FINAL

Santa Ana Watershed Project Authority

Santa Ana River Regional Bacteria Monitoring Program Annual Report: 2020-2021

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Acronyms and Abbreviations

AgSEP	Agricultural Source Evaluation Plan
Babcock	Babcock Laboratories, Inc.
Basin Plan	Santa Ana Region Basin Plan
BMP	Best Management Practice
BPA	Basin Plan Amendment
CEDEN	California Environmental Data Exchange Network
cfs	Cubic Feet per Second
CFU	Colony Forming Units
COC	Chain of Custody
DO	Dissolved Oxygen
EPA	Environmental Protection Agency
IDDE	Illicit Discharge Detection and Elimination
mgd	Million Gallons Per Day
MPN	Most Probable Number
MSAR	Middle Santa Ana River
OCPHL	Orange County Public Health Laboratory
OCPW	Orange County Public Works
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance / Quality Control
RCFC&WCD	Riverside County Flood Control & Water Conservation District
RMP	Regional Monitoring Program
Santa Ana Water Board	Santa Ana Regional Water Quality Control Board
SAR	Santa Ana River
SAWDMS	Santa Ana Watershed Data Management System
SAWPA	Santa Ana Watershed Project Authority
SBCFCD	San Bernardino County Flood Control District
SOP	Standard Operating Procedures
SSV	Single Sample Value
STV	Statistical Threshold Value
State Water Board	State Water Resources Control Board
SWAMP	California's Surface Water Ambient Monitoring Program
SWQSTF	Stormwater Quality Standards Task Force
Task Force	MSAR TMDL / Regional Water Quality Task Force

TMDL	MSAR Bacteria Indicator Total Maximum Daily Limit
TSS	Total Suspended Solids
UAA	Use Attainability Analysis
USEP	Urban Source Evaluation Plan

Executive Summary

The Stormwater Quality Standards Study (SQSS) Task Force was formed in 2002 to embark upon a deliberate and measured approach to protect recreational uses in inland surface waters in the Santa Ana Basin. At the time, there were few examples of such a group including water quality regulators and watershed stakeholders spread across three counties, and encompassing a mix of MS4s, agricultural groups, state lands, and POTWs coalescing together for common values. The SQSS Task Force collaborated on a Basin Plan Amendment (BPA) that pulled from 17 recreational use surveys, six use attainability analyses (UAAs), economic feasibility assessments, hydrologic analysis, CEQA analysis, and many other special studies. Changes to the Basin Plan were approved by EPA Region 9 in April 2015 and allowed for the watershed stakeholders to focus resources on areas of highest priority to protect public health.

A Regional Monitoring Program (RMP) was developed to collect the routine bacteriological data needed to meet key objectives from the work of the SQSS and continue to be achieved following the BPA adoption, as follows:

- Priority 1: Monitor fecal bacteria conditions in the areas of greatest risk of exposure including lakes and streams with designated beaches and active recreational use to ensure water quality objectives (WQOs) are being met or actively addressed.
- Priority 2: Evaluate effectiveness of implementation actions taken to comply with the Middle Santa Ana River (MSAR) bacteria TMDL.
- Priority 3: Collect data to evaluate status and trends in other bacteria impaired waters throughout the Santa Ana Basin.
- Priority 4: Ensure that waters re-designated as 'REC2 Only' meet anti-degradation requirements in the absence of a numeric WQO.

For each of these priority categories, data are synthesized at a summary level and key interpretive findings are highlighted from this 2020-21 annual report in the following sections.

Priority 1 – Waterbody Segments with Greatest Risk of Exposure

Figure ES-1 shows that *E. coli* concentrations in Priority 1 waters remain generally low and support recreational use although 20% exceeded the target at the two sites along the Santa Ana River.

One outlier was identified on July 22, 2020: Enterococci in Lake Elsinore (2,400 MPN/100 mL – Enterococci data not shown in Figure ES-1). This is a second outlier for Enterococci in Lake Elsinore in the sampling record (2016-2020), with first instance occurring in October 2019. Results in the upcoming monitoring year will be evaluated to determine if these high values are outliers or if an intermittent source or condition may exist.

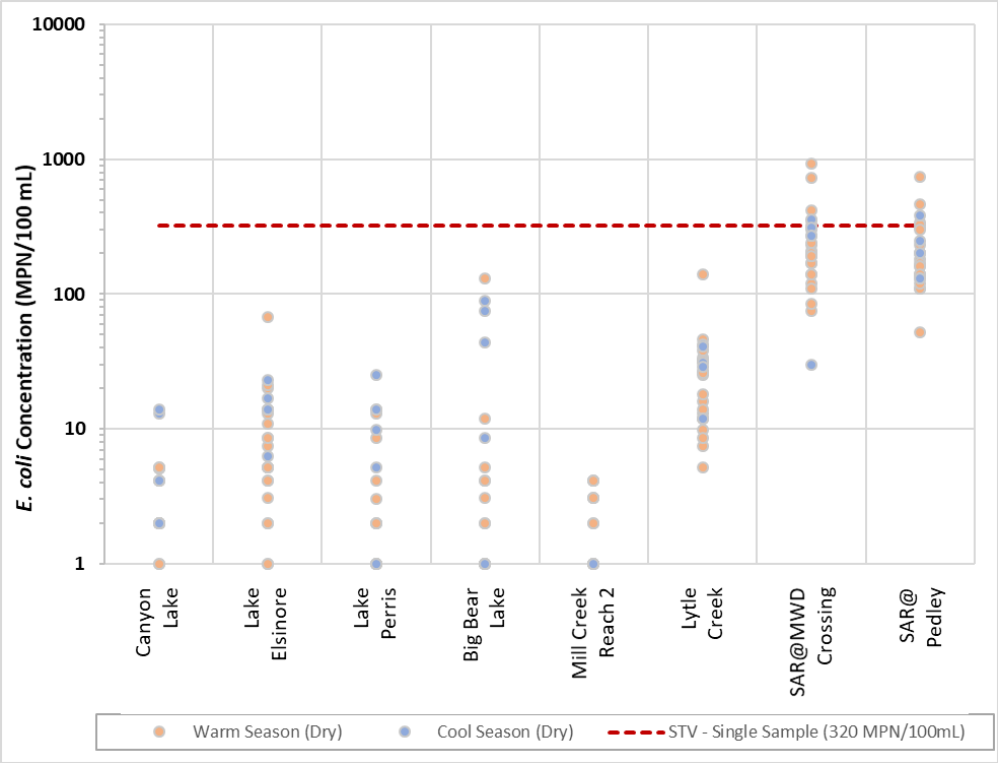

Figure ES-1. *E. coli* Concentrations during Dry Weather in Warm (20 consecutive weeks) and Cool (5 consecutive weeks) Seasons in 2020-2021

Priority 2 – Waters Subject to an Existing TMDL

This RMP annual report characterizes fecal bacteria conditions within the MSAR TMDL waters: Santa Ana River Reach 3, Mill-Cucamonga Creek, and Chino Creek. The TMDL sets concentration-based wasteload and load allocations (WLAs/LAs) and describes actions taken to reduce fecal bacteria in the Santa Ana River Reach 3 as well as Mill-Cucamonga Creek and Chino Creek. Starting in 2005, extensive efforts have been taken by the MSAR bacteria TMDL Task Force to meet the TMDL requirements, including development and ongoing implementation of watershed control plans for urban and agricultural sources. The MSAR bacteria TMDL Task Force conducted comprehensive bacteria loading analyses in 2007, 2012, and 2019 that have shown inflows of *E. coli* to the TMDL waters have declined since the TMDL was adopted. However, there has not been a sufficient reduction of *E. coli* concentrations within the TMDL waters to meet numeric targets at the compliance monitoring locations.

In 2020, sampling in the Santa Ana River at Mission Avenue was included in the Priority 2 sampling program based on findings from the 2019 dry season six-week Synoptic Study[1], which showed most fecal bacteria loads in Reach 3 of the Santa Ana River come from within river sources in Reach 4. There are no MS4 inflows to Santa Ana River Reach 4 that are hydrologically connected to Reach 3 during dry weather. More robust data collection in 2020 (n=25) from this site confirmed the presence of significant fecal bacteria loads within-river upstream from Mission Avenue within Reach 4 of the Santa Ana River, resulting in *E. coli* concentrations consistently exceeding the TMDL geometric mean WLA at the upstream boundary of the TMDL segment (Figure ES-2). Two possible in-river sources are recent fecal deposits from humans and animals (e.g., pets, horses, and or wildlife) in the river and releases from naturalized colonies of *E. coli* growing in channel bottom sediments or biofilm. Naturalized fecal bacteria, including *E.coli,* are bacteria released to the environment that can settle and colonize in the sediments or channel bottom over a wide range of conditions (e.g., temperature, nutrients, etc.).

[1] Middle Santa Ana River Bacteria Synoptic Study and TMDL Triennial Report - https://sawpa.org/wp-content/uploads/2020/05/Final-Synoptic-Study-Report_021020_BabcockLabQAQC-Report-Appended_051920.pdf

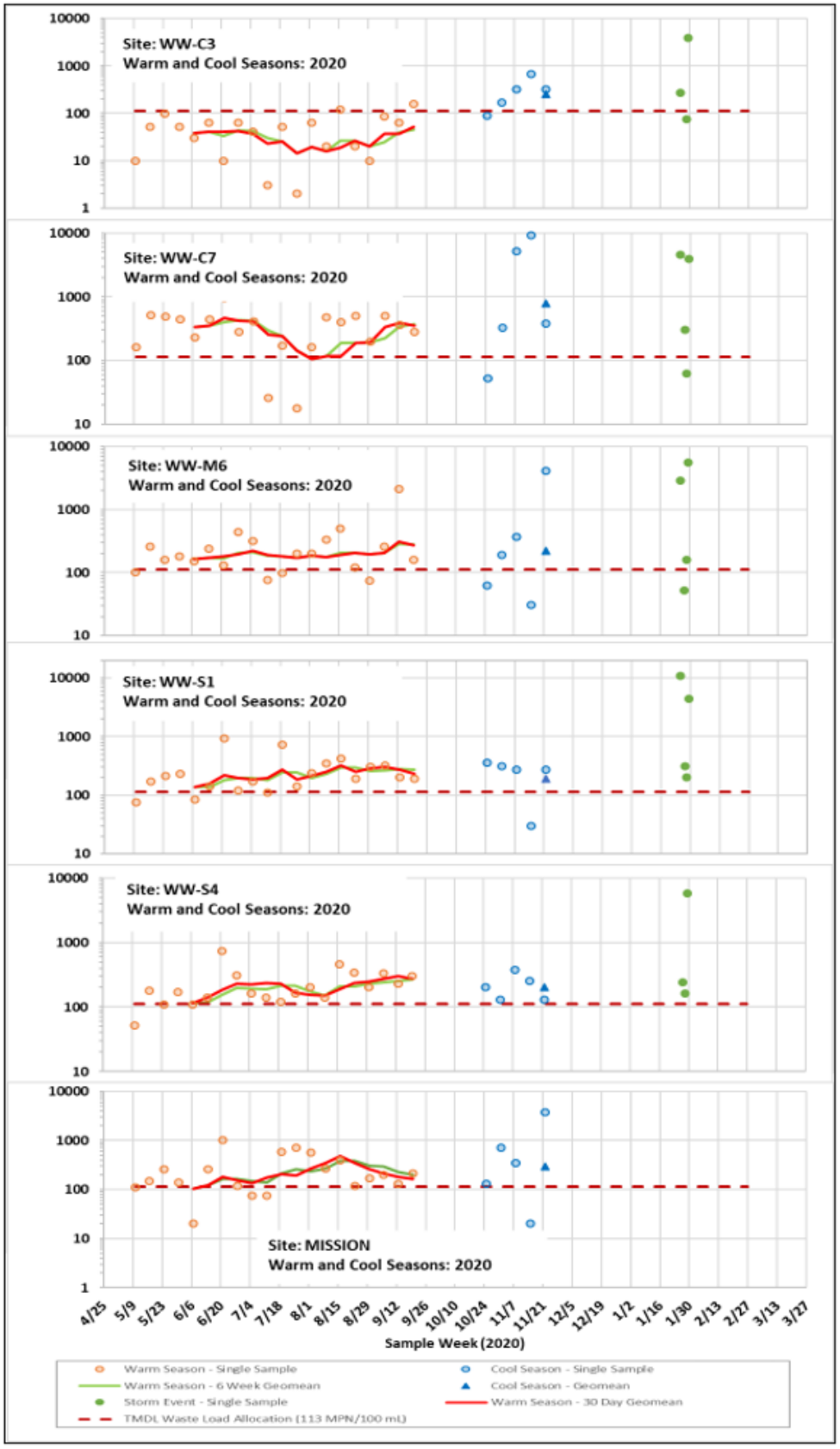

Figure ES-2. *E. coli* (MPN/100 mL) and Geomeans for Priority 2 Waters in 2020-2021

In addition to receiving water monitoring, Tier 2 bacteria source investigations were implemented in the Cucamonga Creek and Magnolia Center Storm Drain watersheds during the 2020 dry season. The investigations followed recommendations of the 2019 dry season Synoptic Study.

The monitoring program for Priority 2 waters also involves collection of one wet weather event per year with samples collected on day 1 of a wet weather event, followed by samples at intervals of 48, 72, and 96 hours to evaluate post-storm bacteria concentrations. In this 2020-2021 RMP data report, 13 years of storm event data were analyzed to assess how long bacteria concentrations are elevated following a wet weather event in the TMDL waters. Figure ES-3 shows *E. coli* concentrations return to pre-event levels generally within 24 hours from runoff returning to pre-event rates.

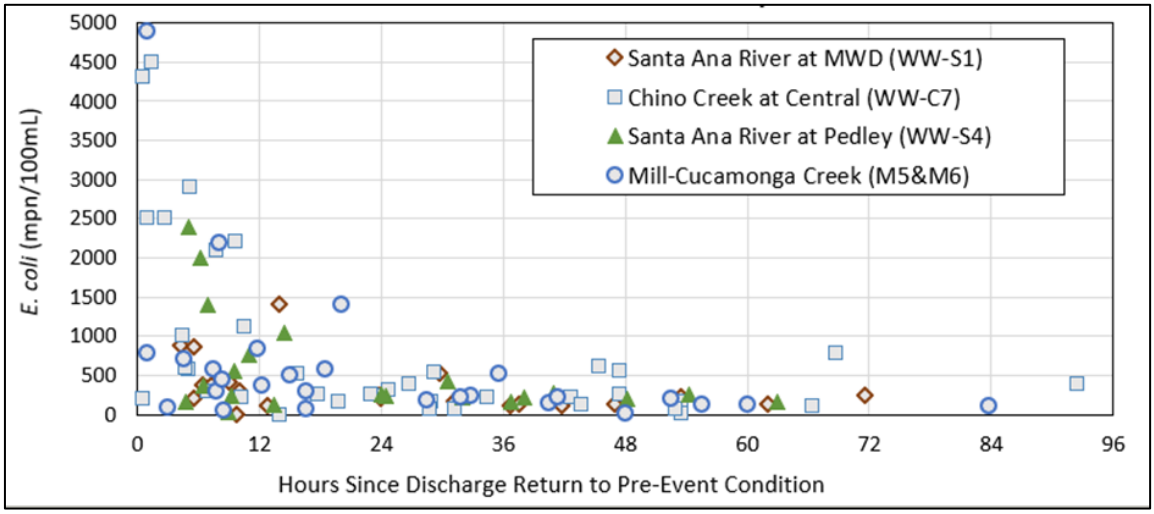

Figure ES-3. Post-storm Event Samples from MSAR TMDL Waters Plotted against the Time Since the Flow Returned to Pre-event Flow Conditions

Priority 3 – Bacteria Impaired Waters Without an Existing TMDL

The Task Force has collaborated with the Regional Board to collect five consecutive-week samples each dry season to characterize current fecal bacteria concentrations in waters that were added to the 303(d) list but do not have a TMDL to date. In some cases, the basis for original 303(d) listing involved data collected over 15 years ago and new monitoring data collected through this RMP has provided updated information.

Five-sample geometric means of *E. coli* or Enterococcus concentration from Priority 3 waters from sampling in each dry season from 2016 to 2020 are reported in Table ES-1 below. No discernable long-term trend of increasing or decreasing fecal bacteria concentrations were noted from the monitoring data. The sampling was completed in this randomized way to ensure a range of conditions was captured. There were no statistically significant correlations between bacteria concentration and any field measured parameters.

Table ES-1. Summary of Key Water Quality Data from RBMP Priority 3 Waters

Freshwaters on 2018 303(d) List with Bacteria Impairment [1]	Existing Site	Range of Conductivity (us/cm)	Estimate Range of Flow (cfs)	Fecal Bacteria Indicator	Geometric Mean of Sampling (mpn/100mL) [2]				
					2016	2017	2018	2019	2020
Goldenstar Creek	P3-RC1	1901 – 2272	0.4 – 8	*E. coli*	242	417	118	360	177
Santa Ana River Reach 4	P3-SBC1	240 – 892	2.6 – 70.6	*E. coli*	48	70	74	25-112	16 -247
San Timoteo Creek Reach 1A	P3-SBC2	402 – 523	0.3 – 1.9	*E. coli*	NA	NA	NA	NA	40
San Timoteo Creek Reach 2	P3-SBC3	802 – 842	0 – 1.3	*E. coli*	NA	NA	NA	NA	607 [4]
Bolsa Chica	P3-OC1	1358 – 2900	0.1 – 1.5	*E. coli*	51	534	31	60	439
				Enterococcus	NA	NA	NA	34	315
Borrego Creek	P3-OC2	NA	0	*E. coli*	Dry	Dry	Dry	Dry	Dry
Buck Gully	P3-OC3	3987 – 6884	0 – 0.9	*E. coli*	74	89	20	351	NA
				Enterococcus	NA	NA	29 [3]	544	NA
Los Trancos Creek	P3-OC5	1000 – 7933	0 – 1.1	*E. coli*	457	658	Dry	Dry	Dry
Morning Canyon Creek	P3-OC6	240 – 21446	0 – 1.0	*E. coli*	633	212	858	170	NA
				Enterococcus	NA	NA	526 [3]	1067	NA
Peters Canyon Channel	P3-OC7	1787 – 2760	0.9 – 9.7	*E. coli*	198	201	562	540	203
				Enterococcus	NA	NA	NA	660	NA
San Diego Creek Reach 1	P3-OC8	2108 – 3742	0.2 – 9.4	*E. coli*	329	116	176	184	55
San Diego Creek Reach 2	P3-OC9	766 – 2735	0.1 – 0.8	*E. coli*	202	373	155	43	146
Serrano Creek	P3-OC11	717 – 2092	0.01 – 1.4	*E. coli*	166	1080	221	864	1572

[1] Waterbodies on the 303(d) list for bacteria impairment that are not included within priority 3 of the RBMP include Knickerbocker Creek, Mill Creek Reach 1, Mountain Home Creek, Mountain Home Creek East Fork and Newport Slough. Reasons for exclusion of these waters are presented in the RBMP Monitoring Plan and QAPP.
[2] Shaded cells indicated exceedance of geomean WQO (*E. coli* – 100 MPN/100mL and Enterococcus – 30 MPN/100mL)
[3] Sampling period extended from December 2018 to February 2019
[4] 5-sample geomeans were not able to be calculated due to channel conditions being dry during at least one of the five scheduled sample weeks

Monitoring of priority 3 waters during the 2016-2020 dry seasons has provided sufficient data to recommend a course of action in each waterbody to either transition to source identification or continue sampling at the same station within the receiving water. Table ES-2 presents recommended courses of action: transition nine of these waters from routine monitoring to source identification, continue to monitor four waterbodies that were added to 303(d) list in 2018. At this time, none of the waterbodies support an alternative to pursue delisting. Lastly, two waterbodies were found to be persistently dry, Los Trancos and Borrego Creek. OCPW will continue to be monitored to determine if the dry condition continues during the dry season.

