City of Santa Barbara

Creeks Division

Fiscal Year 2020 Annual Water Quality Monitoring and Research Report

Report on data collected between July 1, 2019 and June 30, 2020, according to the FY 2020 Water Quality Research and Monitoring Plan

Introduction

The following report describes sampling and results that were based on the Fiscal Year 2019 Research and Monitoring Plan (Research 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. Due to limited staff resources during the pandemic, many of the FY 20 results will be combined with the FY 21 Water Quality Report.*** Please see the Creeks Division 2001-2006 report for a discussion of methods, information on water quality criteria, and a glossary of monitoring terms.

Fiscal Year 2020 Research and Monitoring Plan

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.

The monitoring program consists of six key elements, with associated tasks and research questions. City staff, Committee members, Regional Water Quality Control Board staff, and community members provide input to shape the questions. In addition, some monitoring is required by grants the City has received. All sample collection and monitoring partnerships are geared toward answering these questions.

Grant Project Monitoring Requirements

1. Neonicotinoid Pesticides in Santa Barbara, CA

2. Restoration project monitoring

NPDES Permit Requirements: Phase II Small MS4 General Permit

1. Illicit discharge, detection and elimination (IDDE) – outfall monitoring.

2. Special Studies Monitoring.

3. 303(d) Monitoring.

4. Performance Evaluation Assessment and Improvement Plan modeling and monitoring.

Watershed Assessment

1. Is overall water quality, in terms of indicator bacteria and field properties, getting better over time?

2. What is/was the impact of sustained drought on the water quality, habitat, and stream communities?

3. Are pharmaceutical and personal care products (PPCPs) reaching creeks?

4. What are the background cycles of water flow in SB creeks? Is there 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. What are the impact of tobacco products (cigarette butts) to water quality in creeks?

7. Are low DO concentrations responsible for some low bioassessment scores in Santa Barbara? What are the nighttime concentrations of DO?

8. Dry weather toxicity (see Permit requirements).

Storm Monitoring

1. Is there algal toxicity in Mission Creek during storm events (Permit)?

2. Neonicotinoid Pesticides – at moderately impacted and reference sites.

3. Monitor the Upper Las Positas (Golf Course) to assist with management.

4. Continue to monitor and permeable paver projects.

5. Assess performance of City BMPs.

6. Bird Refuge. What are the inputs of nutrients in storm events?

What is the condition of water discharging from the lagoon during storm events?

7. Monitor Barger Canyon during storm events.

8. Monitor Arroyo Burro Open Space during storm events.

Restoration and Water Quality Project Assessment

What is the baseline water quality at future restoration, Low Impact Development (LID), and/or treatment sites, particularly as they relate to project design and assessment of project performance?

Projects:

1. Westside SURF and Old Mission Creek Restoration. Have habitat assessment and bioassessment scores improved?

2. Arroyo Burro Restoration. How does Arroyo Burro Estuary bioassessment compare to unrestored estuaries?

3. Hope and Haley Diversions (see Permit monitoring).

4. Permeable pavers (see Storm Monitoring).

5. Debris screens, impact on litter, leaf litter, and fecal indicator bacteria.

6. Mission Creek Fish Passage (DO and temperature surveys).

7. Bird Refuge (see Storm Monitoring also).

    a. What is the cause of stink events?

    b. What is the scientific merit of proposed improvement projects?

    c. What is the DO/Salinity of lagoon, compared to the outlet?

    d. What are pre-project conditions for low-flow wetlands?

8. Upper Arroyo Burro Restoration (Barger Canyon, see Storm Monitoring also).

9. Arroyo Burro Open Space Restoration.

Source Tracking/Illicit Discharge Detection

1. Conduct IDDE investigation per General Permit (Section B).

2. Are there new sources of/locations of human fecal material entering storm drains and creeks?

3. What are the causes of persistent beach warnings that occur?

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?

7. What is the risk to human health from recreation in creeks and beaches in Santa Barbara?

8. Are human waste markers present and associated with beach warnings at Leadbetter Beach and E. Beach at Sycamore?

9. Are human waste markers present in creek flows during wet weather?

10. What can be learned from historical FIB Data Analysis?

COVID-19 Impacts

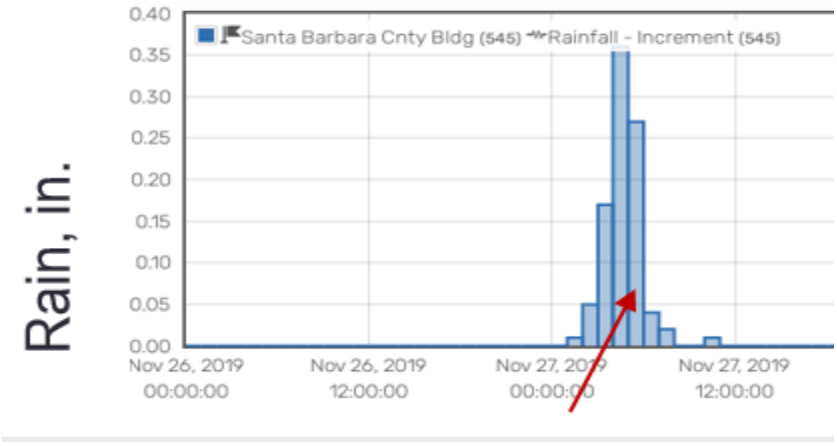
The COVID-19 pandemic affected water quality sampling and research during FY 20, and potentially creek water quality as well. In spring FY 20, Creeks staff were unable to share workspace and vehicles and therefore sampling schedules were modified accordingly. Storm monitoring was not conducted from March 2020-June 2020. Biweekly sampling and Bird Refuge monitoring was completed by Creeks staff working independently and by Watershed Stewards, who worked in an assigned and consistent pair. In addition, Creeks staff hours were impacted by assisting the County of Santa Barbara with COVID-19 data management and by increased demands on enforcement due to encampment activity in the creeks. Contracted research by Dr. Holden (UCSB) was delayed due to laboratory closures. The FY 21 Research Plan was carried over from the FY 20 Research Plan.

