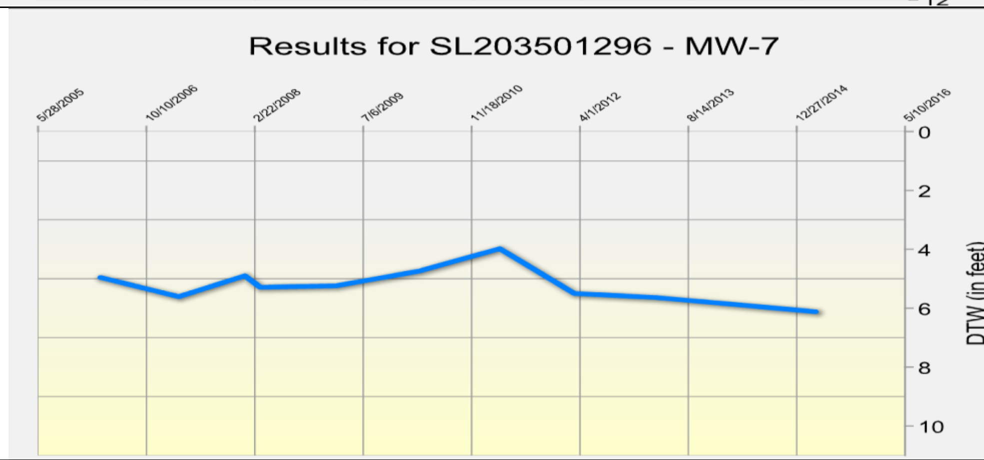
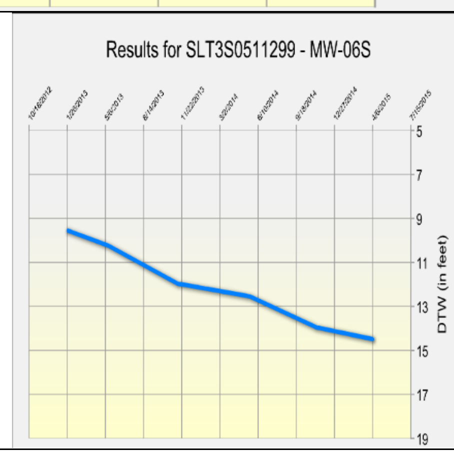
- Decreasing groundwater, flow in creeks.
- Groundwater and flow should return with average year.
- Some sites dry for long periods.
- Beach warnings reduced.
- Fecal indicator bacteria levels in creeks unchanged.
- Biological integrity lower, but within range of other stressors.

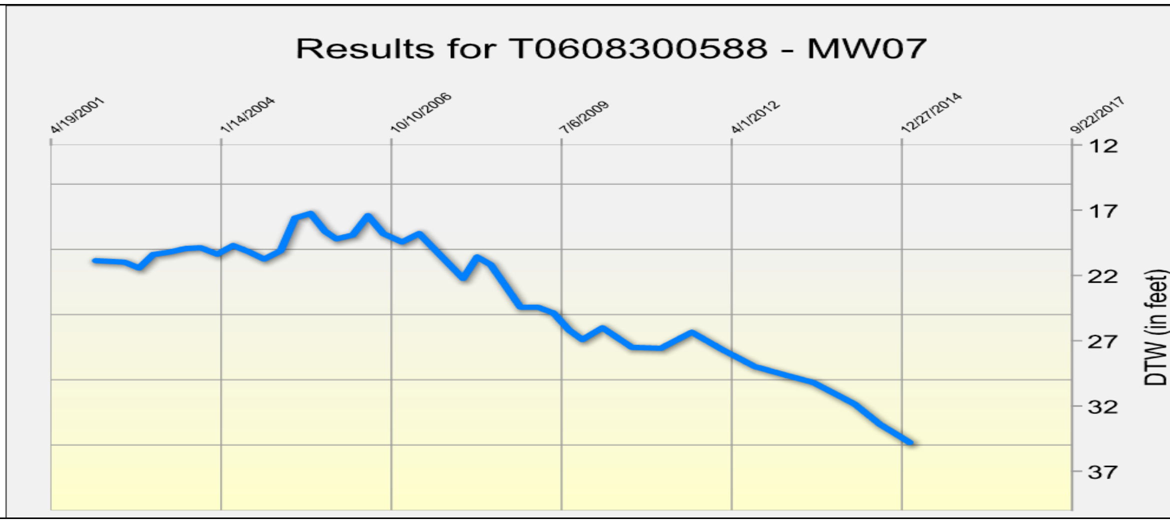
GROUNDWATER AND CREEK FLOW

The following graphs show shallow groundwater profiles from monitoring wells includes in the State Waterboards Groundwater GEOTRACKER. Plots were roughly aligned by date where possible.