Table ES-2. Recommendations for Continued Monitoring or Source Identification in each of the RBMP Priority 3 Waters

Waterbody	Existing Site	Recommended Action	Source Investigation Status
Bolsa Chica	P3-OC1	Transition to source investigation	OCPW developing new bottom-up sampling scheme for 2021 dry season
San Diego Creek Reach 1	P3-OC8	Transition to source investigation	Newport Bay Watershed Source Investigation expected to kick off 2021 dry season
San Diego Creek Reach 2	P3-OC9	Transition to source investigation	Newport Bay Watershed Source Investigation expected to kick off 2021 dry season
Peters Canyon Channel	P3-OC7	Transition to source investigation	Newport Bay Watershed Source Investigation expected to kick off 2021 dry season
Borrego Creek	P3-OC2	Verify persistence of dry condition	N/A
Serrano Creek	P3-OC11	Transition to source investigation	Newport Bay Watershed Source Investigation expected to kick off 2021 dry season
Buck Gully	P3-OC3	Transition to source investigation	Regional Board coordinating with City of Newport Beach
Los Trancos Creek	P3-OC5	Verify persistence of dry condition	N/A
Morning Canyon Creek	P3-OC6	Transition to source investigation	Regional Board coordinating with City of Newport Beach
Goldenstar Creek	P3-RC1	Transition to source investigation	RCFC&WCD identified this waterbody as a potential site for causal assessment activities over the next 5 years through the SMC Regional Bioassessment program
Santa Ana River Reach 4	P3-SBC1	Transition to source investigation	Mainstem sampling through MSAR TMDL Task Force, SAWPA Homeless Encampments Impacts Study
San Timoteo Creek Reach 1A	P3-SBC2	Continue monitoring at five samples/yr	N/A
San Timoteo Creek Reach 2	P3-SBC3	Continue monitoring at five samples/yr	N/A
San Timoteo Creek Reach 3	P3-RC3	Identify location for monitoring at five samples/yr	N/A
Warm Creek	P3-SBC4	Continue monitoring at five samples/yr	N/A

Priority 4 – Waters Re-Designated as REC2 Only

A key component to the 2012 BPA involved the completion of six use attainability analyses (UAAs) that served as the basis for EPA approval of changes to the beneficial use from REC1 and REC2 to REC2 Only in six waterbodies: Cucamonga Creek Reach 1, Temescal Creek Reach 1a and 1b, Santa Ana Delhi Channel Reaches 1 and 2, Greenville-Banning Channel Reach 1, and tidal prisms for Greenville-Banning and Santa Ana Delhi Channels. The Basin Plan describes REC2 Only waters as having "…relatively brief incidental or accidental water contact that is limited primarily to the body extremities (e.g., hands or feet) is generally deemed REC 2 because ingestion is not considered reasonably possible." Numeric water quality objectives included in the Basin Plan for

REC2-Only waters serve to meet antidegradation policy requirements. Statistical analysis of historical datasets on the re-designated waters was performed to derive an anti-degradation target as a statistical threshold value set at the 75th percentile of the data distribution. Each year, the RMP specifies a single sample in these waters to be compared with the site-specific thresholds. If there is an exceedance, follow up samples are collected to ensure that the event falls within the natural variability of the historical data (i.e., there is a 1 in 4 chance that a sample may exceed the 75th percentile without indicating any antidegradation is occurring). In the 2020-2021 monitoring period, an exceedance of the threshold value occurred in Greenville Banning Channel. Follow up sampling over three consecutive months fell below the threshold indicating that no evidence of degradation (Table ES-3).

Table ES-3. Monthly Follow-Up Sampling at Greenville-Banning Channel (P4-OC)

Sample Requirement	Sample Date	*Enterococcus* (MPN/100 mL)
Original Annual Sample	9/14/2020	255[1]
Required Monthly Follow-up Samples	10/28/2020	ND
	11/24/2020	63
	12/16/2020	20

[1] This sample exceeded the anti-degradation target for Greenville-Banning Channel in Tidal Prism of 64 MPN/100mL

The Task Force has showed that changing hydrologic conditions warrant a review of the anti-degradation target for Cucamonga Creek Reach 1. Review of data from USGS gauge 11073495, Cucamonga Creek at Merrill Avenue, shows that typical dry weather flow rates in Cucamonga Creek Reach 1 in the early 2000s ranged from 25-50 cfs. Currently, dry weather flow rates have declined by an order of magnitude (typically <10 cfs) in this segment of Cucamonga Creek. The decrease in flows is largely attributable to IEUA's expansion of recycled water use over this same time period. Data collected over the 2016-2021 period was evaluated to recalculate the antidegradation threshold based on current hydrologic conditions. While flow gage analysis of Cucamonga Creek shows a significant hydrologic transformation, the bacteria concentrations have remained almost identical (Figure ES-4).

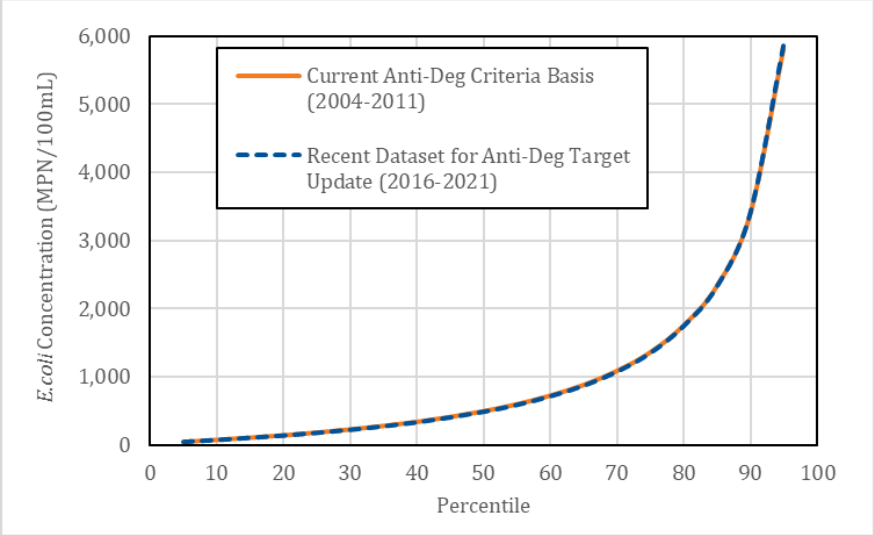

Figure ES-4. Fitted Log Normal Distribution for Current (2002-2011) and Proposed Recalculated Baseline (2016-2021) in Cucamonga Creek Reach 1 during Dry Weather Conditions used to Compute Anti-Degradation Criteria

This outcome differed from the RBMP Task Force's conceptual model that a reduction in dilution from RP1 effluent would result in a rise in fecal bacteria concentrations within the downstream segment of Cucamonga Creek Reach 1. Instead, the similarities in the datasets could be explained by 1) reductions in dry weather bacteria loads from hydrologically connected urban drainage areas proportional to the reductions in diluent water or 2) longer hydraulic residence times allowing for enhanced ultraviolet irradiation of fecal bacteria in-stream, or 3) diminished extent, and shear stress upon, naturalized fecal bacteria colonies in the channel bottom.

Lastly, these findings clearly indicate significant reductions of fecal bacteria loading to Mill-Cucamonga Creek downstream of Cucamonga Creek Reach 1, roughly proportional to increases in recycled water use from RP1. Mill-Cucamonga Creek is one of the MSAR bacteria TMDL waters. This conclusion is also supported by multiple studies at Tier 1 and 2 sites and analysis in the last three Triennial Review reports, which demonstrate the effectiveness of implementation of the comprehensive bacteria reduction plans (CBRPs) by the upstream MS4 permittees. As a result of this finding, it was recommended that the current Anti-Degradation target remain applicable and not be updated to the recent calculation.

Retrospective

It has been nearly two decades since the SQSS Task Force was formed and its successor in 2016, the Regional Monitoring Program Task Force, is continuing to collaborate on common objectives to protect recreational use in the region's inland surface waters. We have used collective understanding of the watershed and scientific advancements to address fecal bacteria impairments and used the tools afforded in the Clean Water Act to prioritize use of resources to protect public health. Tim Moore of Risk Sciences (regulatory expert to the Task Force since inception of the SQSS in 2002) once said, "the single most important element to make our Task Force effective is not the scientific or regulatory expertise of its individuals, but rather faith in the collective benefits from working together and courage to stay together despite numerous outside pressures that want to divide us…" It is apparent that the approach is working; as evidenced by improving water quality conditions in most of the SAR basin's inland surface waters and continuing significant investments in studies and implementation projects in the waters with the highest risk of exposure.

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Section 1
Introduction

The Santa Ana River (SAR) Watershed Bacteria Monitoring Program or Regional Monitoring Program (RMP) was developed to achieve the following objectives through bacteria monitoring:

- Provide the data needed to determine if water quality is safe when and where people are most likely to engage in water contact recreation.
- Facilitate the Total Maximum Daily Load (TMDL) implementation process and track progress toward attainment of applicable water quality standards, where water quality is impaired due to excessive bacterial indicator levels.
- Apply a risk-based implementation strategy to allocate public resources in a manner that is expected to produce the greatest public health benefit.

1.1 Regulatory Background

The SAR RMP supports the implementation of several regulatory-related activities associated with the protection of recreational uses in the Santa Ana River Watershed, including the Basin Plan Amendment (BPA) to *Revise Recreation Standards for Inland Freshwaters in the Santa Ana Region* and the Middle Santa Ana River (MSAR) Bacteria TMDL. Each of the activities addressed by the SAR RMP is described below.

1.1.1 Basin Plan Amendment

On June 15, 2012, the Santa Ana Regional Water Quality Control Board (Santa Ana Water Board) adopted the BPA to *Revise Recreation Standards for Inland Freshwaters in the Santa Ana Region.*[2] This BPA resulted in the following key modifications to the Water Quality Control Plan for the Santa Ana River Basin (Basin Plan) for the Santa Ana region:[3]

- Addition of "Primary Contact Recreation" as an alternative name for the REC1 (water contact recreation) beneficial use;
- Addition of narrative text clarifying the nature of REC1 activities and the bacteria objectives established to protect these activities;
- Differentiation of inland surface REC1 waters on the basis of frequency of use and other characteristics for the purposes of assigning applicable single sample maximum values;
- Revision of REC1/REC2 (non-contact water recreation) designations for specific inland surface waters based on the results of completed Use Attainability Analyses (UAA);

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[2] Santa Ana Water Board Resolution: R8-2012-0001, June 15, 2012

[3] Santa Ana Basin Plan Chapter 5, Page 5-92; http://www.waterboards.ca.gov/santaana/water_issues/programs/basin_plan/docs/2016/Chapter_5_February_2016.pdf

- Revision of water quality objectives to protect the REC1 use of inland freshwaters; and
- Identification of criteria for temporary suspension of recreation use designations and objectives (high flow suspension).

Santa Ana Water Board staff developed the BPA in collaboration with the Stormwater Quality Standards Task Force (SWQSTF), composed of representatives from various stakeholder interests, including the Santa Ana Watershed Project Authority (SAWPA); the counties of Orange, Riverside, and San Bernardino; Orange County Coastkeeper; Inland Empire Waterkeeper; and the Environmental Protection Agency (EPA) Region 9. The BPA was approved by the State Water Resources Control Board (State Water Board) on January 21, 2014[4] and the California Office of Administrative Law on July 2, 2014.[5] However, the EPA did not approve all provisions of the BPA, which required revisions in the form of letters. The EPA issued its comment letter on April 8, 2015 and provided a letter of clarification on August 3, 2015.[6]

The BPA required the establishment of a comprehensive monitoring program to support implementation of the changes to the Basin Plan.[7] The SAR RMP fulfills this requirement.

1.1.2 Statewide Bacteria Provisions

On August 7, 2018, the State Water Resources Control Board adopted *Bacteria Provisions and a Water Quality Standards Policy for Inland Surface Waters, Enclosed Bays, and Estuaries of California* (Statewide Bacteria Provisions)[8]. The Statewide Bacteria Provisions developed new statewide numeric water quality objectives for bacteria to protect primary contact recreation beneficial use, as follows:

- *E. coli*: For all waters where the salinity is equal to or less than 1 part per thousand (ppth) 95 percent or more of the time, a six-week rolling geometric mean not to exceed 100 cfu/100 mL, calculated weekly, and a statistical threshold value (STV) of 320 cfu/100 mL not to be exceeded by more than 10 percent of the samples collected in a calendar month, calculated in a static manner.
- *Enterococcus*: For all waters where the salinity is greater than 1 ppth 95 percent or more of the time, a six-week rolling geometric mean not to exceed 30 cfu/100mL, calculated weekly, and a STV of 110 cfu/100 mL not to be exceeded by more than 10 percent of the samples collected in a calendar month, calculated in a static manner.

The Statewide Bacteria Provisions supersede numeric WQOs for REC1 use contained in regional Basin Plans, except for cases involving a site-specific standard or if an existing TMDL was developed with targets based on prior regional Basin Plan REC1 WQOs (such as the MSAR Bacteria TMDL). The following section describes the MSAR Bacteria TMDL and associated numeric targets, which differ from those included in the Statewide Bacteria Provisions. This comprehensive monitoring program was developed to facilitate data collection needed to

[4] State Water Board Resolution: 2014-0005, January 21, 2014
[5] Office of Administrative Law: #2014-0520-02 S; July 2, 2014
[6] http://www.waterboards.ca.gov/santaana/water_issues/programs/basin_plan/recreational_standards.shtml
[7] Santa Ana Basin Plan Chapter 5, Page 5-114; http://www.waterboards.ca.gov/santaana/water_issues/programs/basin_plan/docs/2016/Chapter_5_February_2016.pdf
[8] State Water Board Resolution: 2018-0038, August 7, 2018

evaluate both TMDL numeric targets and Statewide Bacteria Provisions WQOs for the TMDL waters. Compliance metrics, however, are based solely on the TMDL numeric targets.

Lastly, the Statewide Bacteria Provisions do not supersede narrative WQOs in regional Basin Plans. The BPA to *Revise Recreation Standards for Inland Freshwaters in the Santa Ana Region* is composed of predominantly narrative criteria, which remain in effect for the Santa Ana region. The narrative criteria in the BPA are largely consistent with narrative criteria contained in the Statewide Bacteria Provisions.

1.1.3 Antidegradation Targets

The BPA established site-specific antidegradation targets for waterbodies with only a REC2 designation. For each of these waterbodies, the REC1 beneficial use was de-designated through an approved UAA. The antidegradation targets serve as triggers for additional monitoring or efforts to prevent degradation of water quality in REC2 waterbodies. The targets were developed using a statistical method that fits historical dry weather data to a lognormal distribution. The 75th percentile of the fitted lognormal distribution was selected as the antidegradation target when relying on a single sample result. Table 1-1 summarizes the antidegradation targets for the REC2 waterbodies included in the SAR RMP.

Table 1-1. Antidegradation 75th Percentile Targets for Waterbodies with a REC2 Only Designation in the SAR RMP

Waterbody	*E. coli* (MPN/100 ML)	*Enterococcus* (MPN/100 ML)
Temescal Creek Reach 1a/1b	725 MPN/100 mL	
Santa Ana Delhi Channel Reach 1/2	1,067 MPN/100 mL	
Santa Ana Delhi Channel in Tidal Prism[1]		464 MPN/100 mL
Greenville-Banning Channel in Tidal Prism[1]		64 MPN/100 mL
Cucamonga Creek Reach 1	1,385 MPN/100 mL	

[1] Salinity at site is greater than 1 ppth 95 percent or more of the time

1.2 Monitoring Strategy

One of the principal goals for updating recreational water quality standards in the Santa Ana region was to encourage the most cost-effective allocation of finite public resources. As such, all efforts undertaken to assure compliance with these revised standards should concentrate on projects and programs that are likely to produce the greatest public health benefit.

This risk-based approach, which is designed to guide all aspects of protecting water contact recreation, provides the foundation for this RMP. Just as it is prudent to prioritize mitigation projects in a manner that assures the greatest public health benefit, it is wise to organize related water quality monitoring efforts along the same lines. The RMP is structured to direct water quality monitoring resources to the highest priority waterbodies.

1.2.1 Priority Designation

Basin Plan requirements for an RMP and the risk-based approach described above were used as a basis for the development of a monitoring approach that designates varying levels of monitoring priority. General principles include:

- The most rigorous monitoring should occur in REC1 waterbodies where the expectation for water contact recreation is the highest. Data collection must occur at a sufficient frequency to demonstrate that these waters are safe for recreation.
- Where a waterbody has an adopted TMDL for bacterial indicators, consider existing monitoring requirements that have already been established to evaluate progress towards achieving attainment with water quality objectives.
- For waterbodies listed as impaired, but no TMDL has been adopted, monitoring should occur periodically to provide additional data regarding the impairment status of these waterbodies.
- Ensure sufficient sample collection from REC2 Only waters to assess compliance with antidegradation targets established per the BPA.

These general principles provide the foundation for the development of the SAR RMP, which prioritizes waterbodies as follows:

- *Priority 1*: Establish a monitoring program that can determine whether bacteria levels are "safe" at those locations where and when people are most likely to engage in water contact recreation. These waters are all Tier A waters per the 2012 BPA (Note: A Priority 1 water may also include impaired waterbodies that are designated Tier A REC1 Waters).
- *Priority 2:* Focus monitoring resources on those waterbodies that have been identified as "impaired" due to excessive bacterial indicator concentrations and a TMDL has already been adopted (Note: A Priority 2 water may also be Priority 1 because it is also a Tier A REC1 Water). Monitoring in these waters focuses on evaluating progress toward attainment with the water quality standard for these impaired waters.
- *Priority 3:* Monitor 303(d)-listed or impaired waterbodies where a TMDL has not yet been developed. For these Priority 3 sites, the RMP includes periodic sample collection for 5 consecutive weeks on an annual basis. Data from Priority 3 sites are used to evaluate compliance with the Santa Ana region *E. coli* water quality objective.
- *Priority 4*: Collect the bacteria indicator data needed to implement the antidegradation targets that have been established for waterbodies designated as REC2 Only. Data from Priority 4 sites are used to evaluate compliance with the site-specific antidegradation targets (Table 1-1).

1.2.2 Monitoring Plan and Quality Assurance Project Plan

To support the watershed-wide SAR RMP, the MSAR TMDL Task Force was expanded to include SAR watershed stakeholders and formed the MSAR TMDL / Regional Water Quality Monitoring Task Force (Task Force). The Task Force stakeholders worked collaboratively to prepare the SAR RMP Monitoring Plan and QAPP[9] to support this monitoring program. The monitoring program documents were updated on June 28, 2019.

1.2.3 Annual Report

This Annual Report summarizes the results of the 2020-2021 monitoring efforts. Annual Reports summarizing monitoring efforts from 2016-2019 are available from SAWPA.[10] Previous seasonal water quality reports prepared only for the sites subject to the MSAR Bacteria TMDL (2007 – 2015) are also available.[11]

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[9] SAR RMP Monitoring Plan and QAPP, Version 2.0, August 2019: http://sawpa.org/task-forces/regional-water-quality-monitoring-task-force/#geographic-setting

[10] SAR RMP Annual Monitoring Reports 2016-2018: https://sawpa.org/task-forces/regional-water-quality-monitoring-task-force/#geographic-setting

[11] http://www.sawpa.org/task-forces/middle-santa-ana-river-watershed-tmdl-taskforce/

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Section 2

Santa Ana River Study Area

This section describes the study area and identifies the monitoring locations sampled during the 2020-2021 monitoring year. The Monitoring Plan and QAPP provide a more detailed characterization of the watershed.

2.1 Physical Characteristics

The Santa Ana River watershed encompasses approximately 2,840 square miles of Orange, Riverside, San Bernardino, and a small portion of Los Angeles Counties (Figure 2-1). The mainstem Santa Ana River is the primary waterbody in the watershed. It flows in a generally southwest direction for nearly 100 miles from its headwaters to the Pacific Ocean.

2.1.1 MSAR Bacteria TMDL

Currently, one bacteria TMDL has been adopted for inland freshwater streams in the Santa Ana River Watershed, the MSAR Bacteria TMDL, which was adopted by Santa Ana Water Board in 2005[12] and became effective when approved by the EPA on May 16, 2007. Due to exceedances of the fecal coliform objective established to protect REC1 use during the 1990s, the Santa Ana Water Board added the following waterbodies in the MSAR watershed to the state 303(d) list of impaired waters.

- Santa Ana River, Reach 3 – Prado Dam to Mission Boulevard
- Chino Creek, Reach 1 – Santa Ana River confluence to beginning of hard lined channel south of Los Serranos Road
- Chino Creek, Reach 2 – Beginning of hard-lined channel south of Los Serranos Road to confluence with San Antonio Creek
- Mill Creek (Prado Area) – Natural stream from Cucamonga Creek Reach 1 to Prado Basin
- Cucamonga Creek, Reach 1 – Confluence with Mill Creek to 23rd Street in City of Upland
- Prado Park Lake

The TMDL established compliance targets for both fecal coliform and *E. coli*:

- Fecal coliform: 5-sample/30-day logarithmic mean less than 180 organisms/100 mL and not more than 10 percent of the samples exceed 360 organisms/100 mL for any 30-day period.
- *E. coli*: 5-sample/30-day logarithmic mean less than 113 organisms/100 mL and not more than 10 percent of the samples exceed 212 organisms/100 mL for any 30-day period.

[12] Santa Ana Water Board Resolution: R8-2005-0001, August 26, 2005

Per the TMDL, the above compliance targets for fecal coliform become ineffective upon EPA approval of the BPA.[13]

To focus MSAR Bacteria TMDL implementation activities, stakeholders established the MSAR Watershed TMDL Task Force (MSAR TMDL Task Force) to coordinate TMDL implementation activities designed to manage or eliminate sources of bacterial indicators to waterbodies listed as impaired. The MSAR TMDL Task Force includes representation by key watershed stakeholders, including urban stormwater dischargers, agricultural operators, and the Santa Ana Water Board.