Potential water quality impacts are related to increased trash and human waste in and near creeks and beaches due to encampments. Limited rain in spring 2020 likely protected creeks from contaminated runoff during FY 20.

Pesticide Monitoring

The Creeks Division sampled for key pesticides, including glyphosate, fipronil, and neonicotinoids, and degradation products of each, in dry and wet weather during FY 20. Glyphosate was tested due to public concern about Roundup in news reports. Prior sampling by the Creeks Division took place when detection limits were considerably higher, leading to frequent non-detects.

During dry weather, the herbicide glyphosate and degradation products were not detected in creek or sediment samples; other pesticides were not tested. During a first-flush rain event in November 2019, glyphosate, fipronil, imidacloprid and dinotufuran were detected, mostly at low concentrations, in Laguna Channel, Mission Creek at Montecito Street, and Sycamore Creek at Highway 101; these results are consistent with previous sampling results. A new observation was the detection of glyphosate and imidacloprid, two widely used pesticides, in Rattlesnake Creek, Mission Creek at Rocky Nook Park, and in roof runoff from City buildings (where no product is used). While concentrations were mostly below levels of concern for ecotoxicity, the results point to widespread pesticide contamination, perhaps transported by windblown dust.



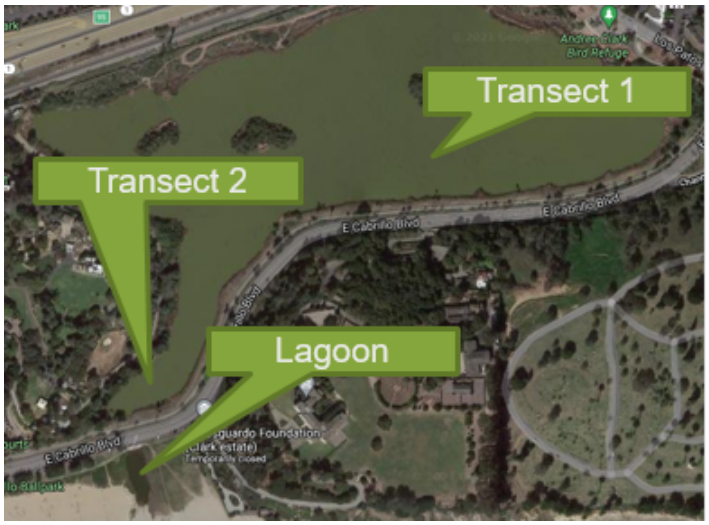
Rain during first flush sampling event, with red arrow showing when samples were collected.

				Mission Creek			Roof runoff				
		Laguna Channel	Sycamore Creek	Rattlesnake	Rocky Nook	Monteci to St.	DS 1 IN	DS 2 IN	DS 3 IN	DS 4 IN	DS 6 IN
		ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
FIPRONIL	Fipronil	1.43	11.6	3.16		56.3					
	Fipronil Sulfide					1.82					
	Fipronil Sulfone	2.96	6.93	3.26		19.2					
	Fipronil Desulfinyl		8.63	1.64		31.5					
	Fipronil detrifluoromethylsulfinyl										
NEONICS	Acetamiprid		7.52			18.4				1.7	
	Acetamiprid-N-Desmethyl										
	Thiacloprid										
	Thiacloprid-amide										
	Thiamethoxam										
	Clothianidin					41.5					
Imida	Imidacloprid	2.57	76.1	14.6	4.84	313		3.08	3.71	7.53	3.34
Imida	5-OH-Imidacloprid										
Imida	Imidacloprid urea		11.1			21.6					
Imida	Imidacloprid olefin										
Imida	Desnitro-imidacloprid		8.77			12.5					
	Dinotefuran	2.52	145	3.82		205					
	Nitenpyram										
	Imidaclothiz										
	Sulfoxaflor-A										
	Sulfoxaflor-B										
	MGK 264-A										
	MGK 264-B										
	Piperonyl butoxide		3.12			31.1					
GLYPHOSATE	Glyphosate	108	26300	2440	150	17200	121	121	171	353	101
	Glufosinate		24.1			18.2					
	AMPA	57.3	3220	173	63.7	1090	84.4	92.5	130	71.6	73.7