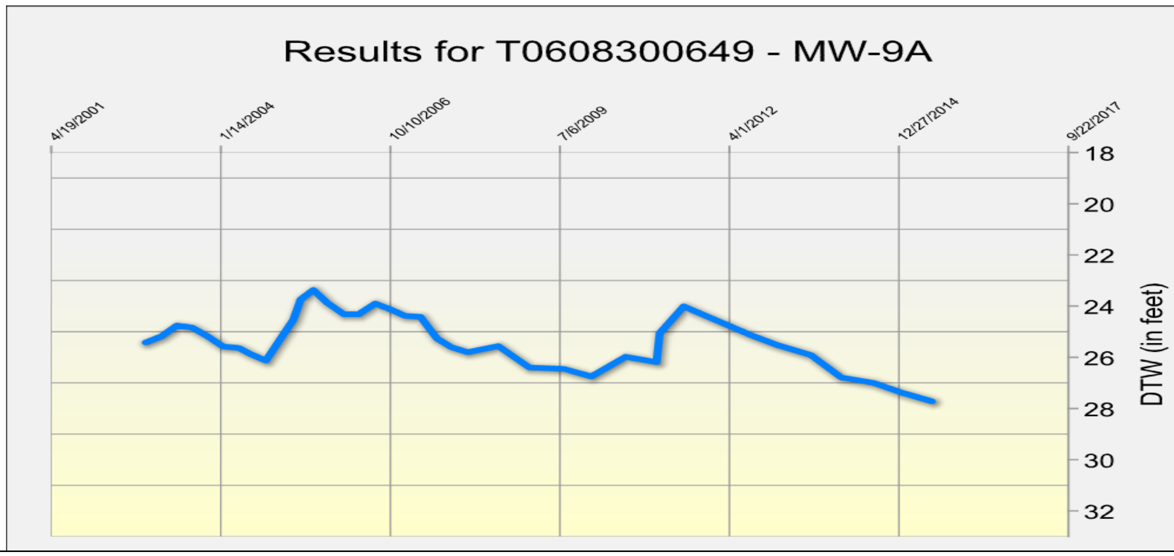
- Some sites are far more sensitive to rainfall than others.
- In general, sites in Mission Creek and Arroyo Burro watersheds are more responsive than sites in the Laguna Channel Watershed, likely to do to paving and piping.

Micheltorena/ San Pascual		

Laguna Channel	
Laguna Channel	
Near Ontare and San Pedro	
By Panera	



Mesa-Oliver Road



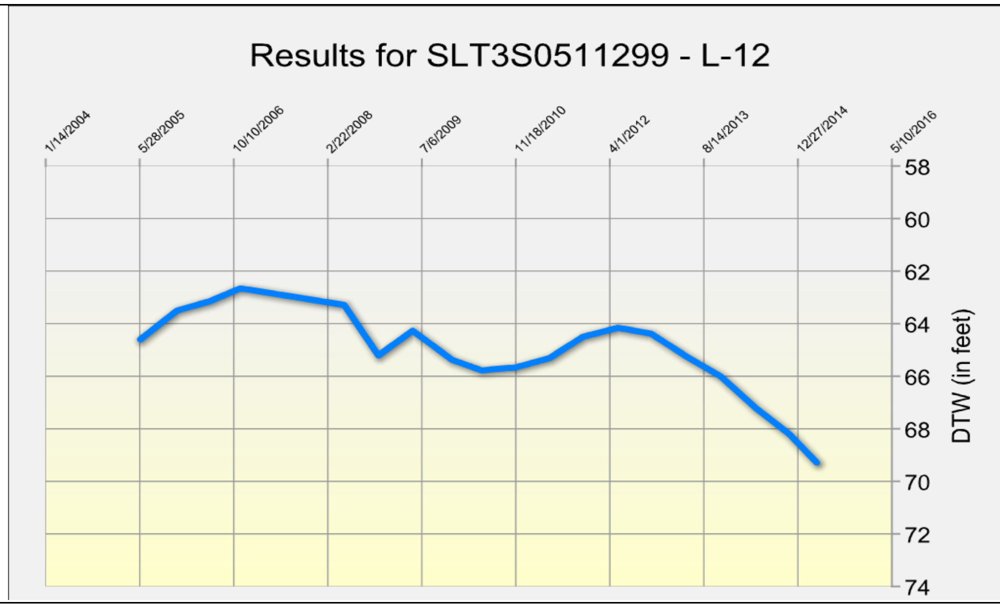
Loreto Plaza		

Figure 10. Shallow groundwater plots showing local response to drought conditions.