The MSAR Bacteria TMDL required urban and agricultural dischargers to implement a watershed-wide bacterial indicator compliance monitoring program by November 2007.[14] Stakeholders worked collaboratively through the MSAR TMDL Task Force to develop this program and prepared the MSAR Water Quality Monitoring Plan and associated Quality Assurance Project Plan (QAPP) for submittal to the Santa Ana Water Board. The MSAR TMDL Task Force implemented the TMDL monitoring program in July 2007; the Santa Ana Water Board formally approved the monitoring program documents in April 2008.[15] This TMDL monitoring program has been incorporated into the SAR RMP.

The MSAR Bacteria TMDL also required the development and implementation of source evaluation plans by urban and agricultural dischargers within six months of the TMDL effective date. These urban and agricultural source evaluations plans (USEP and AgSEP, respectively) were approved by the Santa Ana Water Board in 2008. These programs were incorporated into the SAR Watershed Bacteria Monitoring Program Monitoring Plan and QAPP.[16]

2.1.2 Major Geographic Subareas

The Santa Ana River watershed can be divided into three major geographic subareas:

- San Jacinto River and Temescal Creek Region – This area covers much of the south central and southeastern portions of the watershed and is located mostly within Riverside County. The San Jacinto River drains an area of approximately 780 square miles to Canyon Lake and Lake Elsinore. Often flows from the upper San Jacinto River watershed are captured by Mystic Lake, which is a natural sump or hydrologic barrier to flows moving further downstream to Canyon Lake or Lake Elsinore. Downstream of Lake Elsinore, Temescal Creek carries surface flow, when it occurs, from below Lake Elsinore to where it drains into the Prado Basin Management Zone.

- Santa Ana River above Prado Dam and Chino Basin Region – This area includes much of the north central and northeastern portions of the watershed and is located mostly within San Bernardino County. This region drains to the Prado Basin Management Zone where Prado Dam captures all surface flows from this region and the Temescal Creek watershed.

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[13] Page 3 of 15 of Attachment A to Santa Ana Water Board Resolution R8-2005-0001

[14] Page 6 of 15, Table 5-9y of Attachment A to Santa Ana Water Board Resolution R8-2005-0001

[15] Santa Ana Water Board Resolution: R8-2008-0044; April 18, 2008

[16] SAR Monitoring Plan and QAPP Version 2.0 August 2019: http://www.waterboards.ca.gov/santaana/water_issues/programs/basin_plan/recreational_standards.shtml

The Santa Ana River headwaters are located in the San Bernardino Mountains in the northeastern part of the watershed. Major tributaries to the Santa Ana River in this region include Warm Creek, Lytle Creek, and San Timoteo Creek.

In the north central portion, several major Santa Ana River tributaries arise in the San Gabriel Mountains and drain generally south into the Chino Basin before their confluence with the Santa Ana River, including Day Creek, Cucamonga Creek and San Antonio Creek. Many of these drainages carry little to no flow during dry conditions because of the presence of extensive recharge basins in this region.

The Prado Basin Management Zone above Prado Dam is a flood control basin that captures all flows from the upper part of the Santa Ana River Watershed. For the most part the basin is an undisturbed, dense riparian wetland.

- Santa Ana River below Prado Dam and Coastal Plains Region – This area covers the western portion of the Santa Ana River watershed and includes coastal waterbodies that are not part of the Santa Ana River drainage area. This area is located within Orange County. Below Prado Dam the Santa Ana River flows through the Santa Ana Mountains before crossing the coastal plain and emptying into the Pacific Ocean near Huntington Beach. Groundwater recharge areas near the City of Anaheim capture water in the Santa Ana River and the Santa Ana River is often dry below this area. Other watersheds on the Coastal Plain include Newport Bay, Anaheim Bay-Huntington Harbor, and Coyote Creek.

2.1.3 Middle Santa Ana River Watershed

The MSAR watershed exists within the region Santa Ana River above Prado Dam and Chino Basin Region and covers approximately 488 square miles. The MSAR watershed lies largely in the southwestern corner of San Bernardino County and the northwestern corner of Riverside County. A small part of Los Angeles County (Pomona/Claremont area) is also included. Per the TMDL, the MSAR watershed includes three sub–watersheds (Figure 2-2):

- Chino Basin (San Bernardino County, Los Angeles County, and Riverside Counties) – Surface drainage in this area, which is directed to Chino Creek and Mill-Cucamonga Creek, flows generally southward, from the San Gabriel Mountains, and west or southwestward, from the San Bernardino Mountains, toward the Santa Ana River and the Prado Management Zone.

- Riverside Watershed (Riverside County) – Surface drainage in this area is generally westward or southeastward from the City of Riverside and the community of Rubidoux to Reach 3 of the Santa Ana River.

- Temescal Canyon Watershed (Riverside County) – Surface drainage in this area is generally northwest to Temescal Creek (however, note that Temescal Creek is not included as an impaired waterbody in the MSAR Bacteria TMDL).

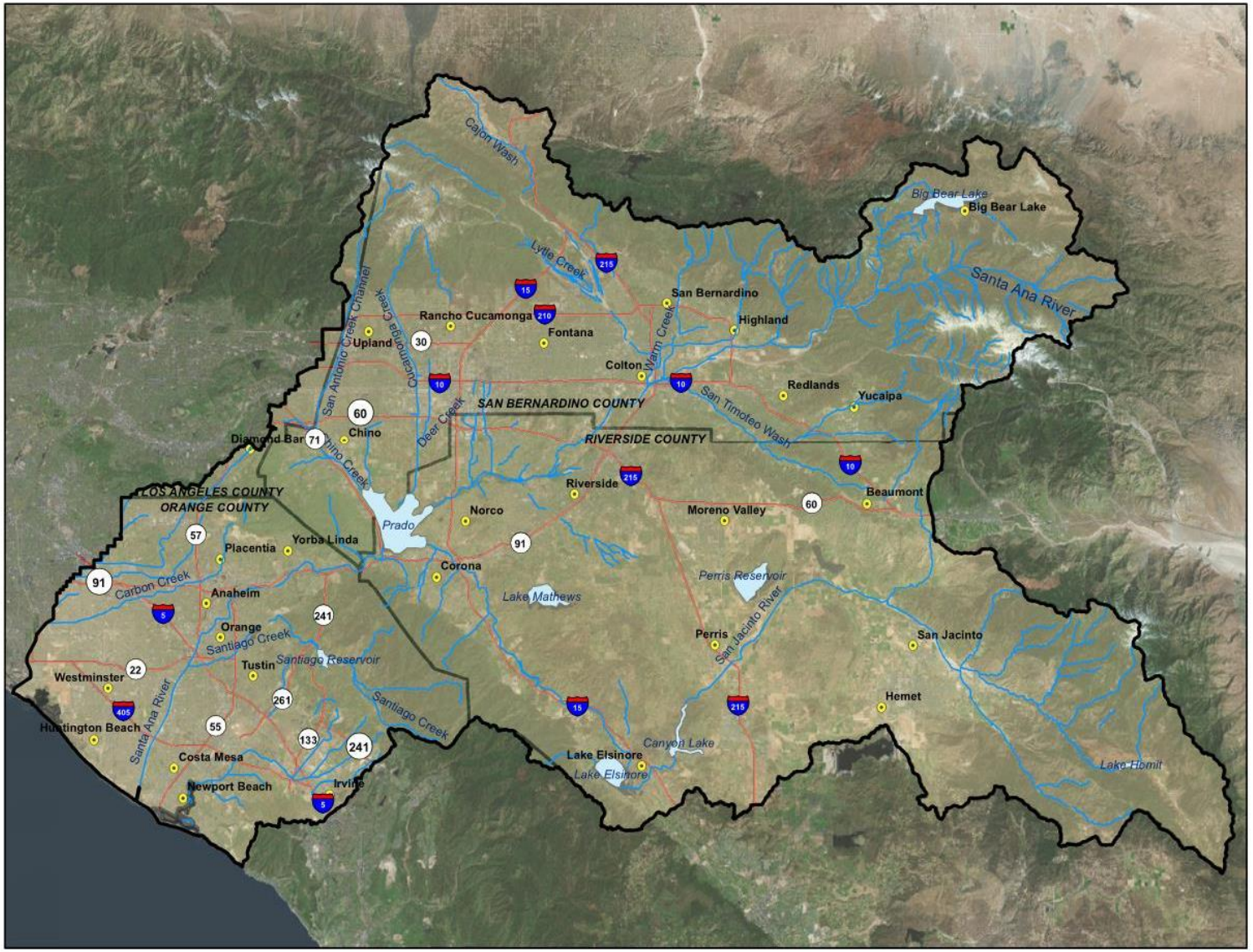

Figure 2-1. Santa Ana River Watershed and Location of Orange, Riverside and San Bernardino Counties (Source: SAWPA)

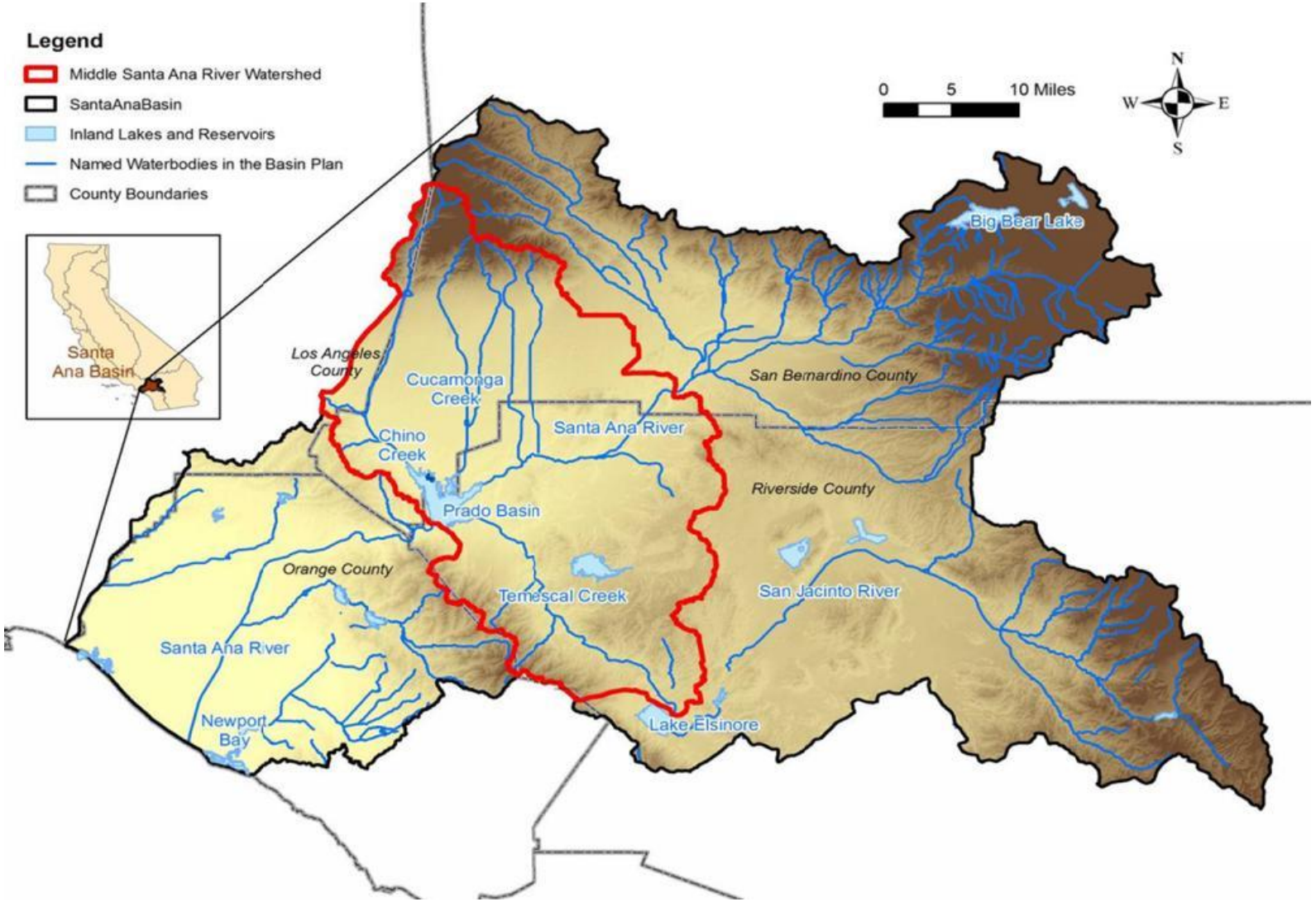

Figure 2-2. Middle Santa Ana River Watershed

Land uses in the MSAR watershed include urban, agriculture, and open space. Although originally developed as an agricultural area, the watershed continues to urbanize rapidly. Incorporated cities in the MSAR watershed include Chino, Chino Hills, Claremont, Corona, Eastvale, Fontana, Jurupa Valley, Montclair, Norco, Ontario, Pomona, Rancho Cucamonga, Rialto, Riverside, and Upland. In addition, there are several pockets of urbanized unincorporated areas. Open space areas include National Forest lands and State Park lands.

2.1.4 Rainfall

Rainfall varies considerably across the watershed with highest average rainfall occurring in the upper mountain areas of the watershed (San Gabriel, San Bernardino, and San Jacinto mountains) (Figure 2-3). Historical average annual rainfall in the northern and eastern areas can be more than 35 inches but is much lower in the lowland regions and central parts of the watershed. In these areas that include Chino and Prado Basin, average annual rainfall ranges from approximately 11 to 19 inches.

Key rainfall gages in the SAR watershed were identified and considered representative of the variability across the watershed (Figure 2-4). Table 2-1 provides the locations of key rainfall gages in the watershed[17] and Table 2-2 summarizes the total monthly rainfall data from each location for the 2020-2021 monitoring year.

Table 2-1. Location of Key Rainfall Gages in the SAR Watershed

Station No.	Station Name	Source	Latitude	Longitude
178	Riverside North	RCFC&WCD	34.0028	-117.3778
179	Riverside South	RCFC&WCD	33.9511	-117.3875
35	Corona	RCFC&WCD	33.8450	-117.5744
131	Norco	RCFC&WCD	33.9215	-117.5724
067	Elsinore	RCFC&WCD	33.6686	-117.3306
90	Idyllwild	RCFC&WCD	33.7472	-116.7144
9022	Fawnskin	SBCFCD	34.2726	-116.9718
2965	Lytle Creek Canyon	SBCFCD	34.2164	-117.4553
2808	Highland Plunge Creek	SBCFCD	34.1120	-117.1278
61	Tustin-Irvine Ranch	OCPW	33.7200	-117.7231
169	Corona del Mar	OCPW	33.6093	-117.8583
219	Costa Mesa Water District	OCPW	33.6453	-117.9336
163	Yorba Reservoir	OCPW	33.8719	-117.8112
5	Buena Park	OCPW	33.8571	-117.9923

[17] Data provided by Orange County Public Works (OCPW), Riverside County Flood Control & Water Conservation District (RCFC&WCD), and San Bernardino County Flood Control District (SBCFCD)

Table 2-2. Monthly Rainfall Totals (inches) During 2020 at Key Rainfall Gages

Station No.	Rainfall Gage	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
178	Riverside North	0.12	0.14	3.74	2.63	0.00	0.00	0.00	0.00	0.00	0.00	0.37	1.35	8.35
179	Riverside South	0.09	0.06	4.21	2.93	0.00	0.00	0.00	0.00	0.00	0.00	0.11	1.22	8.62
35	Corona	0.12	0.28	4.75	4.00	0.00	0.03	0.00	0.00	0.00	0.01	0.47	1.76	11.42
131	Norco	0.13	0.02	3.53	3.05	0.00	0.00	0.00	0.00	0.00	0.00	0.11	1.19	8.03
67	Elsinore	0.29	0.26	3.19	2.46	0.00	0.02	0.00	0.00	0.00	0.00	0.35	1.08	7.65
90	Idyllwild	0.54	0.87	6.22	3.87	0.14	0.02	0.00	0.08	0.00	0.03	1.76	1.95	15.48
9022	Fawnskin	0.36	0.00	4.96	3.11	0.04	0.00	0.00	0.75	0.00	0.00	0.86	0.44	10.52
2965	Lytle Creek Canyon	0.20	0.20	4.60	5.60	0.00	0.00	0.00	0.00	0.00	0.00	1.61	2.17	14.38
2808	Highland Plunge Creek	0.04	1.14	5.36	5.00	0.00	0.03	0.00	0.00	0.00	0.00	1.10	1.34	14.01
61	Tustin-Irvine Ranch	0.72	3.73	4.86	0.13	0.26	0.00	0.00	0.00	0.00	0.27	1.1	2.41	13.48
169	Corona del Mar	0.38	3.13	3.74	0.11	0.02	0.01	0.00	0.02	0.00	0.58	0.84	2.14	10.97
219	Costa Mesa Water District	0.1	3.16	2.7	0.04	0.00	0.00	0.00	0.00	0.02	0.33	0.85	1.92	13.48
163	Yorba Reservoir	0.1	3.99	3	0.29	0.02	0.00	0.00	0.00	0.00	0.2	2.03	1.97	11.6
5	Buena Park	0.25	2.86	2.33	0.04	0.01	0.00	0.00	0.00	0.00	0.13	1.85	1.68	9.15

During the 2020 monitoring season, rainfall varied throughout the watershed with heavier precipitation recorded in the upper watershed and during winter months. While, smaller storms occurred during the summer months, all dry weather monitoring adhered to the dry weather condition established in the Monitoring Plan, which states that dry weather samples be collected only if there is no measurable rainfall in the preceding 72-hour period.

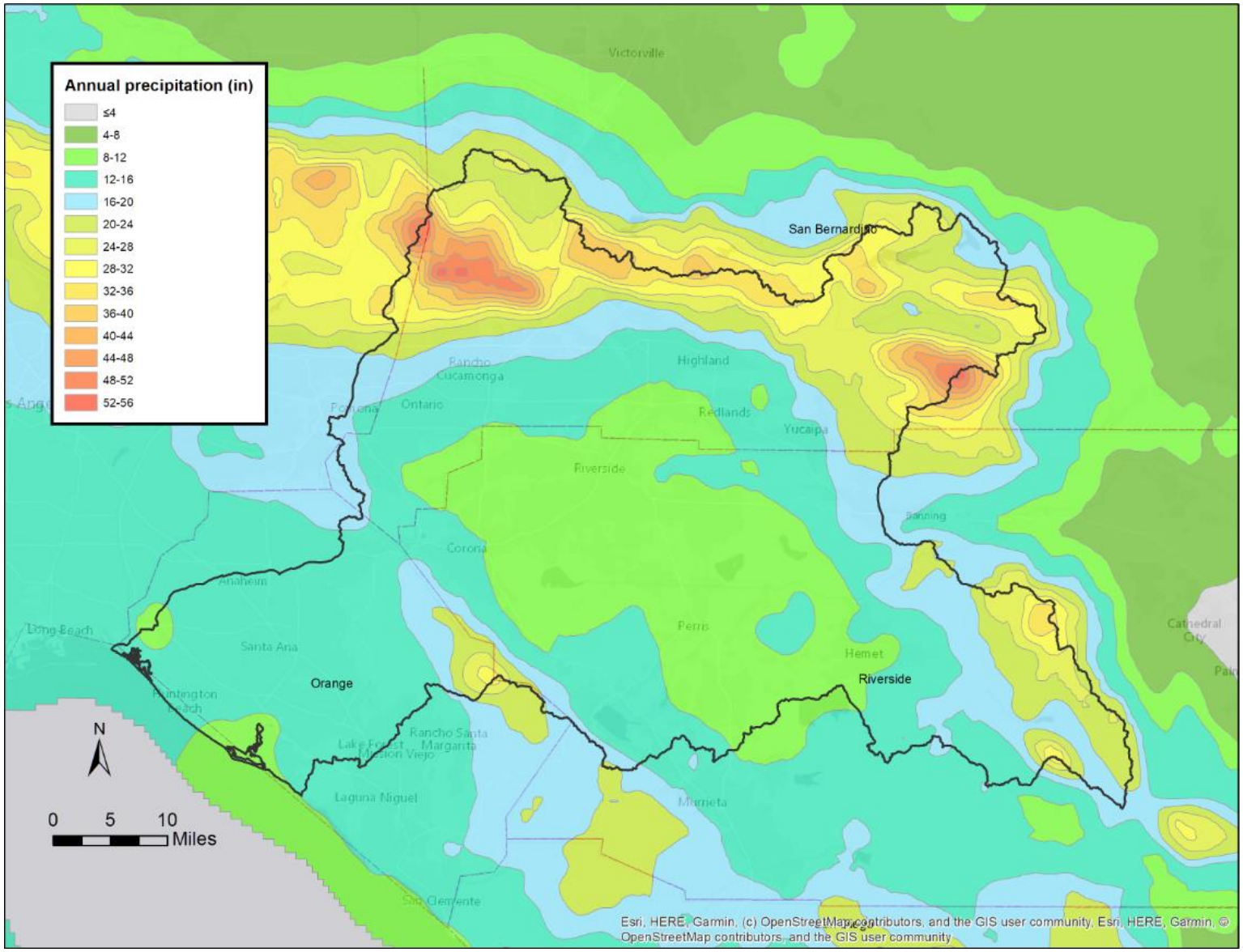

Figure 2-3. Historical Average Annual Rainfall in the Santa Ana River Watershed from 1980-2019