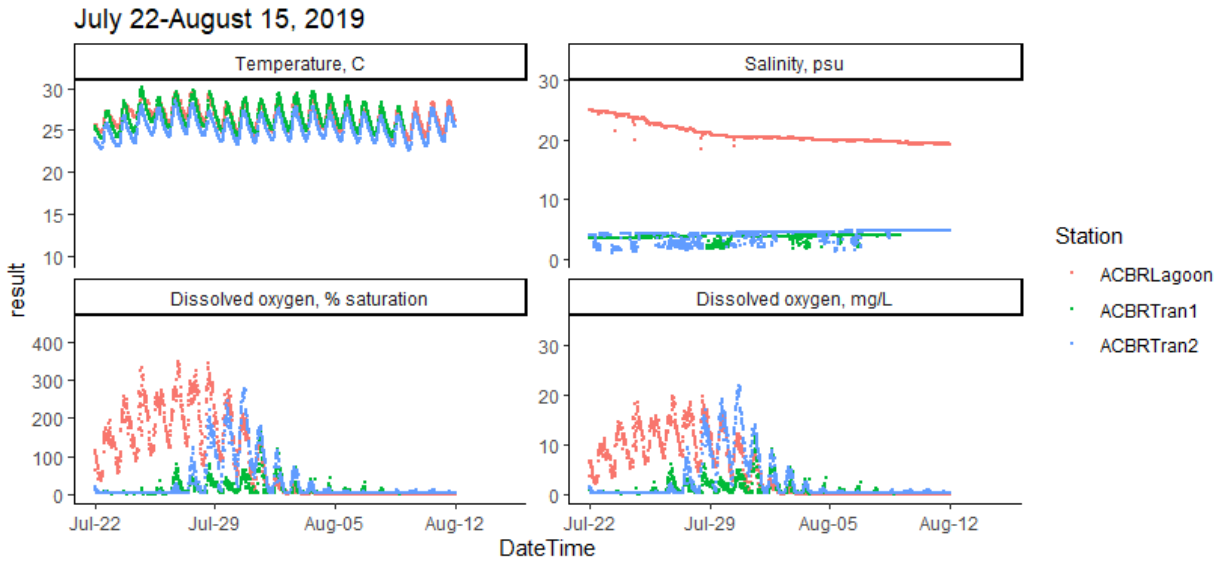
Results from rain sampling. Shading represents highest to lowest concentrations across sites for each pesticide.

Andrée Clark Bird Refuge

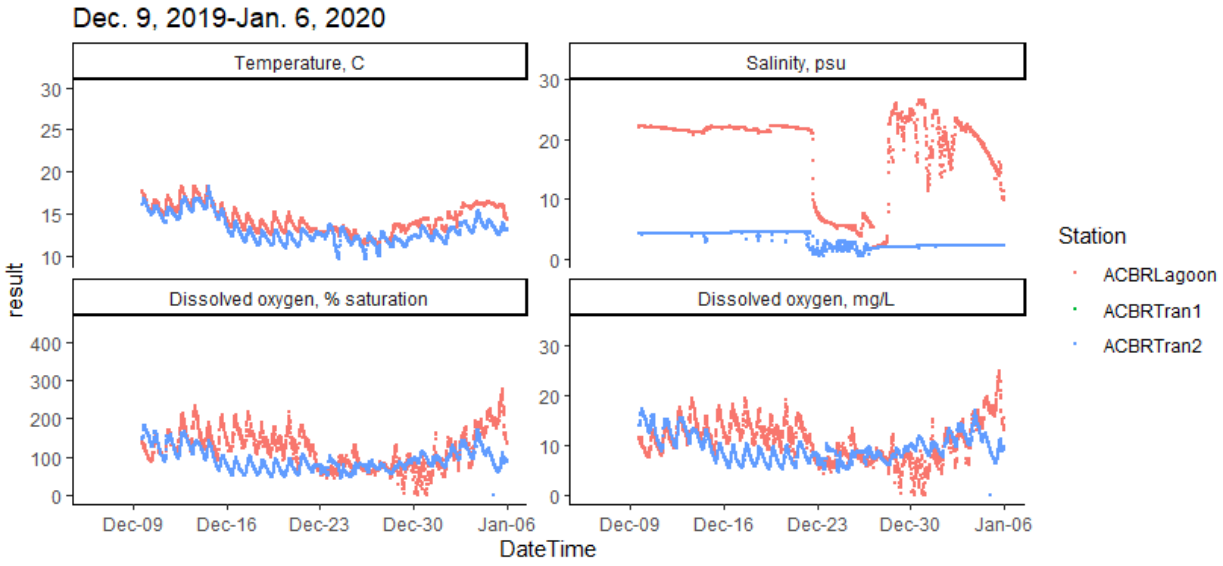
Baseline dry-weather sampling was conducted in the Bird Refuge, the beach lagoon, and the surf zone in order to compare pre-project water quality with post-project data when the restoration project is constructed. Data loggers were also used to observe patterns of algal blooms and decay in the lake and beach lagoon. New sensors were added to include the quantification of chlorophyll a, a more direct measure of algal biomass for FY 21.