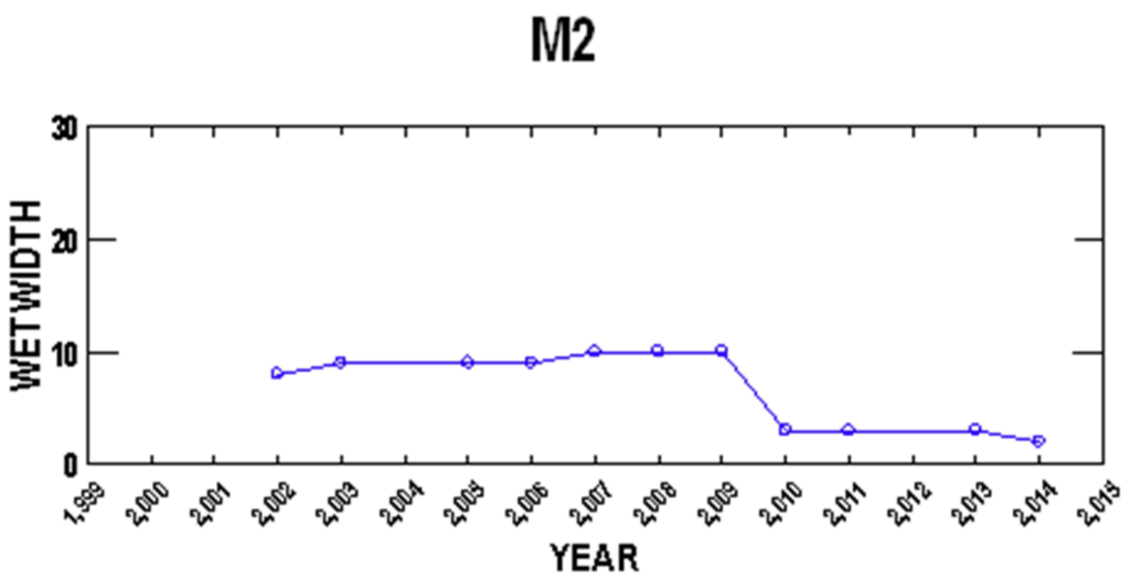


Figure 11. Wet width at Old Mission Creek showing impact of drought (from Bioassessment Report).

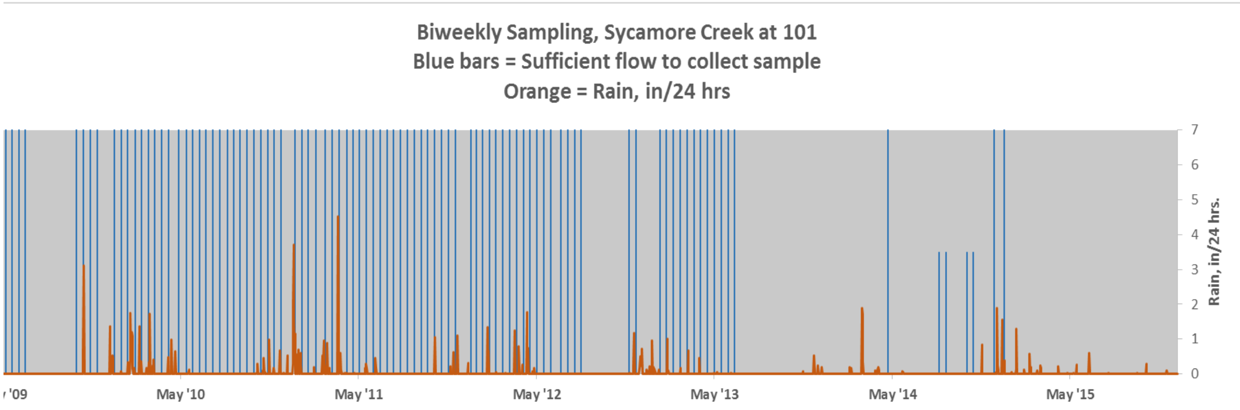


Figure 12. Plot of rain (orange) and biweekly sampling dates with sufficient flow (blue bars) to sample integrator site for Sycamore Creek. The drought has caused 2.5 years of dry creek. Half bars show dates when storms occurred. Three sampling dates within dry period were due to tidal inflow into the estuary.