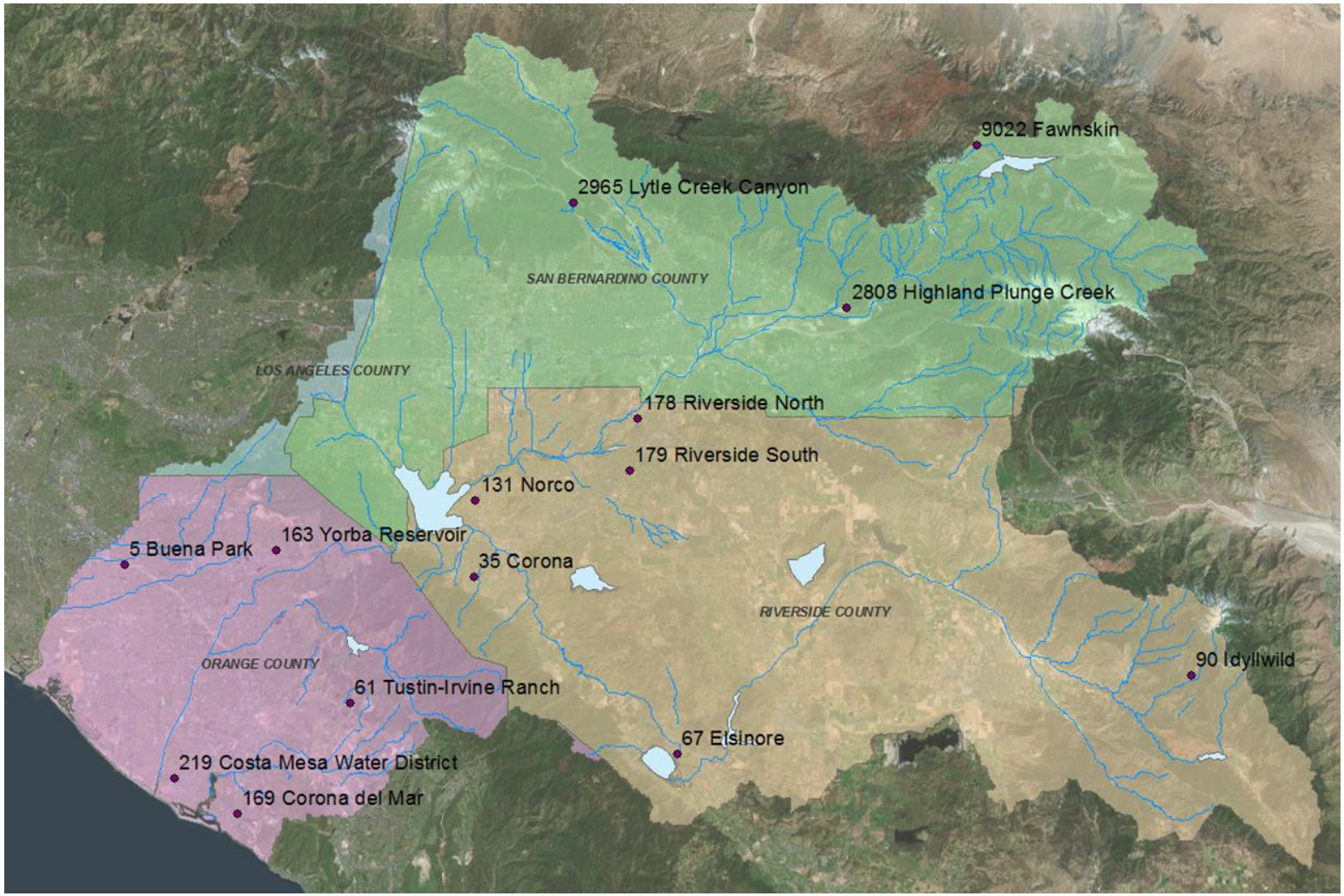

Figure 2-4. Key Rainfall Gages

2.2 Monitoring Locations

The following sections describe the monitoring sites based on priority designations described in Section 1.2.1.

2.2.1 Priority 1

Eight monitoring sites, identified as REC1 Tier A waters, are included for Priority 1 monitoring. This includes four lakes: Big Bear Lake, Lake Perris, Canyon Lake, and Lake Elsinore; and four flowing water sites: SAR Reach 3 (two sites), Lytle Creek, and Mill Creek Reach 2. Five sites are in Riverside County and two sites are in San Bernardino County (Table 2-3, Figure 2-5).

Because the two Priority 1 Santa Ana River sites (MWD Crossing and Pedley Avenue) are also MSAR Bacteria TMDL compliance sites (Table 2-4), data collected from these Priority 1 sites are also used for evaluating compliance with the MSAR Bacteria TMDL.

Table 2-3. Priority 1 REC 1 Tier A Monitoring Sites

Site ID	Site Description	County	Latitude	Longitude
P1-1	Canyon Lake at Holiday Harbor	Riverside	33.6808	-117.2724
P1-2	Lake Elsinore	Riverside	33.6753	-117.3674
P1-3	Lake Perris	Riverside	33.8614	-117.1908
P1-4	Big Bear Lake at Swim Beach	San Bernardino	34.2482	-116.9034
P1-5	Mill Creek Reach 2	San Bernardino	34.0891	-116.9247
P1-6	Lytle Creek (Middle Fork)	San Bernardino	34.2480	-117.5110
WW-S1	Santa Ana River Reach 3 at MWD Crossing	Riverside	33.9681	-117.4479
WW-S4	Santa Ana River Reach 3 at Pedley Avenue	Riverside	33.9552	-117.5327

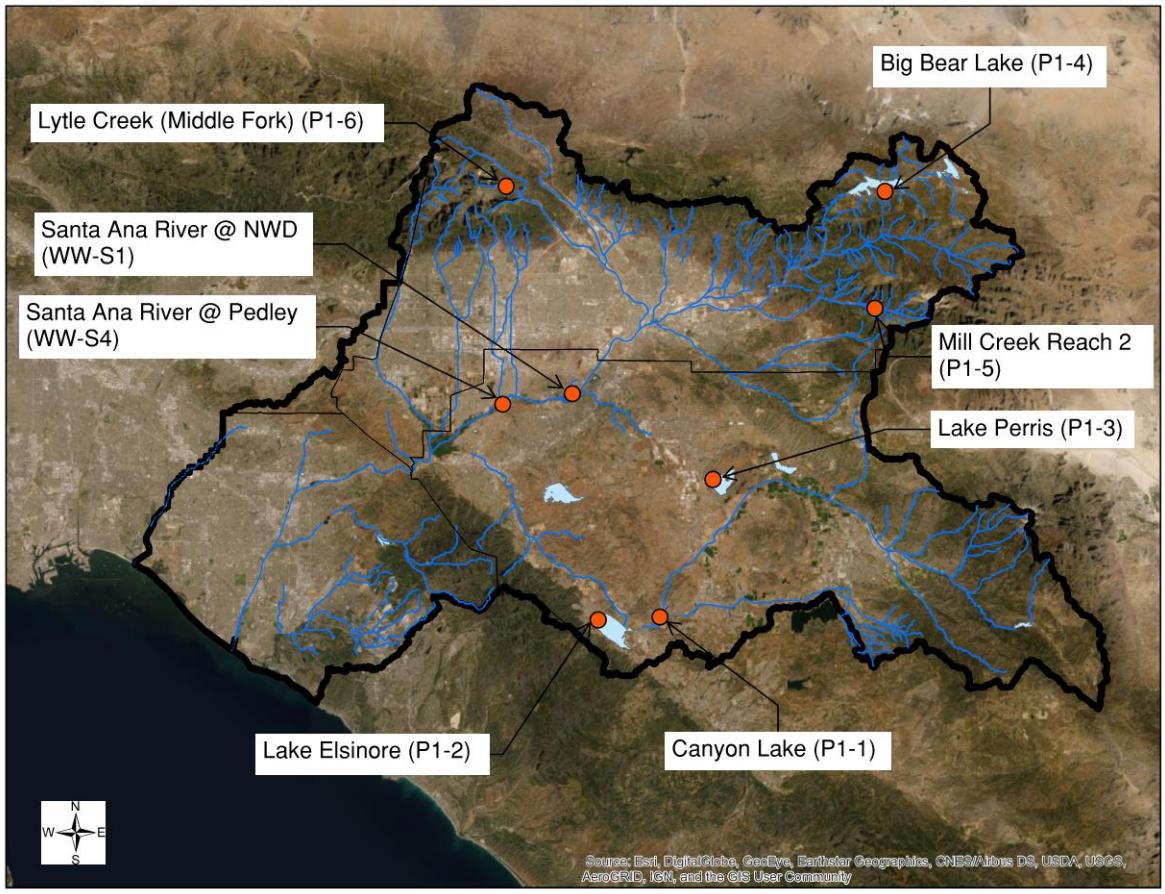

Figure 2-5. Priority 1 Monitoring Sites

2.2.2 Priority 2

Priority 2 monitoring sites are primarily the same monitoring sites previously established for evaluating compliance with the numeric targets in the MSAR Bacteria TMDL: two Santa Ana River Reach 3 sites (at MWD Crossing and at Pedley Avenue), and one site each on Mill-Cucamonga Creek, Chino Creek, and Prado Park Lake[18] (Table 2-4; Figure 2-6). As discussed in Section 2.2.1, the two Santa Ana River sites are also Priority 1 waters, i.e., as Tier A waters, they are locations where the risk of exposure to pathogens during recreational activities is highest.

Table 2-4. Priority 2 Monitoring Sites

Site ID	Site Description	County	Latitude	Longitude
WW-M6	Mil-Cucamonga Creek below Wetlands	San Bernardino	33.9268	-117.6250
WW-C7	Chino Creek at Central Avenue	San Bernardino	33.9737	-117.6889
WW-C3	Prado Park Lake	San Bernardino	33.9400	-117.6473
WW-S1	Santa Ana River Reach 3 at MWD Crossing	Riverside	33.9681	-117.4479
WW-S4	Santa Ana River Reach 3 at Pedley Avenue	Riverside	33.9552	-117.5327
MISSION	Santa Ana River at Mission Blvd. Bridge	Riverside	33.9906	-117.3951

[18] See Section 4.1.1 in the Monitoring Plan for the original basis for the selection of these monitoring sites.

Figure 2-6. Priority 2 Monitoring Sites

2.2.3 Priority 3

In the Santa Ana River watershed, 23 waterbodies are currently on the 303(d) List as impaired for indicator bacteria, but no TMDL has been adopted. Eight waterbodies were not included in the original RMP for reasons described in Section 3.3.3.2 of the Monitoring Plan. Of the thirteen waterbodies that are monitored in the RMP in 2020-2021, nine are in Orange County, one in Riverside County, and one in San Bernardino County (Figure 2-7). Table 2-5 provides the location of each Priority 3 monitoring site. Previous water quality data and the basis for listing these monitoring sites are described in the Monitoring Plan.

Table 2-5. Priority 3 Monitoring Sites

Site ID	Site Description	County	Latitude	Longitude
P3-OC1	Bolsa Chica Channel upstream of Westminster Blvd/Bolsa Chica Rd	Orange	33.7596	-118.0430
P3-OC2	Borrego Creek upstream of Barranca Parkway	Orange	33.6546	-117.7321
P3-OC3	Buck Gully Creek Little Corona Beach at Poppy Avenue/Ocean Blvd	Orange	33.5900	-117.8684
P3-OC5	Los Trancos Creek at Crystal Cove State Park	Orange	33.5760	-117.8406
P3-OC6	Morning Canyon Creek at Morning Canyon Beach	Orange	33.5876	-117.8658
P3-OC7	Peters Canyon Wash downstream of Barranca Parkway	Orange	33.6908	-117.82404
P3-OC8	San Diego Creek downstream of Campus Drive (Reach 1)	Orange	33.6553	-117.8454
P3-OC9	San Diego Creek at Harvard Avenue (Reach 1)	Orange	33.6880	-117.8187
P3-OC11	Serrano Creek upstream of Barranca/Alton Parkway	Orange	33.6483	-117.7248
P3-RC1	Goldenstar Creek at Ridge Canyon Drive	Riverside	33.8964	-117.3586
P3-SBC1	Santa Ana River Reach 4 above S. Riverside Avenue Bridge	San Bernardino	34.0248	-117.3628
P3-SBC2	San Timoteo Creek Reach 1A at Anderson St.	San Bernardino	34.0615	-117.2629
P3-SBC3	San Timoteo Creek Reach 2 at San Timoteo Canyon Rd.	San Bernardino	34.0615	-117.2629
P3-SBC4	Warm Creek below Fairway Dr.	San Bernardino	34.0646	-117.3072

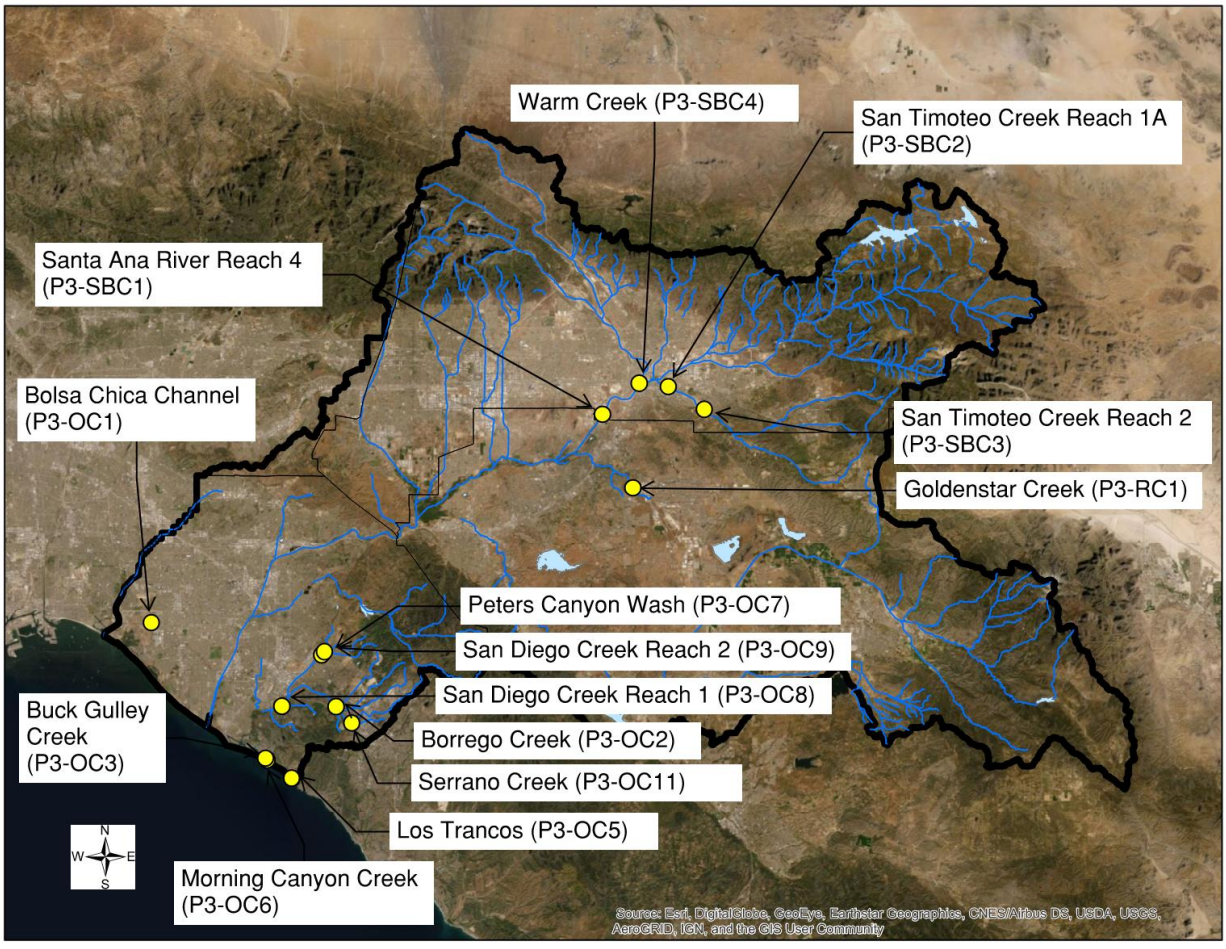

Figure 2-7. Priority 3 Monitoring Sites

2.2.4 Priority 4

Four waterbodies designated REC2 Only as a result of approved UAAs were monitored as Priority 4 sites. San Bernardino County and Riverside County each have one Priority 4 waterbody. The remaining wo Priority 4 waterbodies are in Orange County with one waterbody having two sites. These sites are summarized in Table 2-6 and Figure 2-8 and described as follows:

- *Santa Ana Delhi Channel* – The Santa Ana Delhi Channel has two reaches (Reaches 1 and 2) that are REC2 Only. Two monitoring sites were selected for the Santa Ana Delhi Channel to provide sample results from freshwater and tidal prism areas: (a) upstream of Irvine Avenue (P4-OC1); and (b) within the tidal prism at the Bicycle Bridge (P4-OC2).
- *Greenville-Banning Channel Tidal Prism Segment* – The 1.2-mile segment extending upstream of the confluence between Santa Ana River and Greenville-Banning Channel is designated REC2 Only. The monitoring site is located at an access ramp approximately 60 meters downstream of the trash boom below the rubber diversion dam.
- *Temescal Creek* – The monitoring site is located on the concrete section of Temescal Channel just upstream of the Lincoln Avenue Bridge.
- *Cucamonga Creek Reach 1* – Cucamonga Creek Reach 1 extends from the confluence with Mill Creek in the Prado area to near 23rd Street in the City of Upland. The monitoring site for Cucamonga Creek Reach 1 is at Hellman Road.

Table 2-6. Priority 4 Monitoring Sites

Site ID	Site Description	County	Latitude	Longitude
P4-RC2	Temescal Creek at Lincoln Avenue	Riverside	33.8941	-117.5772
P4-OC1	Santa Ana Delhi Channel Upstream of Irvine Avenue	Orange	33.6602	-117.8810
P4-OC2	Santa Ana Delhi Channel in Tidal Prism	Orange	33.6529	-117.8837
P4-OC3	Greenville-Banning Channel in Tidal Prism	Orange	33.6594	-117.9479
P4-SBC1	Cucamonga Creek at Hellman Avenue	San Bernardino	33.9493	-117.6104

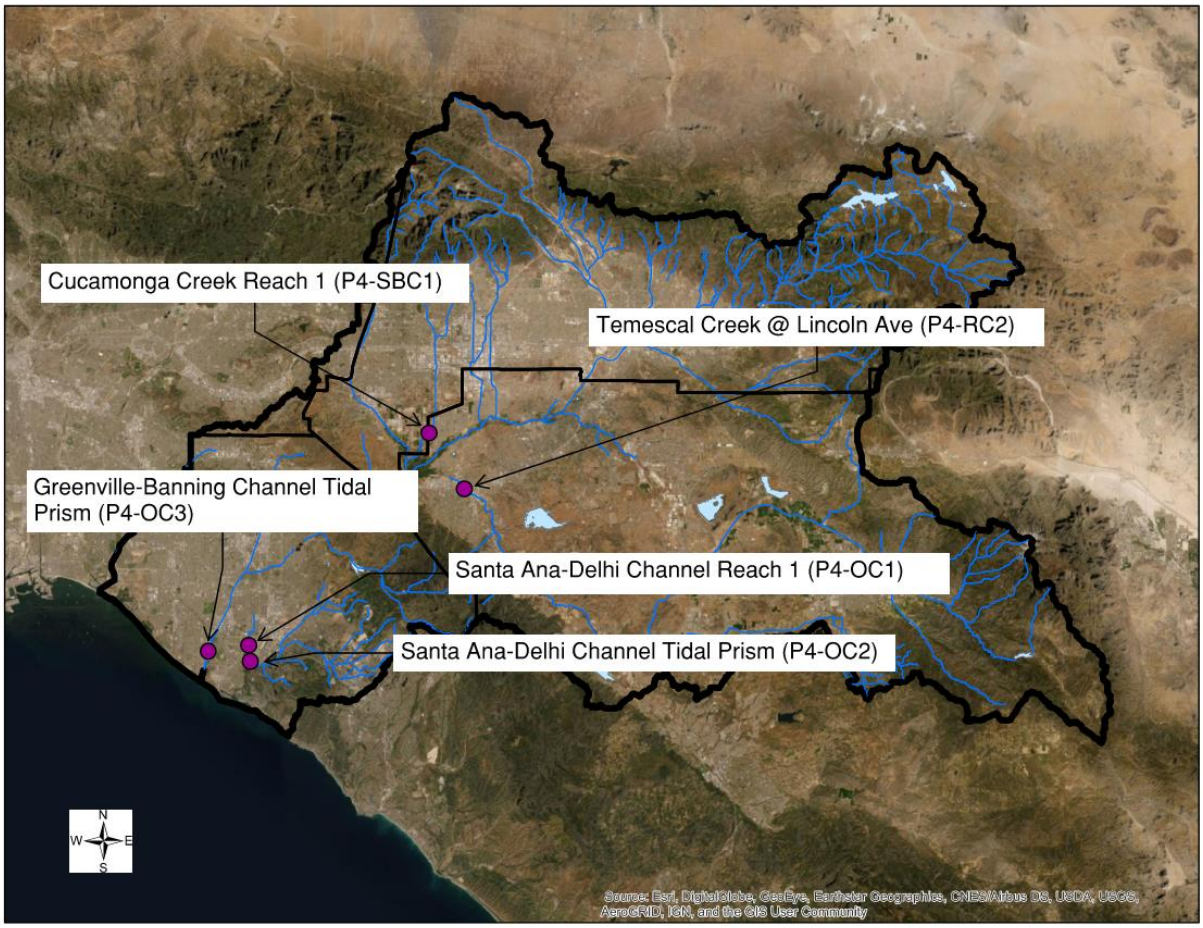

Figure 2-8. Priority 4 Monitoring Sites (top: Riverside County and San Bernardino County; bottom: Orange County)

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Section 3
Methods

The RMP Monitoring Plan and QAPP provide detailed information regarding the collection and analysis of field measurements and water quality samples. The following sections provide a summary of these methods.