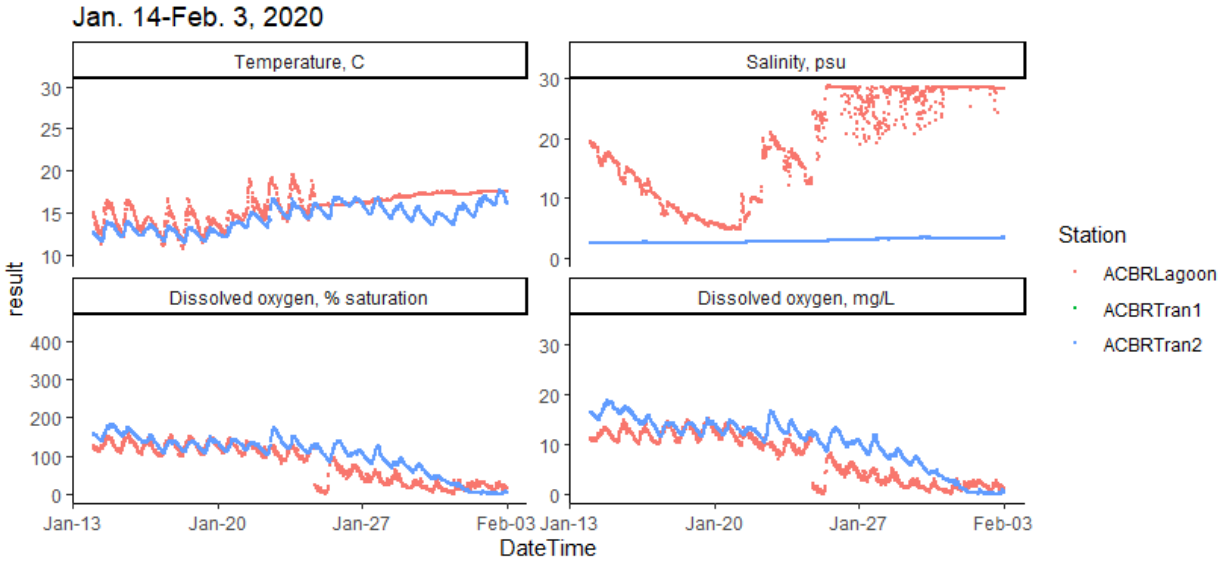
Map of sensor locations.



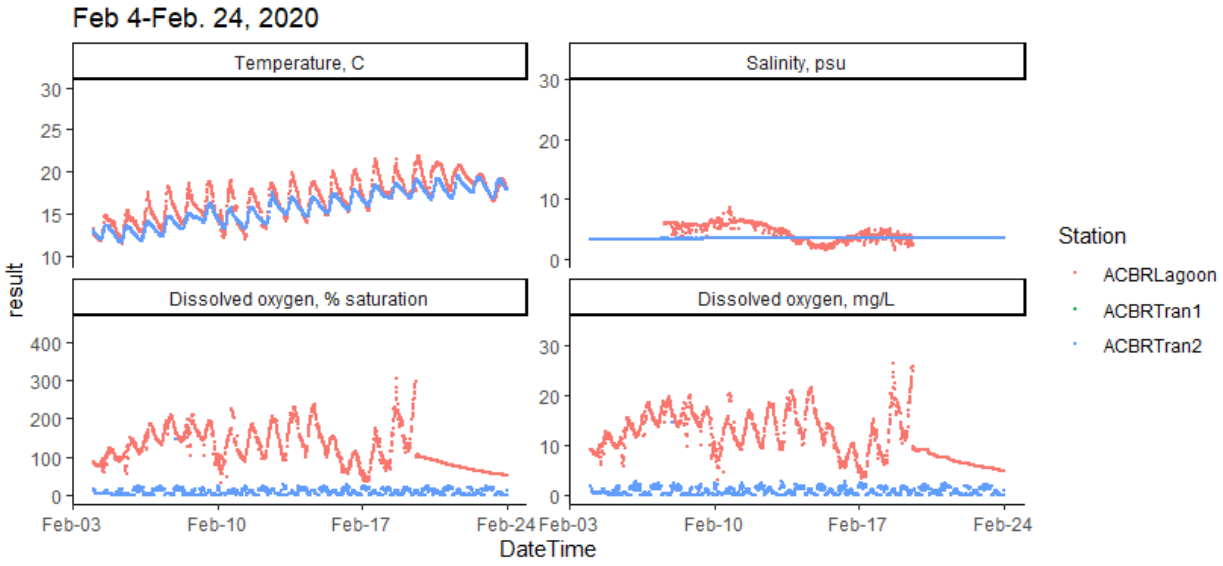
Sensor results showing a summer bloom and decay.



Sensor results showing a rain event followed by high tides.



Sensor results showing tidal input and weir separation.



Sensor results showing sustained low dissolved oxygen in the lake side.

Creek Restoration and Water Quality Improvement Projects

Samples for nutrients, indicator bacteria, oil and grease, metals, and pesticides were collected from the City's bioretention planters. At least one more year of samples must be collected from these sites before there are enough data to draw statistical conclusions about performance.

General Permit Monitoring

The Creeks Division conducts monitoring and load reduction calculations to meet the NPDES General Permit Requirements. In FY 20 data was analyzed and the General Permit 6 Year Monitoring Report was prepared. The following is a partial representation of submitted data.

Introduction

During Permit Year 7, the City carried out monitoring for Special Studies and 303(d) Monitoring under Regional-Board Approved Monitoring Plan/QAPPs. The City also carried out extensive monitoring and research under the Creeks Advisory Committee-approved Water Quality Research and Monitoring Plan (not included here).

Special Studies Monitoring

Special Studies Monitoring was carried out according to the approved Monitoring Plan/QAPP with the following exceptions: the Haley Drain was not sampled due to lack of flow during dry weather. The Hope Drain and Westside Drain were not sampled due to lack of operation. As discussed in previous reports, the City added second LID project, the Streets, Sidewalks and Alleys Project, to load reduction estimates.