BEACH WARNINGS

- 50% fewer beach warnings at Arroyo Burro and E. Beach at Mission during drought.
- Fewer storms, fewer lagoon breachings in dry weather.

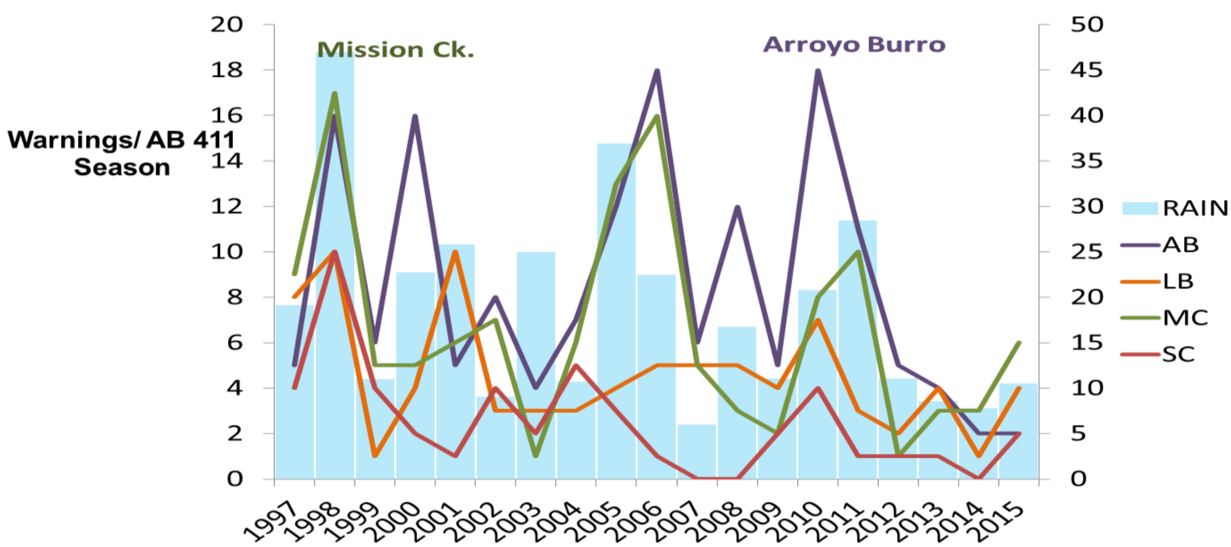
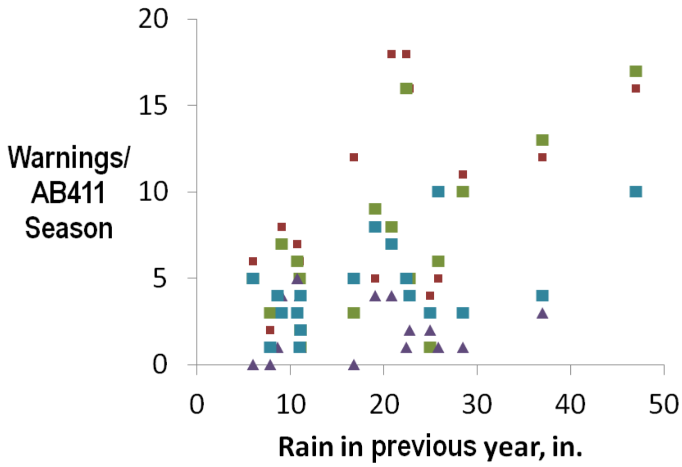


Figure 13. AB411 Beach Warnings and Annual Rainfall.



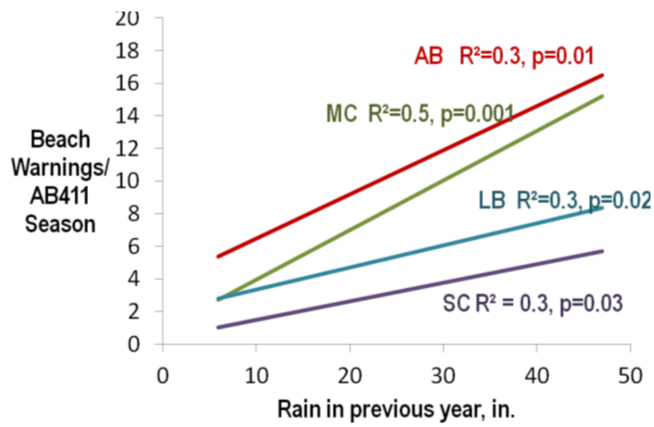


Figure 14. Correlations between annual rainfall and beach warnings during AB 411 season,