3.1 Sample Frequency

3.1.1 Dry Weather

Dry weather sample collection occurs during both warm, dry (April 1 – September 30) and cool, dry (October 1 – November 30) season periods. Sample collection target schedule dates for each year of the monitoring program are established in Section 3.3 of the Monitoring Plan and are summarized in this section. Dry weather, warm season monitoring was conducted at most sites over a 20-week period from May 10 through September 20, 2020. Dry weather, cool season monitoring occurred over a five-week period from October 18, through November 22, 2020. Dry weather conditions are defined as no measurable rainfall within a 72-hour period prior to sampling.

During dry weather monitoring, the frequency of sample collection for each priority level varies as follows:

- Priority 1 and Priority 2 sites were monitored weekly for 20 consecutive weeks during the warm, dry season and for five consecutive weeks during the cool, dry season.
- Priority 3 sites were monitored weekly for five consecutive weeks during the warm or cool, dry seasons. The fourteen Priority 3 sites were separated into five groups to maximize efficiency during sample collection periods.
- Priority 4 sites were sampled once per year between June 21 and September 21. Greenville Banning Channel (P4-OC3) did not meet the site-specific antidegradation target in 2020 and required three monthly follow-up samples. All other Priority 4 sites met their antidegradation targets in 2020 and did not require additional sampling.

3.1.2 Wet Weather

Wet weather sample collection occurs during the wet season (November 1 – March 31). Per the MSAR Bacteria TMDL, wet weather monitoring is conducted for one storm event per wet season. For each storm event, samples are collected from Priority 2 sites on the day of the storm event as well as 48, 72, and 96 hours after the onset of the storm. During the 2020-2021 wet season, the January 25, 2021 storm was monitored with samples collected on January 25, 27, 28, and 29, 2021.

3.1.3 Summary of Sample Collection Effort

In general, the 2020-2021 monitoring program was successful in meeting the requirements with the exception of some events where site conditions could not accommodate sampling. Differences between planned and executed sampling events are summarized in Table 3-1 and described as follows:

- Two sites (Borrego Creek and Los Trancos Creek) were dry during the monitoring period. Although field crews visited each site during each scheduled monitoring event, samples from those sites were not collected due to dry conditions.
- Additional samples were collected at Santa Ana River Reach 4 to continue developing an increased dataset for potential future delisting from the 303(d) List of Impaired Waters.
- Three samples were not collected from Mill Creek Reach 2 (P1-5) due to the proximity to the El Dorado fire causing the sampling access road to be inaccessible. The El Dorado fire occurred at the end of the warm, dry season and resampling later would not result in additional geomean calculations.
- Samples were not collected from Buck Gully (P3-OC3) and Morning Canyon (P3-OC6) due to ongoing coordination efforts between the Regional Board and the City of Newport.

Table 3-1. Summary of Water Quality Sample Collection Activity

Priority	Planned/Collected	Dry Weather	Wet Weather
Priority 1	Planned	200	0
	Collected	197[1]	0
Priority 2	Planned	150	20
	Collected	150	20
Priority 3	Planned	95	0
	Collected	85[2]	0
Priority 4	Planned	16	0
	Collected	19[3]	0

[1] Three samples were not collected at Mill Creek Reach 2 (P1-5) due to wildfires in the area
[2] Five samples were not collected at Borrego Creek (P3-OC2) and five samples were not collected from Los Trancos Creek (P3-OC5) as conditions were dry during each monitoring event.
[3] Three additional samples were collected at Greenville Banning Channel (P4-OC3) due to an exceedance of the antidegradation target.

3.2 Sample Analysis

Monitoring at each site included recording field measurements and collection of water quality samples. OCPW staff monitored all sites located in Orange County under their jurisdiction, while CDM Smith and CWE, on behalf of the MSAR TMDL / Regional WQ Monitoring Task Force, monitored all sites located in Riverside County and San Bernardino County. The following water quality data were gathered from each site:

- Field measurements: temperature, pH, dissolved oxygen (DO), conductivity, turbidity, and flow

- Laboratory analysis: total suspended solids (TSS), bacteria (E. coli or Enterococcus)
- E. coli is quantified at all but three sites in this Regional Monitoring Program where enterococcus is collected instead
- Enterococcus is quantified at Lake Elsinore (P1-2) and two Orange County sites, Santa Ana Delhi Channel in Tidal Prism (P4-OC2) and Greenville-Banning Channel in Tidal Prism (P4-OC3) due to persistence of salinities greater than 1ppt.

3.3 Sample Handling

Sample collection and laboratory delivery followed approved chain-of-custody (COC) procedures, holding time requirements, and required storage procedures for each water quality sample as described in the Monitoring Plan and QAPP. Samples collected from Riverside County and San Bernardino County were analyzed for *E. coli* and TSS concentrations by Babcock Laboratories (Babcock). Samples collected from Orange County by OCPW were analyzed by the Orange County Health Care Agency Water Quality Laboratory (OCPHL) for *E. coli* and by Weck Laboratories and Enthalpy Analytical for TSS. Appendix C includes a summary of quality assurance/quality control (QA/QC) activities conducted during the period covered by this report, including field blanks and field duplicates.

3.4 Data Handling

CDM Smith and SAWPA maintain a file of all laboratory and field data records (e.g., data sheets, chain-of-custody forms) as required by the QAPP. CDM Smith's field contractor, CWE, OCPW and the Santa Ana Water Board provided CDM Smith all field measurements and laboratory results, laboratory reports, field forms, photos, and COCs. CDM Smith compiled the field measurements and laboratory analysis results into a project database that is compatible with guidelines and formats established by the California Surface Water Ambient Monitoring Program for the California Environmental Data Exchange Network (CEDEN). CDM Smith conducts a QA/QC review of the data for completion and compatibility with the databases. After the QA/QC review, CDM Smith submits the data annually to CEDEN and to SAWPA.

3.5 Data Analysis

Data analysis relied primarily on the use of descriptive and correlation statistics. For any statistical analyses, the bacterial indicator data were assumed to be log-normally distributed as was observed in previous studies.[19] Accordingly, prior to conducting statistical analyses, the bacterial indicator data were log transformed.

[19] Middle Santa Ana River Bacterial Indicator TMDL Data Analysis Report, prepared by CDM Smith on behalf of the Task Force. March 19, 2009. http://www.sawpa.org/wp-content/uploads/2015/02/FinalDataAnalysisReport_033109.pdf

Section 4
Results

This section summarizes the results of data analyses of the 2020-2021 dataset, which includes the 2020 dry season and the 2020-2021 wet season. Where appropriate to provide context, data results are compared to water quality results previously reported for the same locations. Appendix A (Tables A-1 through A-34) summarizes the water quality results observed at each site throughout the sample period covered by this report.

E. coli concentrations observed at each site are summarized and compliance is assessed using water quality standards or antidegradation targets established by the BPA and numeric targets established by the MSAR Bacteria TMDL. Data analysis relied primarily on the use of descriptive and correlation statistics.

4.1 Priority 1

4.1.1 Water Quality Observations

Water quality parameters measured in the field during the warm, dry and cool, wet seasons at Priority 1 sites (Table 4-1) are summarized in Figures 4-1 through 4-7. Key observations are summarized as follows:

- Figure 4-1 shows that no Priority 1 sites had all of their pH measurements remain within the allowable pH range of 6.5 to 8.5; the water quality objective established in the Santa Ana Basin Plan. No sites had any measurements below the allowable range, with all exceedances measured at a value greater than 8.5. The highest exceedance percentage was seen at Lake Perris (P1-3) where 84 percent of the samples were greater than the allowable limit.
- Figure 4-2 shows distribution of water temperature by station demonstrating that water temperature has a direct relationship with cooler ambient air temperatures (median less than 20°C) at higher elevations and higher ambient air temperatures (median greater than 23°C) in lower elevations. Likewise, water temperature responds directly to the seasonal ambient temperatures of the wet and dry seasons.
- Figure 4-3 shows that the majority of DO levels range from 6 to 10 mg/L. WQOs for minimum DO for waterbodies with the WARM and COLD habitat beneficial use designations are 5 mg/L and 6 mg/L, respectively.[20] These standards were met at all Priority 1 sites except for 16 percent of measurements taken at Canyon Lake and 32 percent of measurements taken at Lake Elsinore.
- Conductivity (Figure 4-4) appears to vary based on geography as sites located in the upper portions of the watershed (Mill Creek Reach 2, Big Bear Lake, and Lytle Creek) have lower conductivity (less than 300 µS/cm at two sites and less than 500 µS/cm at Big Bear Lake) than sites located in the downstream portions of the watershed (500 to 1,100 µS/cm). Flow

[20] Basin Plan Chapters 3 and 4. WARM represents warm freshwater habitat while COLD represents cold freshwater habitat.

in waterbodies in the upper watershed generally consist of rain and snow melt, while flow in waterbodies in the lower watershed also include groundwater baseflow and runoff, which commonly have higher salt concentrations. Lake Elsinore exhibits particularly high conductivity (2,923 to 3,384 µS/cm), which is not unusual for a terminal lake.

- Turbidity for the eight sites were generally low with values ranging between 0 and 5 NTU. Stations with the greatest variability throughout the year were Lake Elsinore and Big Bear Lake (1 NTU to 32 NTU). Seasonal variability is higher in the lake monitoring sites as the warm samples typically result in higher values than the cool samples. This could be caused by swimmers, wildlife, and eutrophication.
- TSS at the eight sites were generally low at all eight sites. Similar to turbidity, TSS had the largest range for Lake Elsinore and Big Bear Lake (7 to 87 mg/L).
- Flow is lower at the upstream sites, Mill Creek Reach 2 (2 to 30 cubic feet per second [cfs]) and Lytle Creek (1 to 25 cfs). Flow is greatest at SAR at Pedley Avenue (16 to 111 cfs), which is fed by the other sites (Figure 4-7). Note that Figure 4-7 shows flow only for stream sites and does not include lake sites, where flow is not measured.

Table 4-1. Priority 1 Monitoring Sites

Site ID	Site Description	County
P1-1	Canyon Lake at Holiday Harbor	Riverside
P1-2	Lake Elsinore	Riverside
P1-3	Lake Perris	Riverside
P1-4	Big Bear Lake at Swim Beach	San Bernardino
P1-5	Mill Creek Reach 2	San Bernardino
P1-6	Lytle Creek (Middle Fork)	San Bernardino
WW-S1	Santa Ana River Reach 3 at MWD Crossing	Riverside
WW-S4	Santa Ana River Reach 3 at Pedley Avenue	Riverside

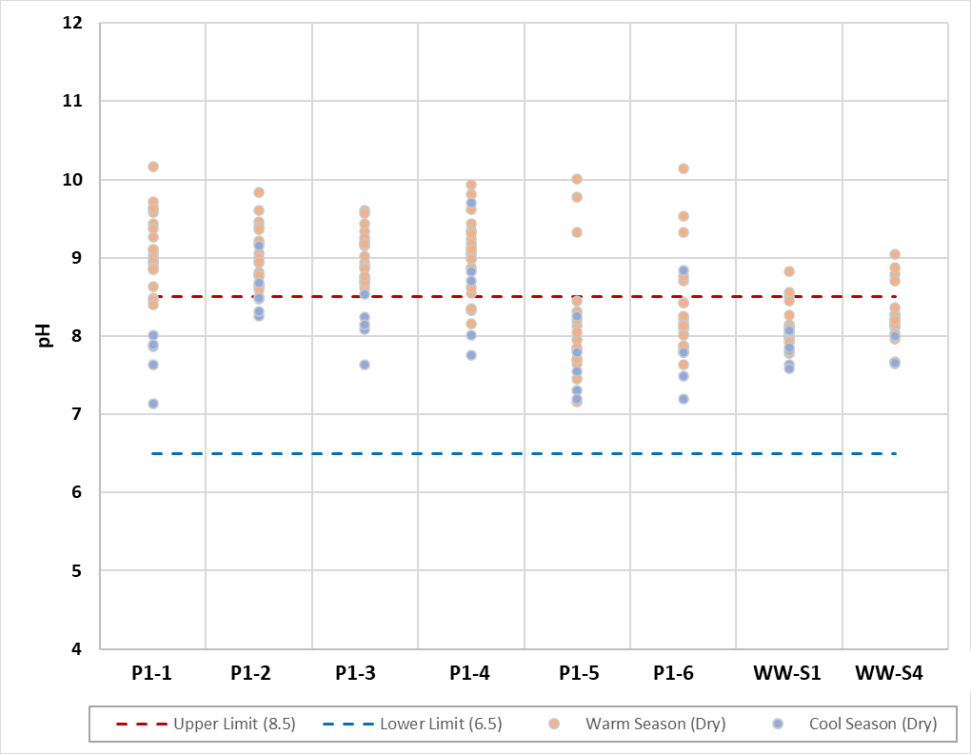

Figure 4-1. Distribution of pH Measurements at Priority 1 Sites

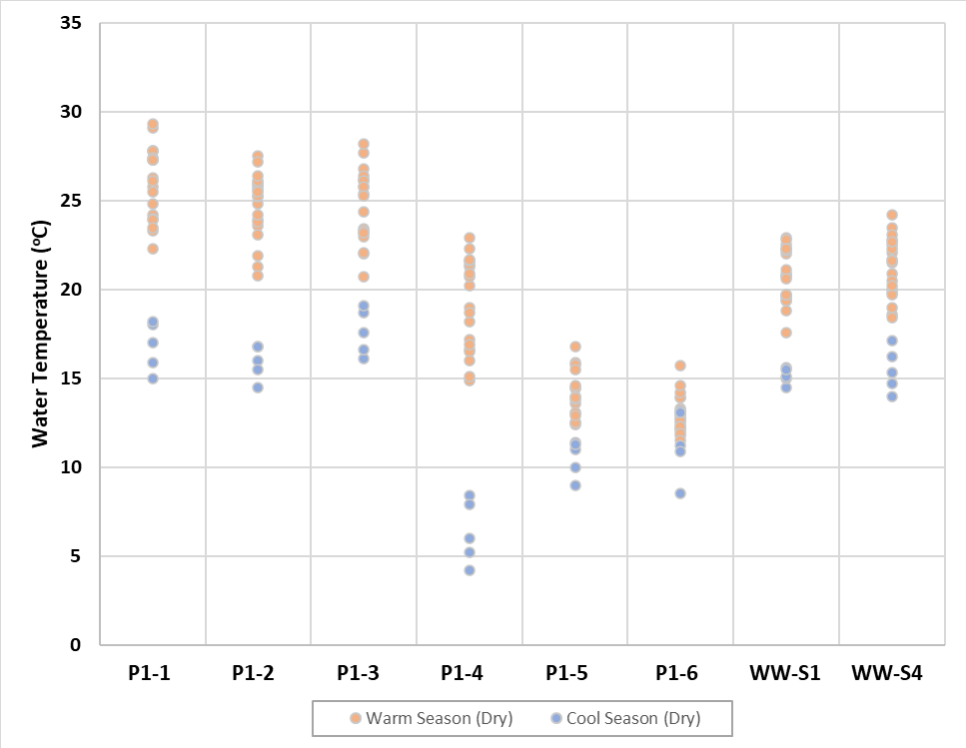

Figure 4-2. Distribution of Water Temperature Measurements at Priority 1 Sites

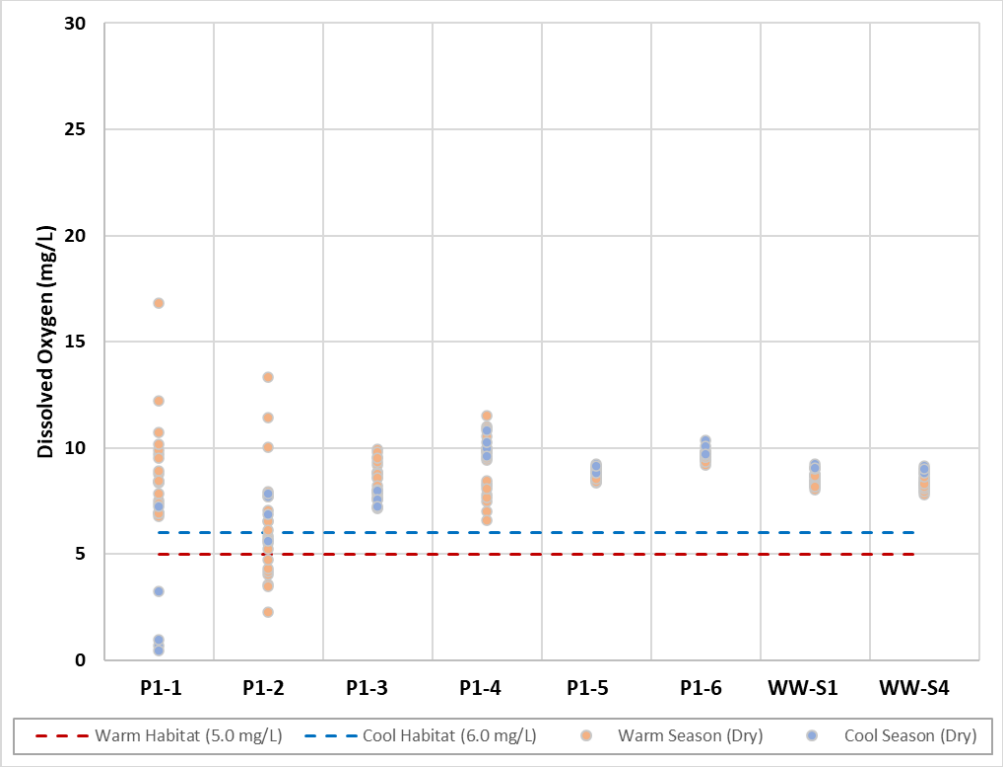

Figure 4-3. Distribution of Dissolved Oxygen Measurements at Priority 1 Sites

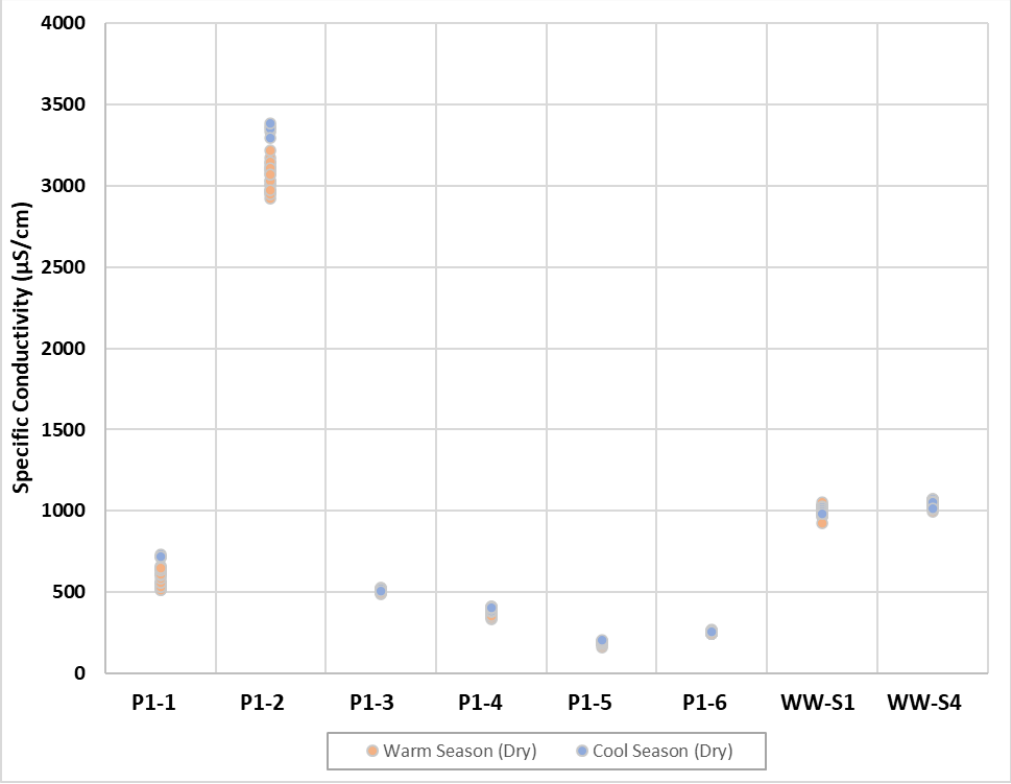

Figure 4-4. Distribution of Specific Conductivity Measurements at Priority 1 Sites