In Permit Year 5, the City completed and made available a 5-year report that included a comparison of data collection to baseline data and discussion of monitoring program results. In the current Year 6 report, the format returns to that used during Years 1-4.

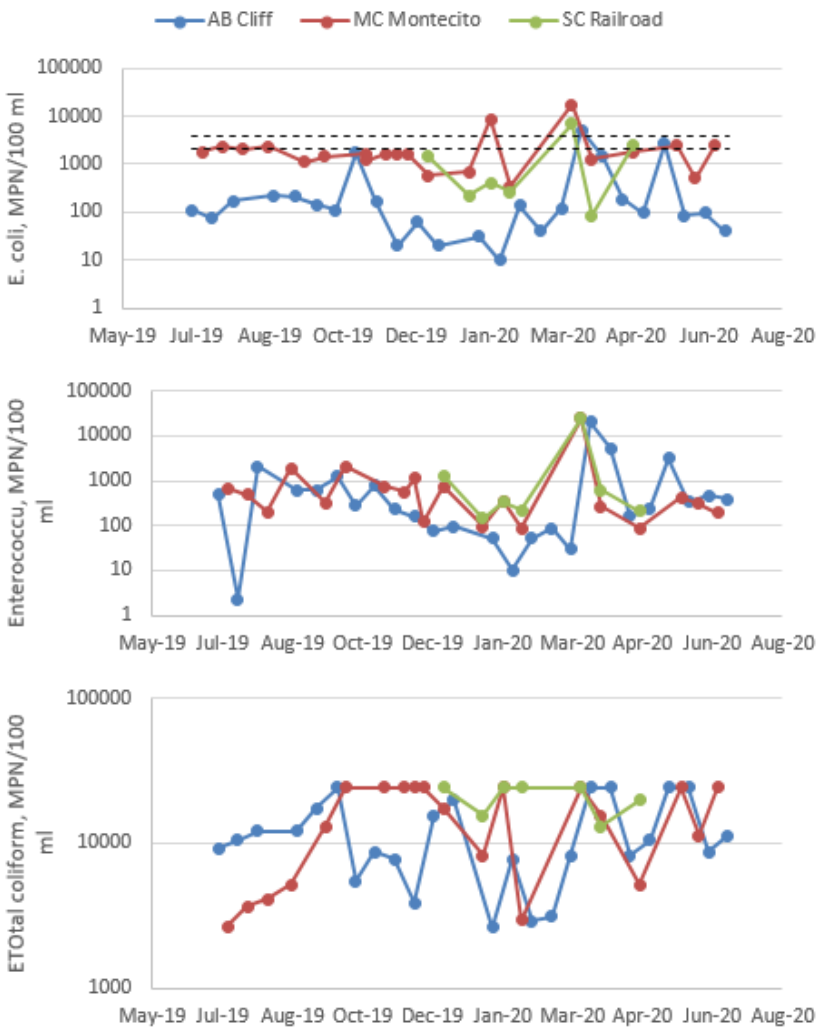
303(d) Monitoring

303(d) Monitoring was carried out according to the approved Monitoring Plan/QAPP with the following exceptions:

Sycamore Creek was not sampled on 19 sample dates due to non-existent flow in the creek. Mission Creek was not sampled on one samples dates, and Arroyo Burro was not sampled on five sample dates due to holiday closures of City offices, storm sampling, and staff illness. Fecal indicator bacteria results are shown in Figure 1. Project Action Limits are shown for visual comparison; however additional calculations are required to demonstrate exeedances. Table 1 shows the samples which exceed Project Action Limits; note, however, that the water quality objectives underlying the Project Action Limits were developed mostly for beach environments and are not typically applied to freshwater. For comparison purposes, beach water quality exceedances are summarized in Table 2 (these data were acquired from the County of Santa Barbara and were not sampled by the City).

Toxicity testing was completed during Permit Year 5.

There is no separate or specific report required by the Permit for this Project. Recent fecal indicator bacteria data generated under this project have not been uploaded and checked by the Regional Data Center for upload to California Environmental Data Exchange Network (CEDEN) because the Regional Data Center does not have staff available to check uploads.



Fecal indicator bacteria results during Permit Year 6. Missing data points represent dates when creek was not flowing due to drought. Horizontal lines represent or partially represent Project Action Limits as follows: fecal coliform/E. coli, 10% of samples should not exceed 4,000 MPN/100 ml (upper line) during any 30 day period and 5-sample/30 day geomean should not exceed 2,000 MPN/100 ml (lower line); note that due to only two samples collected per 30-day period, the upper limit functions as a single sample maximum for these samples and note that geomeans were not calculated due to sampling frequency < 5 samples/30 days. Enterococcus: no Project Action Limit. Total coliform: Samples should not exceed 1,000 MPN/100 ml when the ratio of fecal coliform/total coliform>0.1.

303(d) Fecal Indicator Bacteria Monitoring Results, Permit Year 6. Shading represents exceedances. See Figure 1 heading for standards.

StationID	Date		E Coli		Enterococcus		Total coliform	Ratio
AB Cliff	7/1/2019		110		480		9208	0.01
AB Cliff	7/15/2019		74		2.3		10462	0.01
AB Cliff	7/29/2019		173		2098		12033	0.01
AB Cliff	8/26/2019		216		601		12033	0.02
AB Cliff	9/9/2019		211		613		17329	0.01
AB Cliff	9/24/2019		143		1250	>	24192	0.01
AB Cliff	10/7/2019		109		275		5475	0.02
AB Cliff	10/21/2019		1720		780		8664	0.20
AB Cliff	11/4/2019		161		228		7701	0.02
AB Cliff	11/18/2019		20		156		3873	0.01
AB Cliff	12/2/2019		62		74		15531	0.00
AB Cliff	12/16/2019		20		96		19863	0.00
AB Cliff	1/13/2020		31		52		2613	0.01
AB Cliff	1/27/2020		10		10		7701	0.00
AB Cliff	2/10/2020		134		52		2909	0.05
AB Cliff	2/24/2020		41		86		3130	0.01
AB Cliff	3/9/2020		120		30		8164	0.01
AB Cliff	3/23/2020		5172		19863	>	24192	0.21
AB Cliff	4/6/2020		1439		5172	>	24192	0.06
AB Cliff	4/20/2020		185		160		8164	0.02
AB Cliff	5/4/2020		97		243		10462	0.01
AB Cliff	5/18/2020		2613		3076	>	24192	0.11
AB Cliff	6/1/2020		85		341	>	24192	0.00
AB Cliff	6/15/2020		97		464		8664	0.01
AB Cliff	6/29/2020		41		384		11199	0.00
MC Monteci	7/8/2019		1793		670		2654	0.68
MC Monteci	7/22/2019		2359		495		3654	0.65
MC Monteci	8/5/2019		2046		199		4106	0.50
MC Monteci	8/22/2019		2282		1918		5172	0.44
MC Monteci	9/16/2019		1092		318		12997	0.08
MC Monteci	9/30/2019		1467		2046	>	24192	0.06
MC Monteci	10/28/2019		1607		749	>	24192	0.07
MC Monteci	10/28/2019		1198		563	>	24192	0.05
MC Monteci	11/11/2019		1624		1106	>	24192	0.07
MC Monteci	11/18/2019		1669		122	>	24192	0.07
MC Monteci	11/25/2019		1674		738		17329	0.10
MC Monteci	12/9/2019		573		97		8164	0.07
MC Monteci	1/6/2020		677		359	>	24192	0.03
MC Monteci	1/21/2020		8664		86		2924	2.96
MC Monteci	2/3/2020		345	>	24192	>	24192	0.01
MC Monteci	3/16/2020		17329		262		15531	1.12
MC Monteci	3/30/2020		1259		85		5172	0.24
MC Monteci	4/27/2020		1785		416	>	24192	0.07
MC Monteci	5/27/2020		2481		307		11199	0.22
MC Monteci	6/8/2020		504		189	>	24192	0.02
SC Railroa	12/9/2019		1467		1274	>	24192	0.06
SC Railroa	1/6/2020		218		146		15531	0.01
SC Railroa	1/21/2020		399		341	>	24192	0.02
SC Railroa	2/3/2020		259		218	>	24192	0.01
SC Railroa	3/16/2020		6867	>	24192	>	24192	0.28
SC Railroa	3/30/2020		86		620		12997	0.01
SC Railroa	4/27/2020		2489		211		19863	0.13
EXCEEDANCES			4					13

Bioassessment

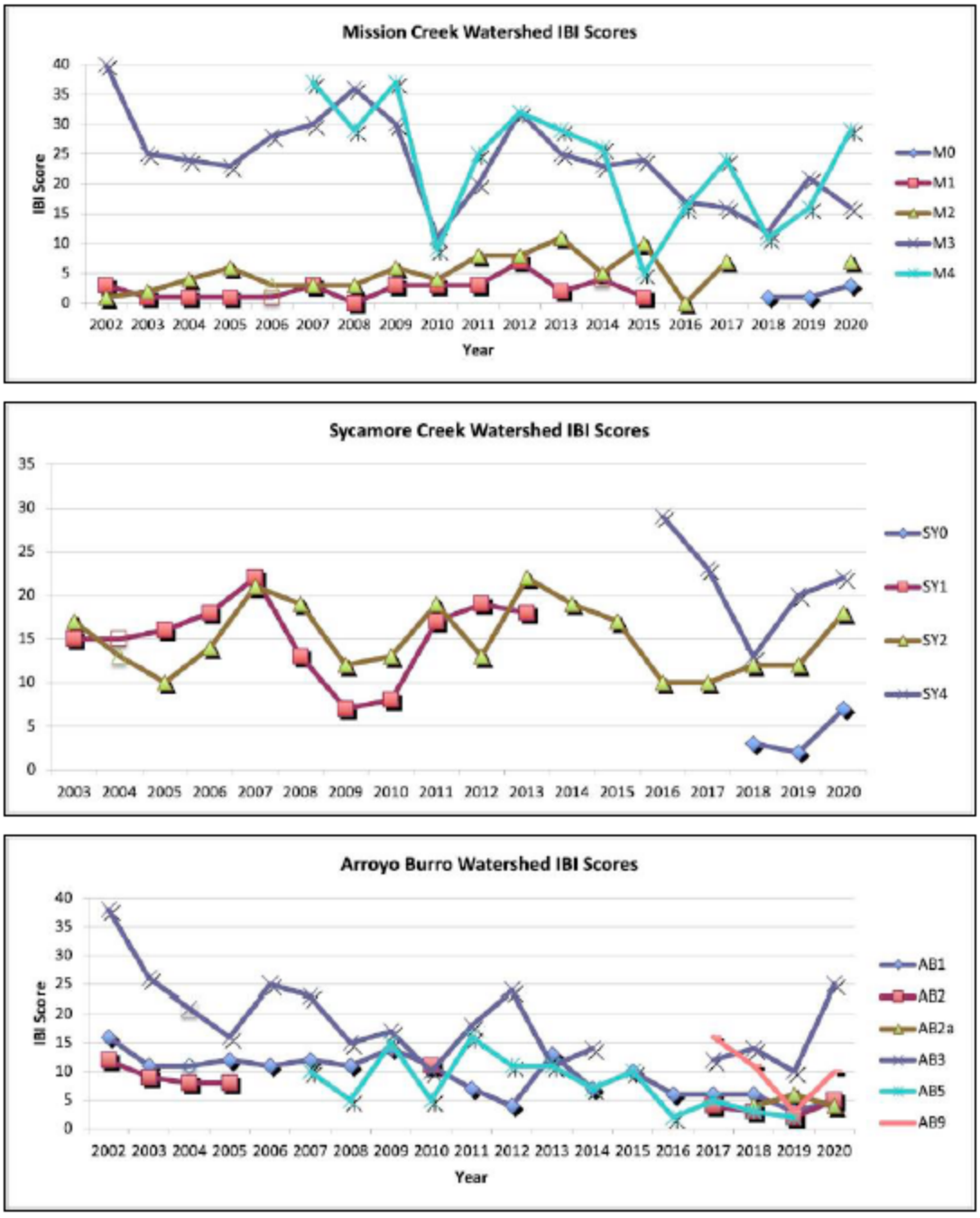
Bioassessment is the study of the biological community in a body of water to help evaluate the health of the habitat, including water quality. The Creeks Division Research and Monitoring Program uses bioassessment to compare the condition of different creek locations, track water quality changes over time, and follow progress of creek restoration projects. Bioassessment is also used to help understand impacts of development, climate variation, and wildfire on water quality and habitat conditions in Santa Barbara creeks.