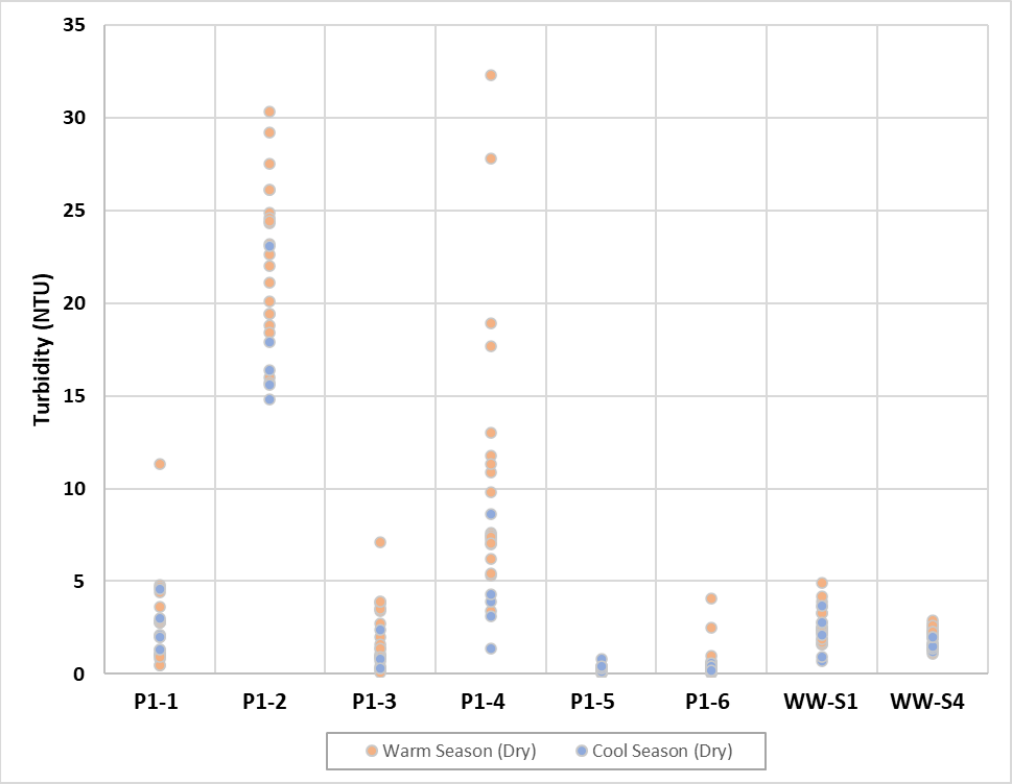

Figure 4-5. Distribution of Turbidity Measurements at Priority 1 Sites

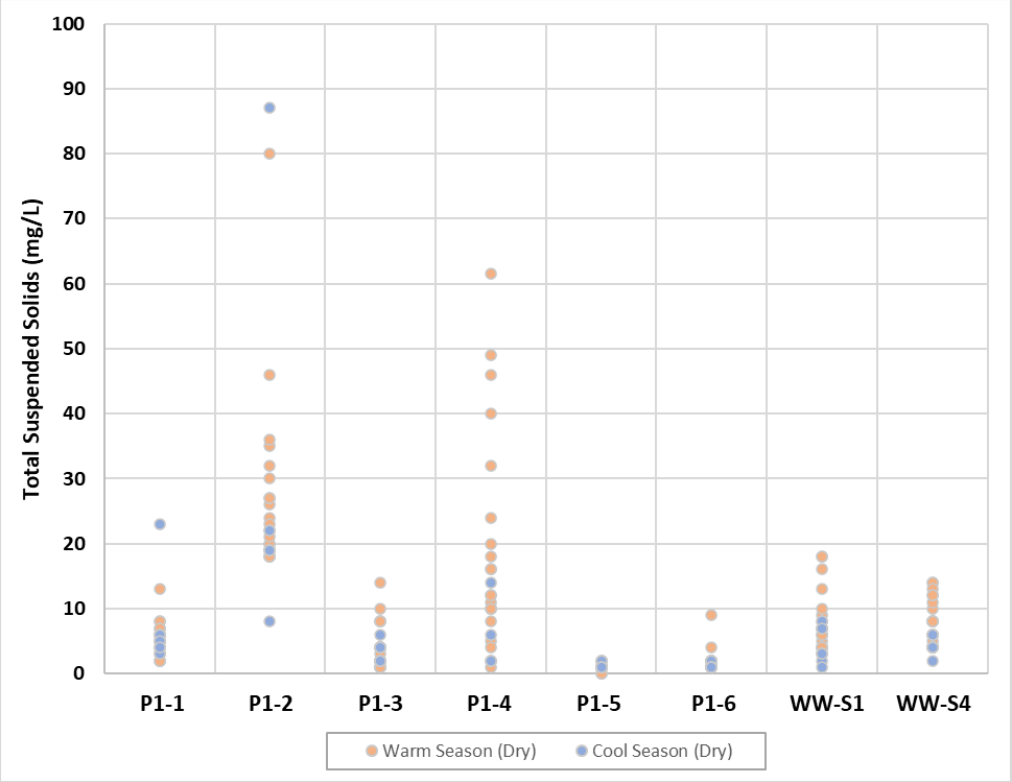

Figure 4-6. Distribution of TSS Measurements at Priority 1 Sites

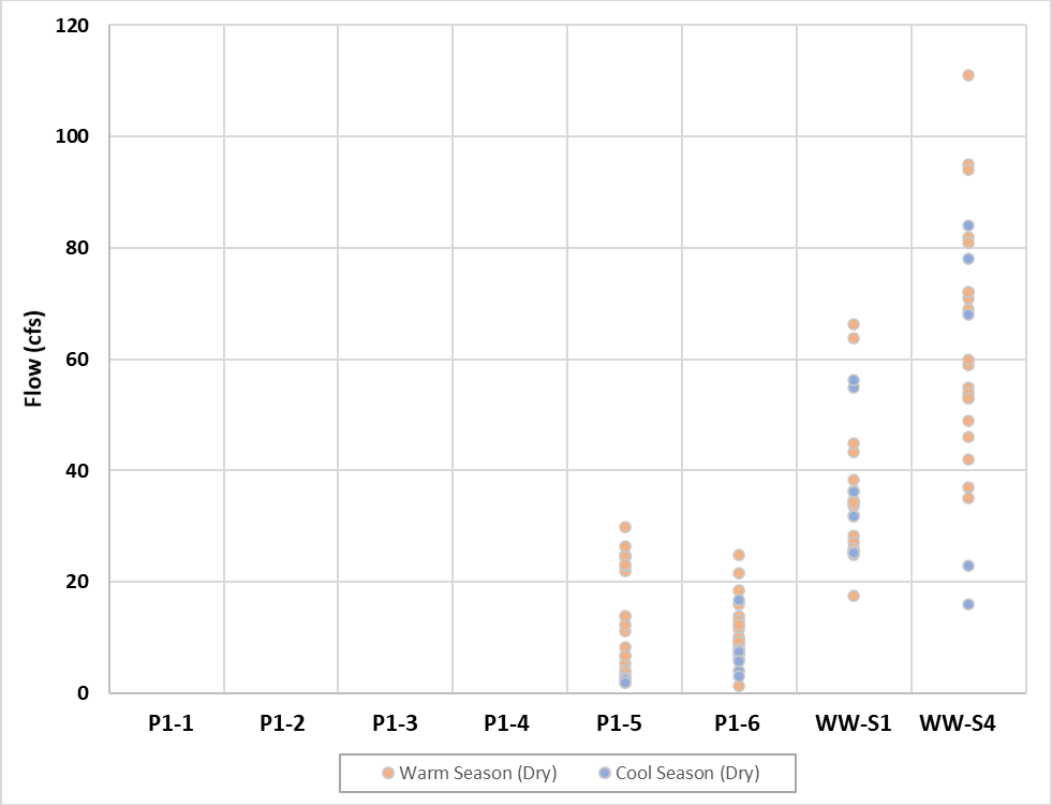

Figure 4-7. Distribution of Flow Measurements at Priority 1 Sites
**Note that lake sites are not monitored for flow*

4.1.2 Bacteria Characterization

Figure 4-8 presents the distribution of *E. coli* concentrations observed at Priority 1 sites during the warm, dry and cool, dry seasons.

Only the SAR sites had a few samples with *E. coli* levels above the STV single sample limit; the other sites had low concentrations of *E. coli*. All samples collected from Canyon Lake, Lake Elsinore, Big Bear Lake, Mill Creek Reach 2, and Lytle Creek were below the STV single sample limit of 320 MPN/100mL.

E. coli concentrations at the two SAR sites were consistently higher than concentrations at all other Priority 1 sites (Figure 4-8). All of the individual *E. coli* sample results from the six sites not located in SAR were less than 320 MPN/100 mL while 80 percent of the individual sample results from the two SAR sites were less than 320 MPN/100 mL.

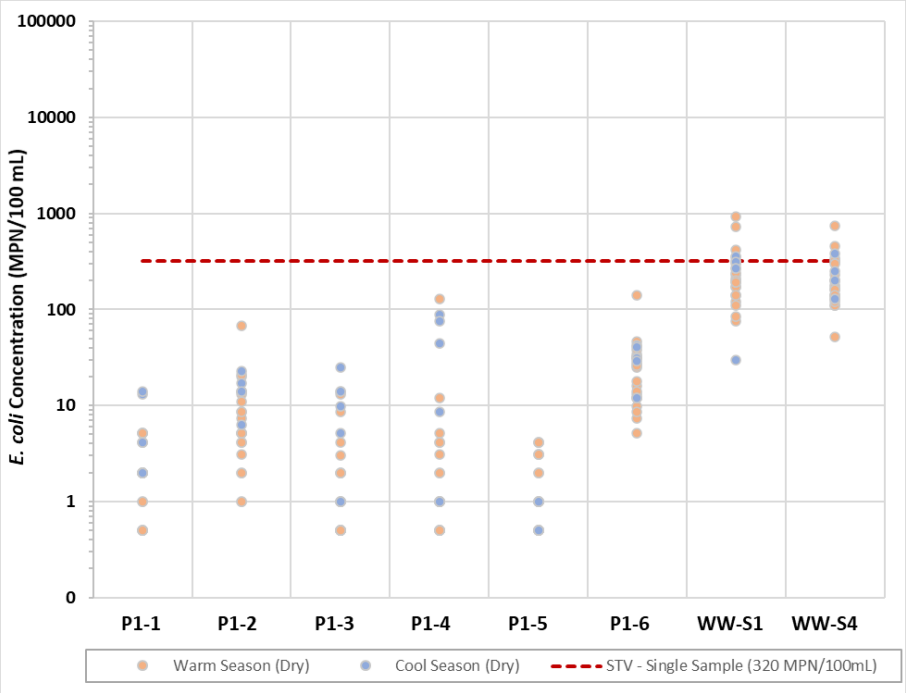

Figure 4-8. Distribution of *E. coli* Concentrations at Priority 1 Sites

Figures 4-9 through 4-16 show the individual and geomean *E. coli* concentrations for each Priority 1 site. Geomeans from the warm, dry season are 6-week rolling geomeans while the geomean from the cool, dry season is a 5-week geomean. When sample concentrations were below the laboratory detection limit, one-half of that detection limit was used to calculate the geometric mean. The figures show that at the lake sites (P1-1 to P1-4) sites, the cool, dry season samples had slightly higher *E. coli* concentrations than in the warm, dry season. Seasonal bacteria levels at the riverine sites were comparable.

Key observations from the Priority 1 site data include:

- The highest *E. coli* concentration observed at a Priority 1 site was 930 MPN/100 mL at SAR @ MWD Crossing the week of June 21, 2020 (Figure 4-17).
- Aside from the SAR sites, Priority 1 *E. coli* concentrations continue to consistently meet water quality objectives with few exceptions that have been noted as outliers.

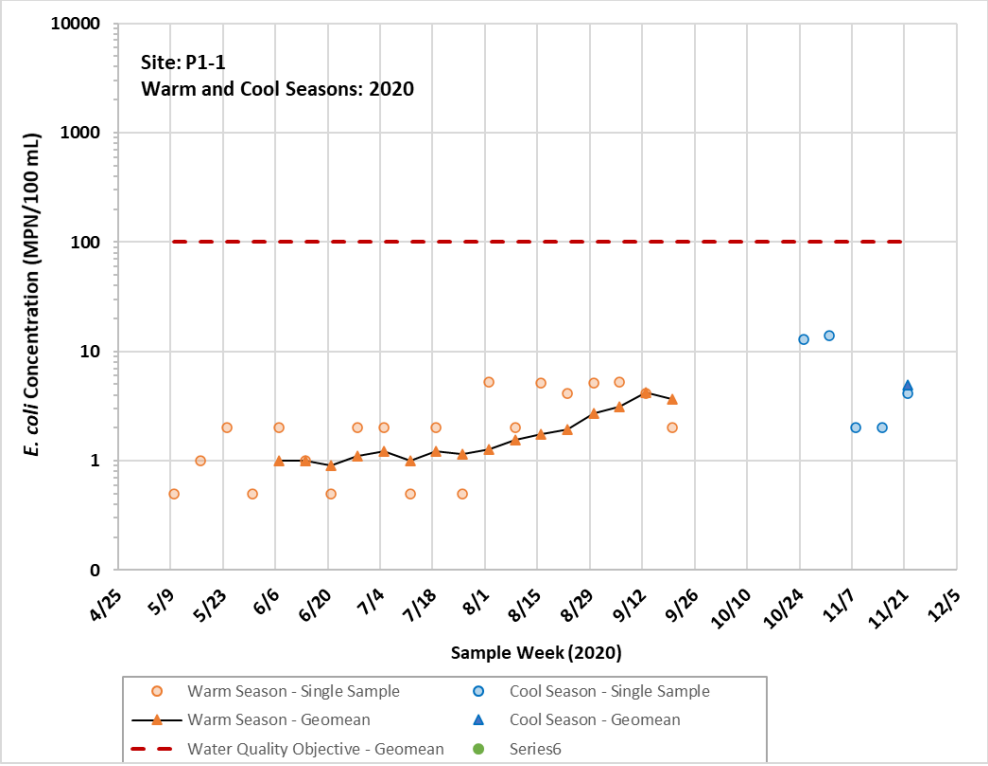

Figure 4-9. *E. coli* Concentrations and Geomeans at Canyon Lake (P1-1)

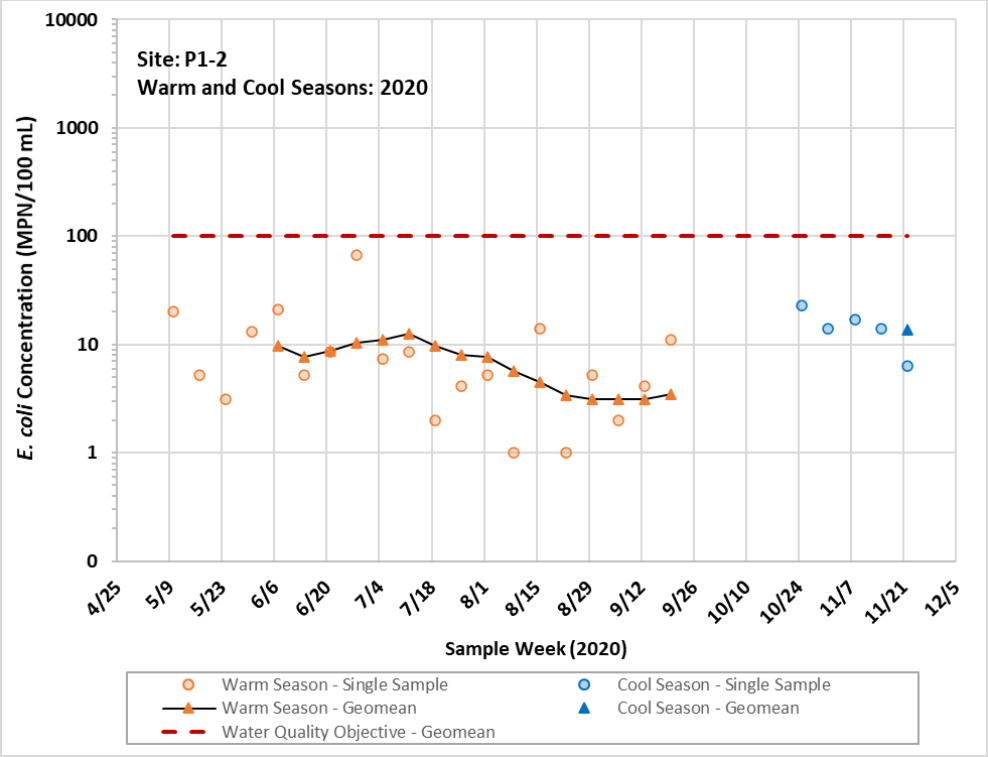

Figure 4-10. *E. coli* Concentrations and Geomeans at Lake Elsinore (P1-2)

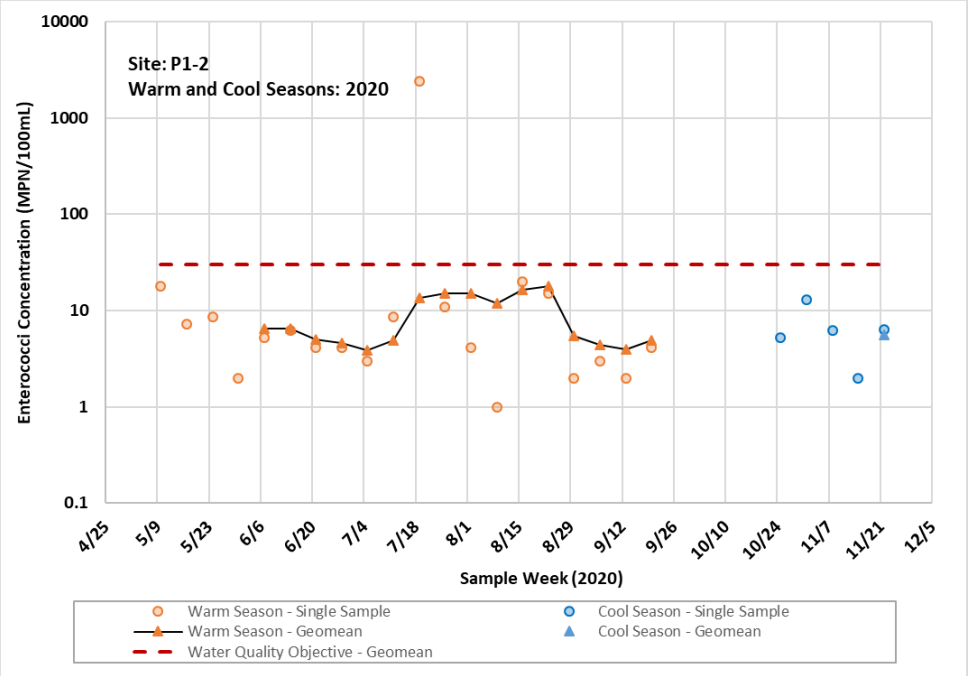

Figure 4-11. *Enterococci* Concentrations and Geomeans at Lake Elsinore (P1-2)