Bioassessment can be considered the third tier of analysis for understanding water quality concerns. The first tier, water-quality sampling, measures concentrations of specific chemicals that are known to harm or benefit aquatic organisms. The second tier, toxicity testing, measures the response of a laboratory test organism (juvenile fish, invertebrates, and/or freshwater algae) to creek water samples, thereby summing the impacts of all toxic chemicals that may be present at the time of sampling. The third tier, bioassessment, quantifies the community of benthic macroinvertebrate (BMI) organisms present in the creek to determine if water quality is impaired. Bioassessment effectively integrates the effect of potential contaminants over a long period of time. Pristine sites are known to have high numbers of sensitive organisms, such as mayflies, whereas impaired sites have a higher number of organisms, such as midges, that are known to be more tolerant of pollutants.

Since 2002, the Creeks Division has utilized the services of Ecology Consultants, Inc. to conduct the field sampling, laboratory analysis, and statistical calculations required to complete bioassessment monitoring. The results are used by the consultant to generate an Index of Biological Integrity (IBI) to simplify comparisons among locations and time points. Several creek sites have been monitored every year since 2001 (the County of Santa Barbara funded the 2001 study), whereas other sites have been tested for a subset of years in response to specific research questions. For the past eight years, results from the City and County studies have been combined in one report for the South Coast. Estuarine sites were added in 2011 in order to assess the Mission Lagoon and Laguna Channel Restoration Project area.

IBI scores were calculated by year for all City of Santa Barbara stream study reaches, inclusive of the Sycamore Creek, Mission Creek, and Arroyo Burro watersheds. Highly distrubed sites (HIGH DIST) across the 3 watersheds (i.e., M0, M1, M2, AB1, AB2, SY0, SY1) have consistently been Very Poor to Poor over the years. Moderately disturbed sites (MOD DIST) and M/R I/F (i.e., intermittent flow) sites M3, SY2, SY4, AB3, and AB9 have typically fluctuated from Poor to Fair over the years, This was the case for all but AB3, which had an IBI score of 25 (Good), and would be a reference sites (REF) if not for intermittent flow. REF