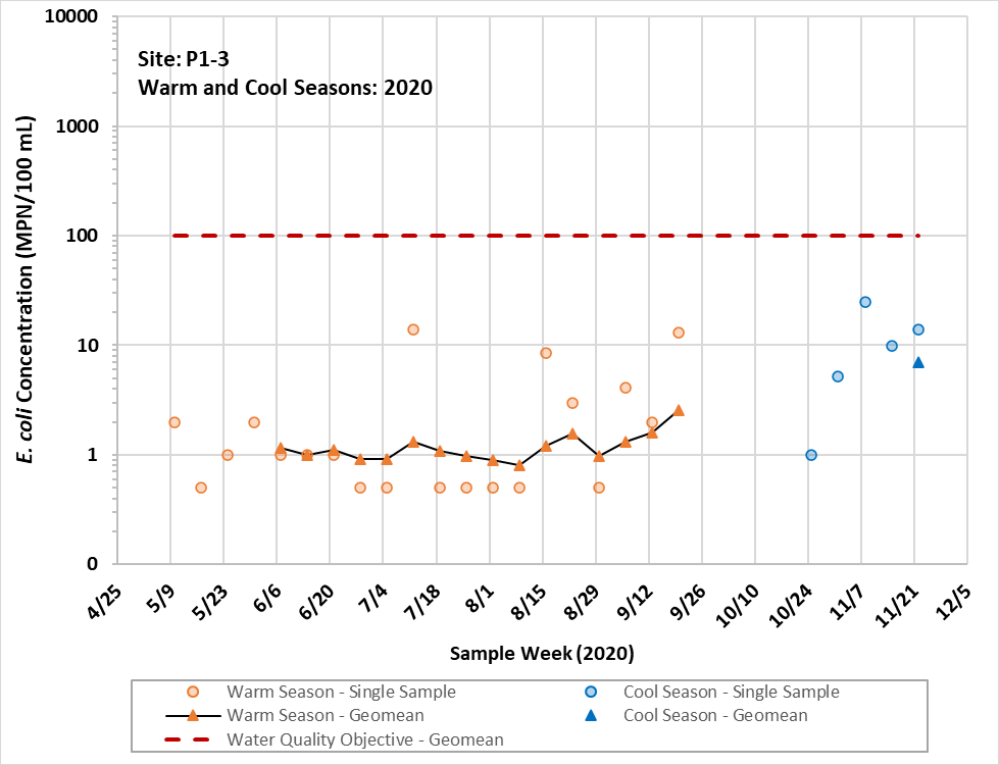

Figure 4-12. *E. coli* Concentrations and Geomeans at Lake Perris (P1-3)

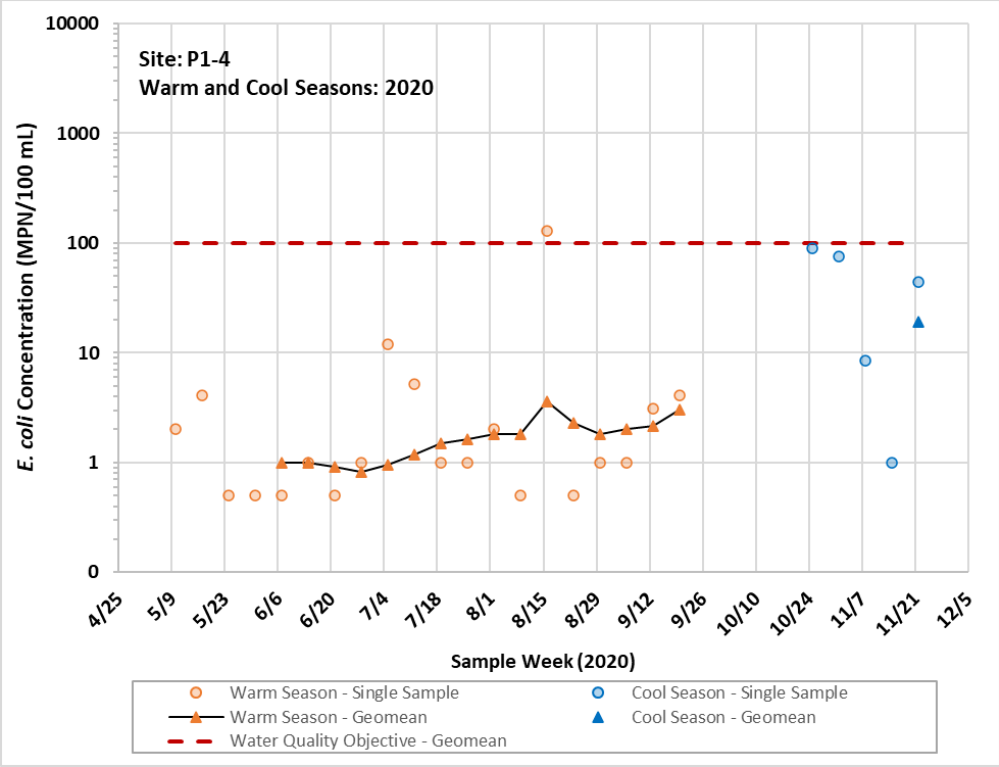

Figure 4-13. *E. coli* Concentrations and Geomeans at Big Bear Lake (P1-4)

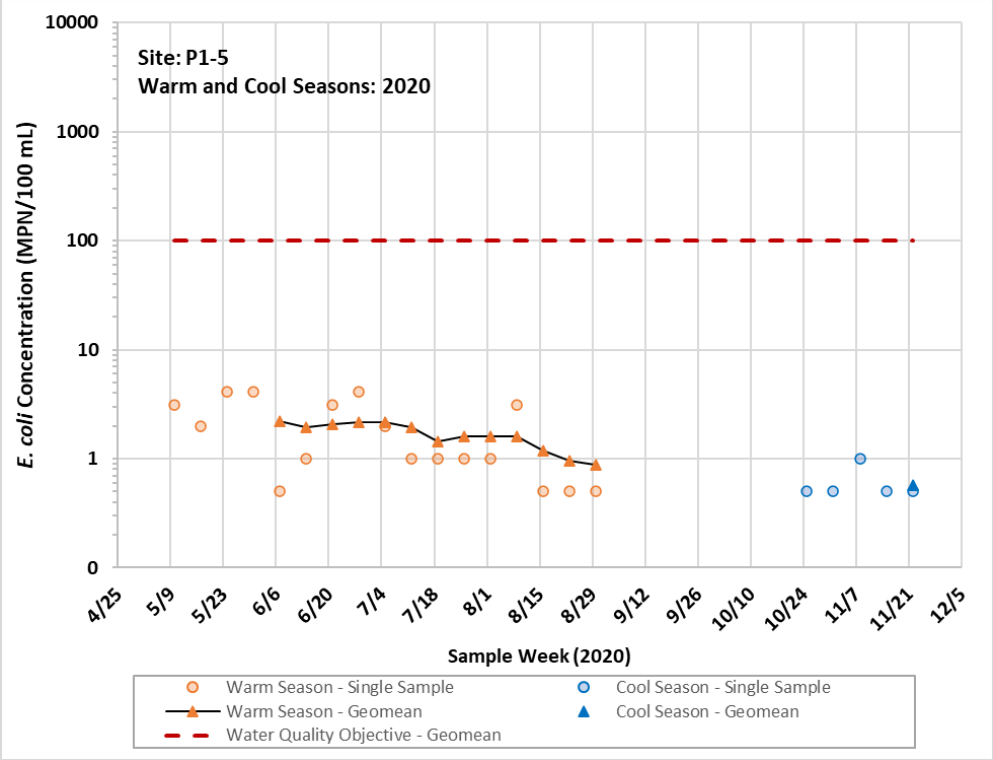

Figure 4-14. *E. coli* Concentrations and Geomeans at Mill Creek Reach 2 (P1-5)

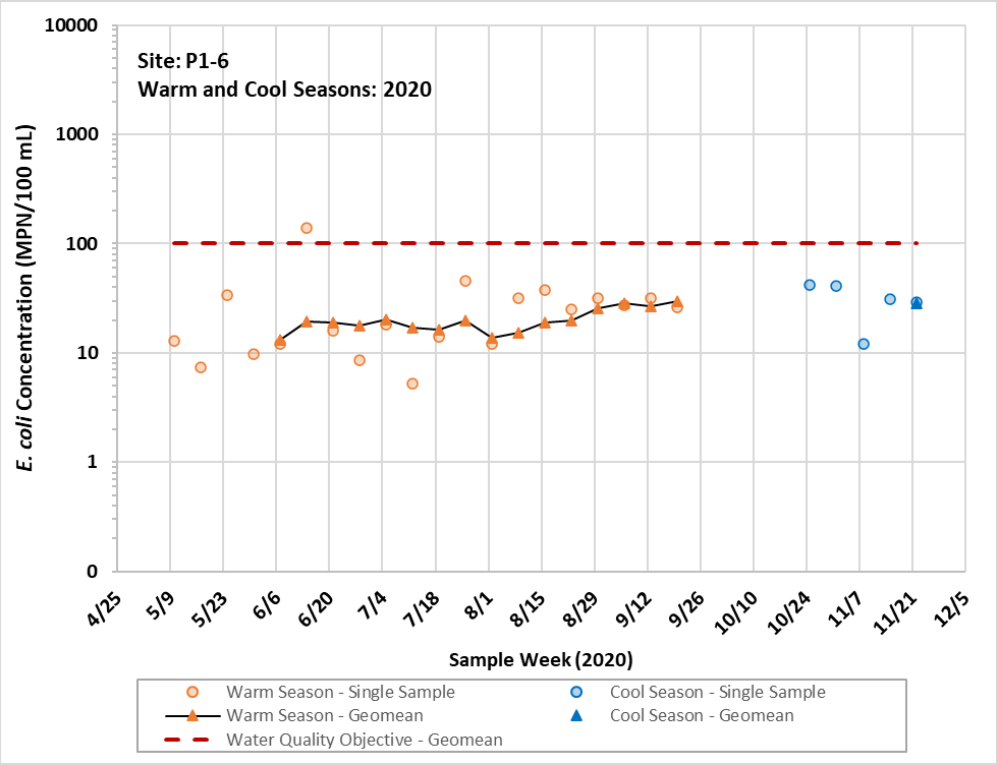

Figure 4-15. *E. coli* Concentrations and Geomeans at Lytle Creek (P1-6)

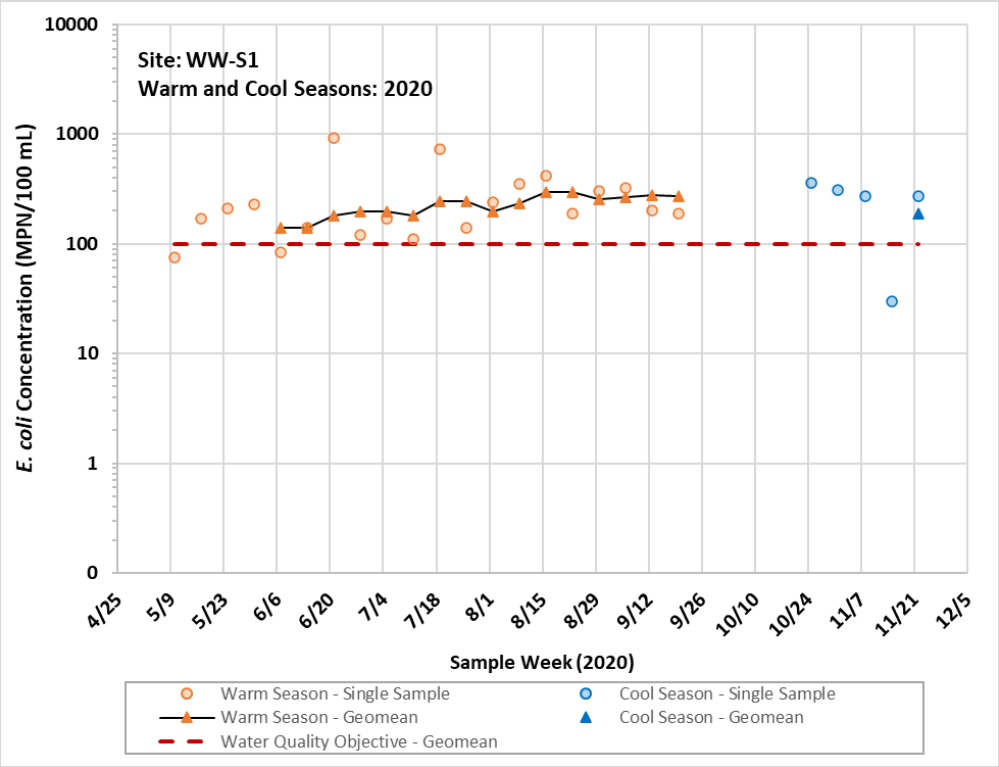

Figure 4-16. *E. coli* Concentrations and Geomeans at Santa Ana River at MWD Crossing (WW-S1)

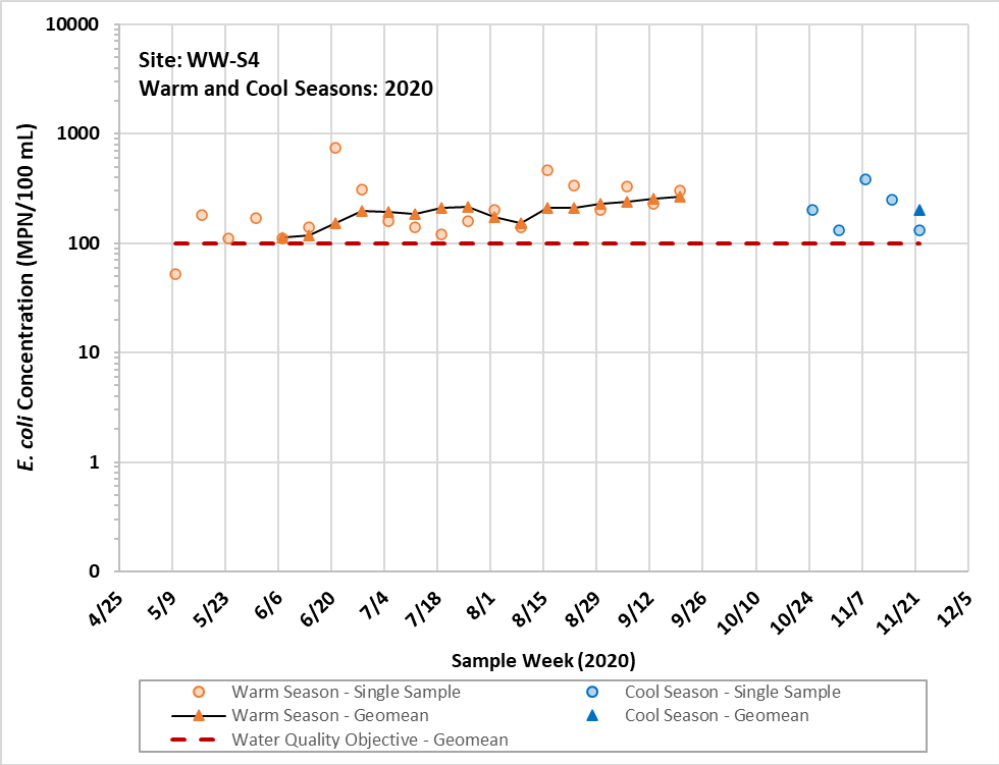

Figure 4-17. *E. coli* Concentrations and Geomeans at Santa Ana River at Pedley Avenue (WW-S4)

4.1.3 Bacteria Compliance Analysis

The compliance analysis compared the *E. coli* geomeans to the Statewide Bacteria Provisions geomean WQO of 100 MPN/100 mL. During the warm, dry season, rolling geometric means were calculated based on six weekly samples. During the cool, dry season, the geometric mean was calculated based on five weekly samples. The Statewide Bacteria Provisions also establish a single statistical threshold value (STV) of 320 MPN/100 mL for REC-1 waters that cannot be exceeded by more than 10 percent of samples in any calendar month.

Six out of eight Priority 1 sites had no geomean nor STV exceedances (Table 4-2). The two sites that exceeded the geomean WQO were SAR at MWD Crossing (WW-S1) and SAR at Pedley Avenue (WW-S4) with 100 percent exceedance frequencies. The same two sites also had samples that exceeded the STV.

Five samples at SAR at MWD Crossing (WW-S1) and five samples at SAR at Pedley Avenue (WW-S4) exceeded the 90th percentile STV. The percentage of samples exceeding the STV per month is shown in Table 4-3.

Table 4-2. 2020-2021 Monitoring Season Frequency of Exceedance with *E. coli* Geomean (100 MPN/ 100 mL) and STV (320 MPN/100 mL) Water Quality Objective During the 2020 Dry Weather Samples

Site ID	Site	Geometric Mean Criterion Exceedance Frequency (%)	STV Criterion Exceedance Frequency (%)
P1-1	Canyon Lake	0	0
P1-2	Lake Elsinore	0	0
P1-3	Lake Perris	0	0
P1-4	Big Bear Lake	0	0
P1-5	Mill Creek Reach 2	0	0
P1-6	Lytle Creek (Middle Fork)	0	0
WW-S1	Santa Ana River Reach 3 at MWD Crossing	100	20
WW-S4	Santa Ana River Reach 3 at Pedley Avenue	100	20

Table 4-3. Monthly Frequency of Exceedance of STV (320 MPN/100 mL) Water Quality Objective During the 2020 Dry Weather Samples for the Santa Ana River Sites

Month	Number of Samples Collected	STV Criterion Exceedance Frequency (%)	
		SAR @ MWD Crossing	SAR @ Pedley Avenue
May	4	0	0
June	4	25	25
July	4	25	0
August	5	40	40
September	3	0	33
October	1	100[1]	0
November	4	0	25

[1] A single sample was collected during the month of October

4.2 Priority 2

4.2.1 Water Quality Observations

Water quality parameters measured in the field at Priority 2 sites (Table 4-4) are summarized in Figures 4-18 through 4-24. Key observations are summarized as follows:

- Figure 4-18 shows that all the pH measurements were above the lower allowable limit of 6.5, however, several measurements exceeded the upper allowable limit of 8.5. The exceedances were observed at Prado Park Lake (72 percent of measurements).
- Water temperatures are generally similar among Priority 2 sites and are slightly lower during the cold, dry season than the dry, warm season (Figure 4-19).
- All Priority 2 sites are designated with the WARM beneficial use and should meet a minimum DO level of 5 mg/L. All DO levels from the three SAR sites, Mill-Cucamonga Creek and Prado Park Lake, are greater than 5 mg/L (Figure 4-20), while six dry weather samples from Chino Creek were below 5 mg/L. Algal growth documented on the bottom of Chino Creek during dry sample events may have caused low DO levels.

- Specific conductivity (Figure 4-21) is similar at the two SAR sites ranging from 810 µS/cm to 1075 µS/cm. Specific conductivity in Prado Park Lake rose during the summer months as a result of evapo-concentration.
- Turbidity (Figure 4-22) and TSS (Figure 4-23) are similar with low ranges for most of the sites except at Prado Park Lake and Chino Creek. Prado Park Lake and Chino Creek showed the largest variations with turbidity ranges from 0 to 33.2 NTU and total suspended solids from 1 to 47 mg/L.
- Flow is lowest at Prado Park Lake (spill from the lake) with rates ranging from 1.1 to 11.0 cfs. Chino and Cucamonga Creeks had slightly higher but similar ranges of flow (4 to 33.9 cfs and 4.2 to 50.9 cfs, respectively). Flow is higher in the SAR and highest at the most downstream site SAR at Pedley Avenue (Figure 4-24). Maximum flow at SAR at Pedley Avenue (111 cfs) is approximately 70 percent higher than the maximum flow at SAR at MWD Crossing (66.2 cfs) due to effluent discharge from Riverside WQCP.