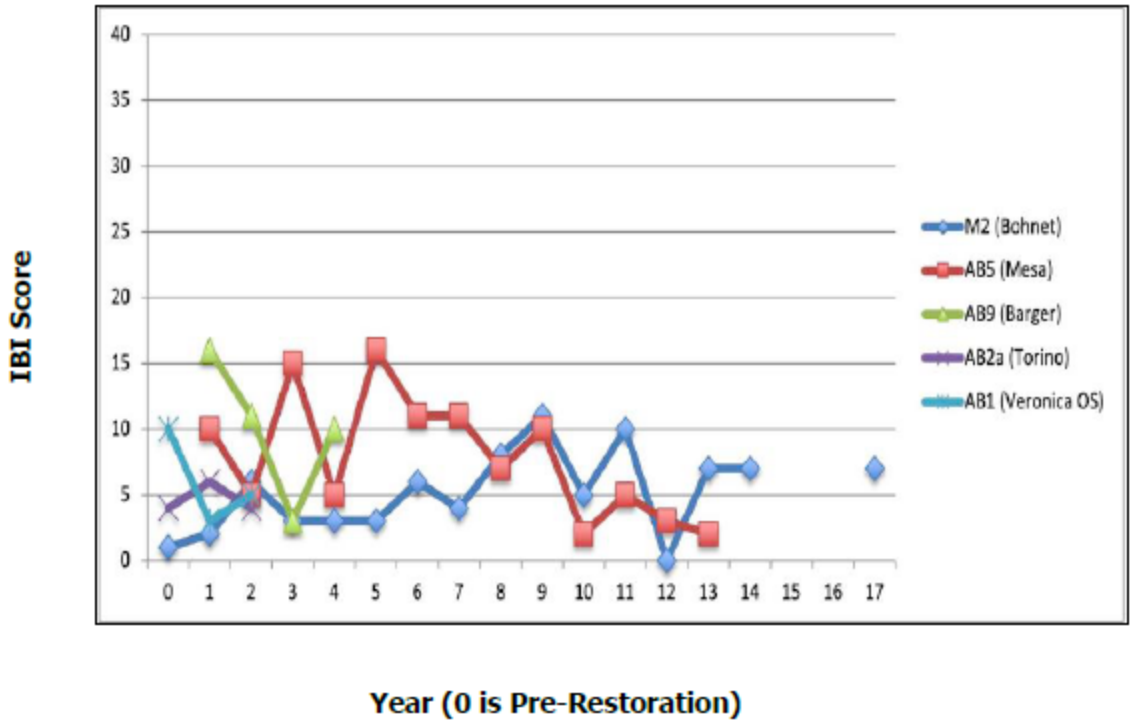
site M4 had year-round flow and scored 29 (Good), an improvement over recent years when flow was intermittent.



IBI scores for Santa Barbara creeks over time.

The City of Santa Barbara has undertaken stream habitat restoration projects at several sites in the Arroyo Burro and Mission Creek watersheds. Restoration efforts at these sites

have involved re-shaping the stream channel and banks (or complete reconstruction in the case of AB5), improvement of storm water infiltration and filtering using bioswales, removal of existing non-native vegetation, and replanting and establishment of native riparian vegetation. Two of these restoration projects, M2 (Old Mission Creek) and AB5 (Mesa Creek), were initiated several years ago (M2 in 2002 and AB5 in 2007). Three other projects were initiated more recently, in 2016 at AB9 (Barger Canyon Creek), and in 2018 at AB1 (lower Arroyo Burro Creek) and AB2a (Arroyo Burro upstream of Torino Rd.).



IBI scores at restoration sites.

Long term restoration sites M2, AB5, and more recently AB9, have shown improvements in habitat conditions over time, as reflected by improved Habitat Assessment score. Improved Habitat Assessment scores at M2, AB5, and AB9 owe largely to restored streamside, riparian vegetation and channel morphology due to initial restoration efforts and long-term maintenance. Native riparian plant cover and riparian canopy cover have greatly improved at all three of these restoration sites, presumably improving habitat conditions for riparian birds and other terrestrial vertebrate and invertebrate species. The improved riparian habitat at these sites has also improved bank stability, and has presumably resulted in lower average stream temperatures, reduced algal blooms, and more stable dissolved oxygen levels. The restoration projects at AB1 and AB2a were initiated in 2018, and these sites will require more time for visible improvements to occur.

Beach Water Quality

Beach water quality, as measured by fecal indicator bacteria, was impacted by rain and king tides in FY 20. Late rain led to beach warnings issued during the AB411 season (April 1- October 31).

Santa Barbara County Beach Water Quality Results Warning means one or more of the AB 411 criteria were exceeded, and #N/A represents no sample was collected, typically on days where resamples were collected for some beaches but not others. Blank cells represent that the sample was collected and the results were in compliance with the standards.

Date	Arroyo Burro	East Beach at Mission Creek	East Beach at Sycamore Creek	Comments
7/1/2019				
7/15/2019				
7/22/2019				
7/29/2019				
8/5/2019				
8/12/2019				
8/26/2019				
9/2/2019				
9/9/2019				
9/16/2019				
9/23/2019				
9/30/2019				
10/7/2019				
10/14/2019				
10/21/2019				
10/28/2019	#N/A	#N/A		
11/4/2019				
11/12/2019		Warning		
11/18/2019				
11/25/2019	Warning			
12/2/2019				
12/11/2019	#N/A	Warning	#N/A	
12/16/2019				
12/26/2019	Warning	Warning	Warning	
1/8/2020	#N/A	Warning	#N/A	
1/13/2020				
1/20/2020		#DIV/0!	#DIV/0!	
1/27/2020				
2/10/2020				
2/17/2020				
2/24/2020				
3/2/2020				Rain Event
3/9/2020				Rain Event
3/16/2020	Warning	Warning	Warning	Rain Event
3/23/2020		Warning		Rain Event
3/25/2020	#N/A		#N/A	
3/30/2020				
4/6/2020	Warning	Warning	Warning	Rain Event
4/13/2020	Warning	Warning	Warning	Rain Event
4/15/2020	#N/A	Warning	#N/A	Rain Event
4/20/2020				Rain Event
4/27/2020		Warning		Rain Event

5/11/2020	Warning			
	#N/A	#N/A	#N/A	
5/18/2020				
5/25/2020				
6/1/2020		Warning		
6/3/2020	#N/A	Warning	#N/A	
6/8/2020				
6/15/2020				
6/22/2020				
6/29/2020				