Table 4-4. Priority 2 Monitoring Sites

Site ID	Site Description	County
WW-C3	Prado Park Lake	San Bernardino
WW-C7	Chino Creek at Central Avenue	San Bernardino
WW-M6	Mill-Cucamonga Creek below Wetlands	San Bernardino
WW-S1	Santa Ana River Reach 3 at MWD Crossing	Riverside
WW-S4	Santa Ana River Reach 3 at Pedley Avenue	Riverside
MISSION	Santa Ana River at Mission Blvd. Bridge	Riverside

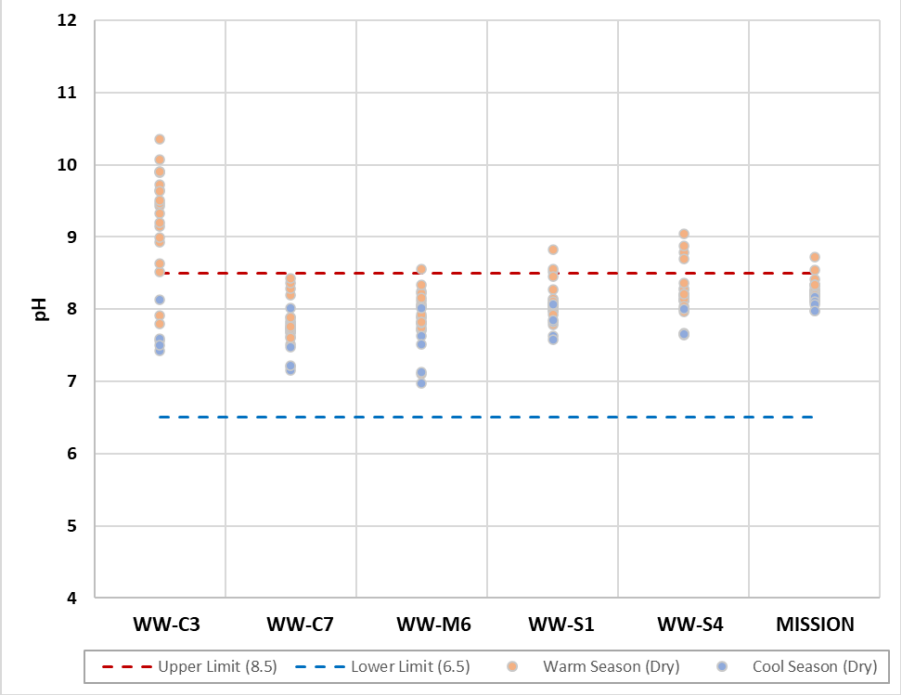

Figure 4-18. Distribution of pH Measurements at Priority 2 Sites

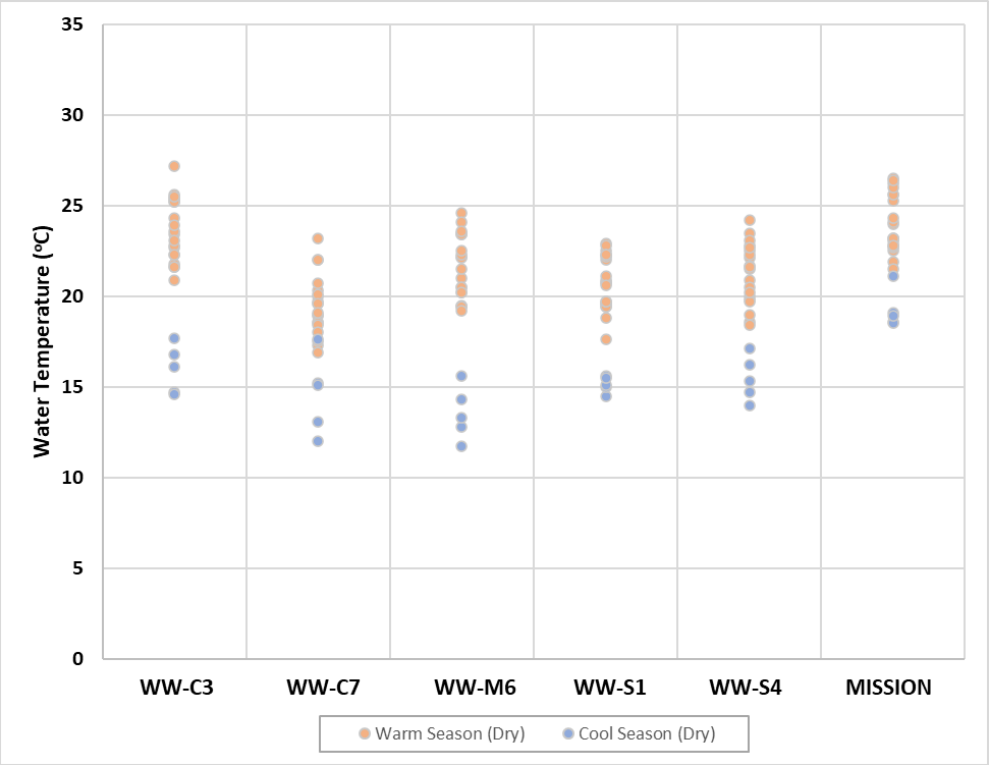

Figure 4-19. Distribution of Water Temperature Measurements at Priority 2 Sites

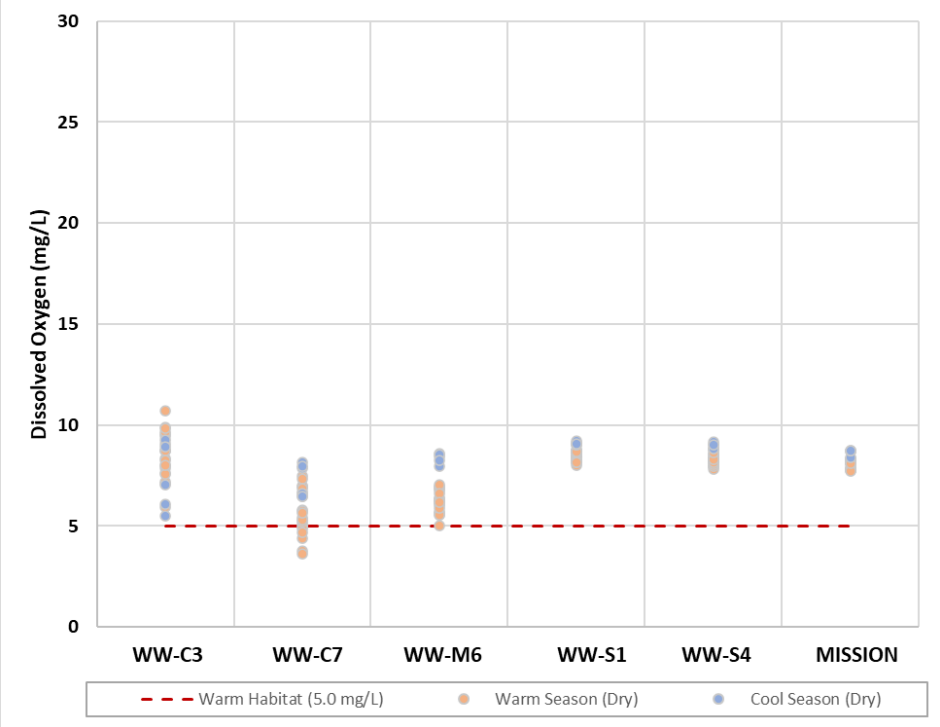

Figure 4-20. Distribution of Dissolved Oxygen Measurements at Priority 2 Sites

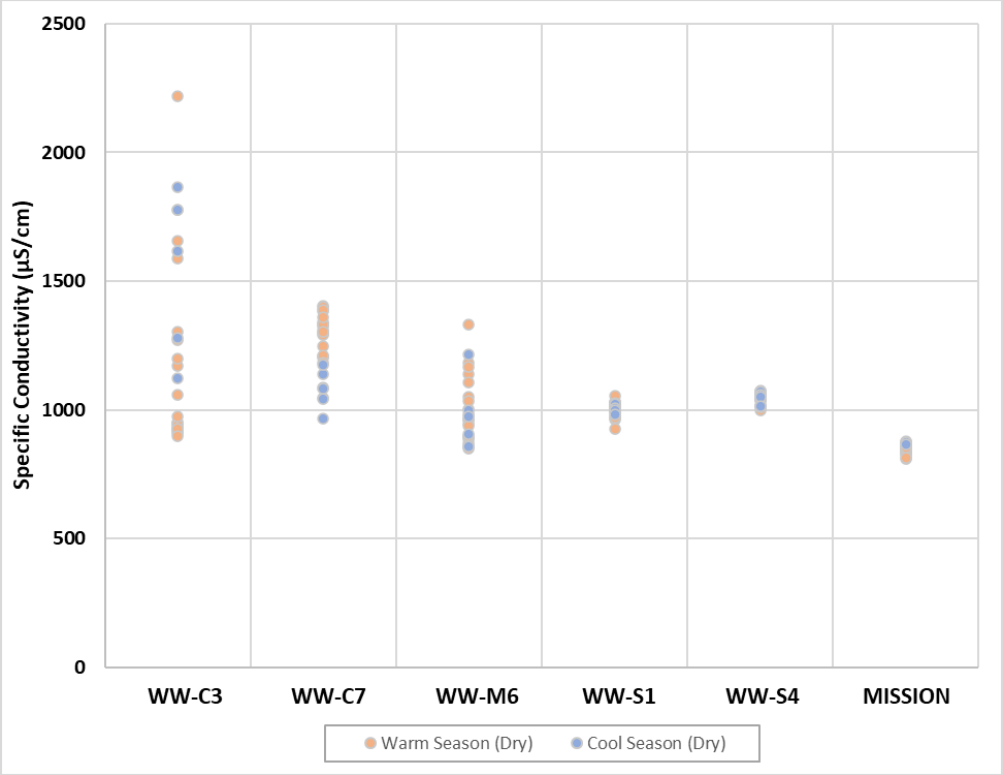

Figure 4-21. Distribution of Specific Conductivity Measurements at Priority 2 Sites

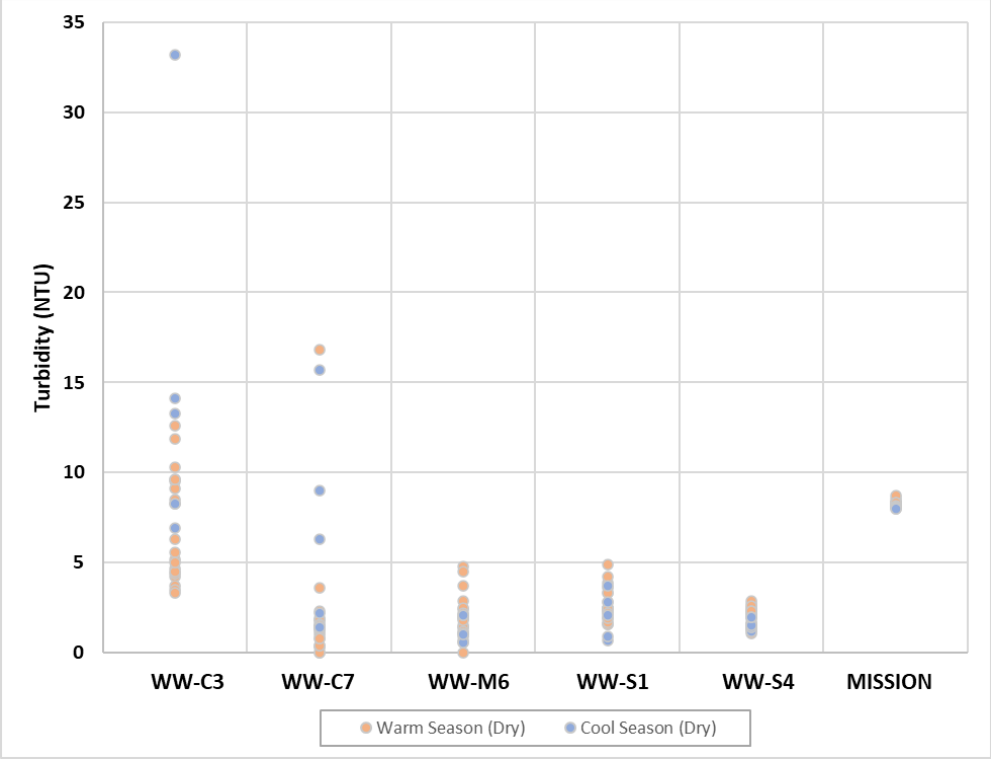

Figure 4-22. Distribution of Turbidity Measurements at Priority 2 Sites

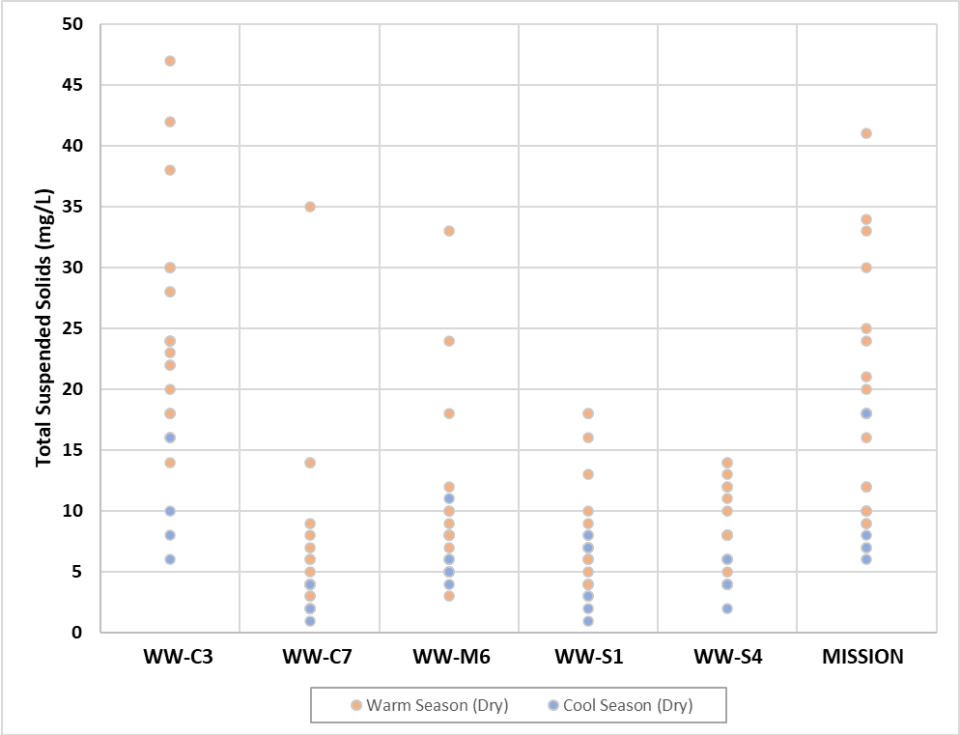

Figure 4-23. Distribution of TSS Measurements at Priority 2 Sites

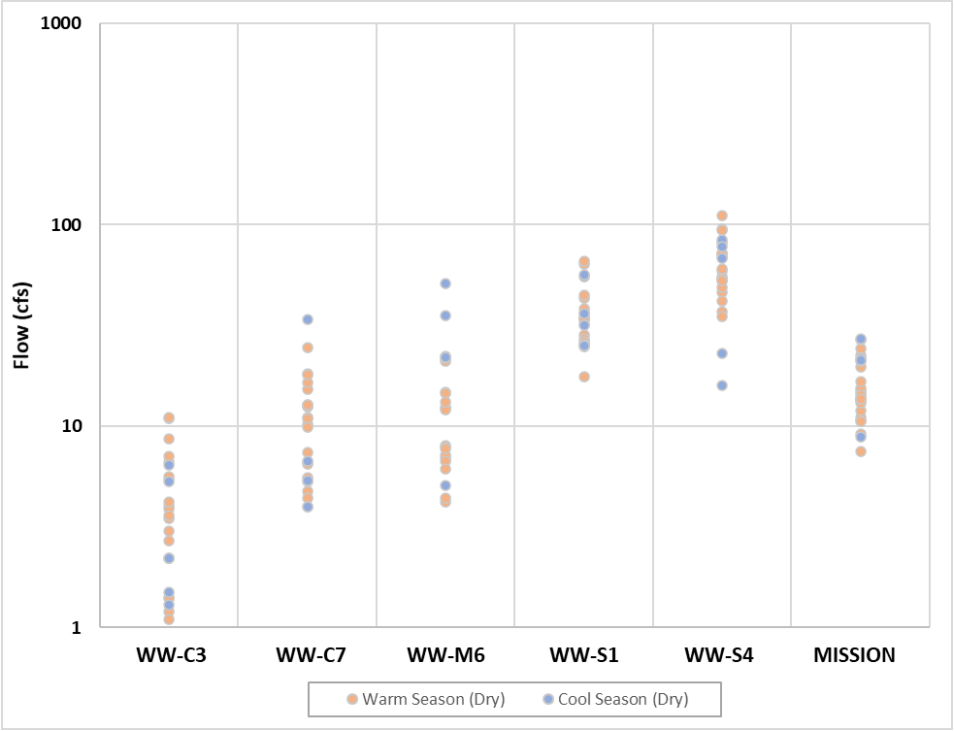

Figure 4-24. Distribution of Flow Measurements at Priority 2 Sites

4.2.2 Bacteria Characterization

Figure 4-25 summarizes the distribution of *E. coli* concentrations observed at Priority 2 sites during the warm, dry and cool, wet seasons.

4.2.2.1 Dry Weather

Chino Creek had the highest single sample observed *E. coli* concentration of 9,200 MPN/100 mL which was observed during the 2020-2021 cool, dry season. Bacteria concentrations during the cool season were higher for most of the Priority 2 sampling sites than they were during the warm season. The largest difference was seen in Chino Creek with a median warm season concentration of 380 MPN/100mL (n=25) and a median cool season concentration of 2,790 MPN/100mL (n=5). Higher bacteria levels in the cool, dry season at Prado Park Lake resulted in the geomean a greater than the 113 MPN/100ml WLA.

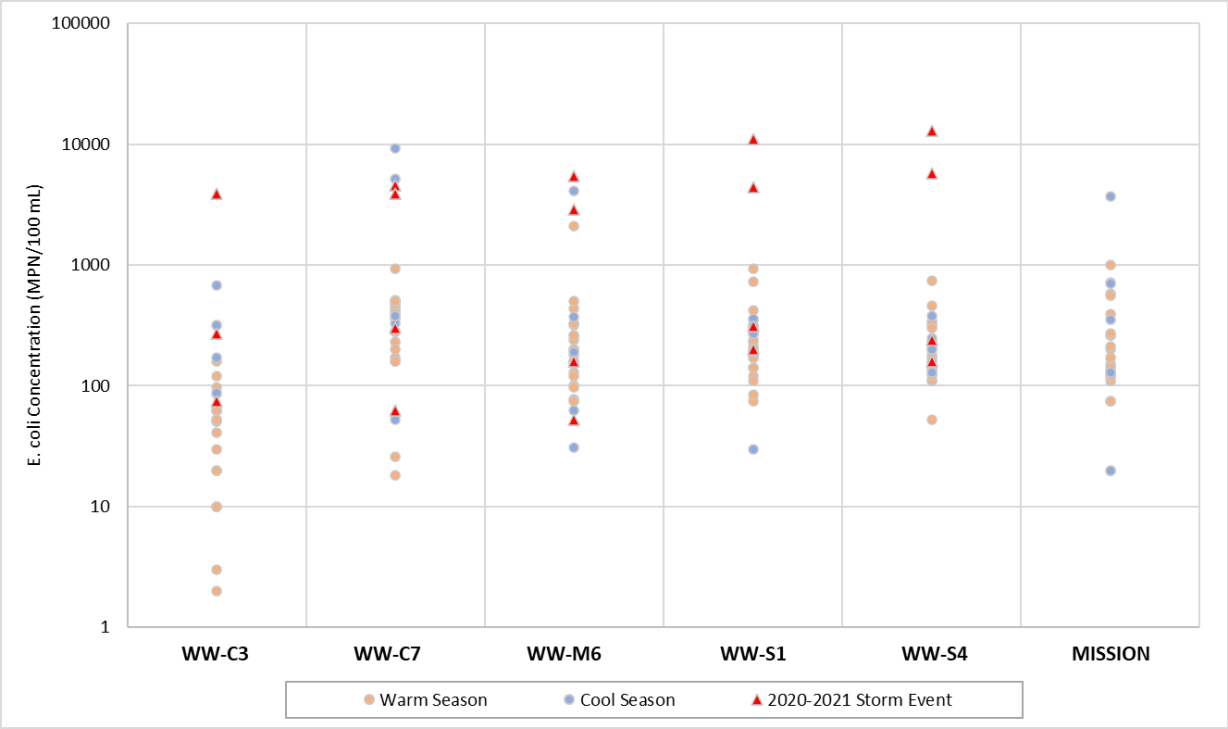

Figure 4-25. Distribution of *E. coli* Concentrations at Priority 2 Sites (Note: No wet weather data was collected from MISSION)

E. coli concentrations at Prado Park Lake ranged from 2 to 680 MPN/100 mL. Following the 2018-2019 monitoring period, an apparent trend of declining *E. coli* concentration at this site was attributed to repairs to pipeline underneath the lake. Since then, there has been a trend of higher bacteria concentrations during the cool season. Ongoing monitoring will be important to identify possible causes for the elevated concentrations.

Figures 4-26 through 4-31 show the individual and rolling geomean *E. coli* concentrations as well as concentrations from four storm samples during the 2020-2021 monitoring period, noting that no storm samples were collected at the Mission site. The figures include geomeans that were calculated using two different methods, one is based on a six-week rolling calculation and the

other is a 30-day rolling calculation. The six-week rolling geomean serves as the basis for evaluating inland freshwaters per the statewide bacteria provisions that became effective in March 2019. The use of a six-week rolling geomean superseded numeric criteria in the Basin Plan, but do not supersede any TMDL numeric targets or allocations. Thus, plots also include five-sample, 30-day geomeans per the 2005 MSAR bacteria TMDL.

For the Santa Ana River monitoring sites (Figure 4-29 through 4-30), *E. coli* concentrations exceed the geometric mean criteria by a relatively small margin (30-day rolling geomeans ranged from 103 to 378 MPN/100 mL), continuing a result from previous sampling periods. The 2019 dry season Synoptic Study found that uncontrollable sources that are not conveyed through the MS4 account for the majority (77%) of the total bacteria load in Reach 3 of the Santa Ana River. Furthermore, the 2019 study showed no relationship between *E. coli* concentration and presence of human HF 183 marker within the receiving waters. This finding strongly suggests that the *E. coli* observed in the Santa Ana River is coming from natural or uncontrollable sources (e.g., sediment releases, wildlife) than controllable sources (e.g., MS4 discharges). The reader is referred to the Middle Santa Ana River Synoptic Study and TMDL Triennial Report for more detail on this source analysis.

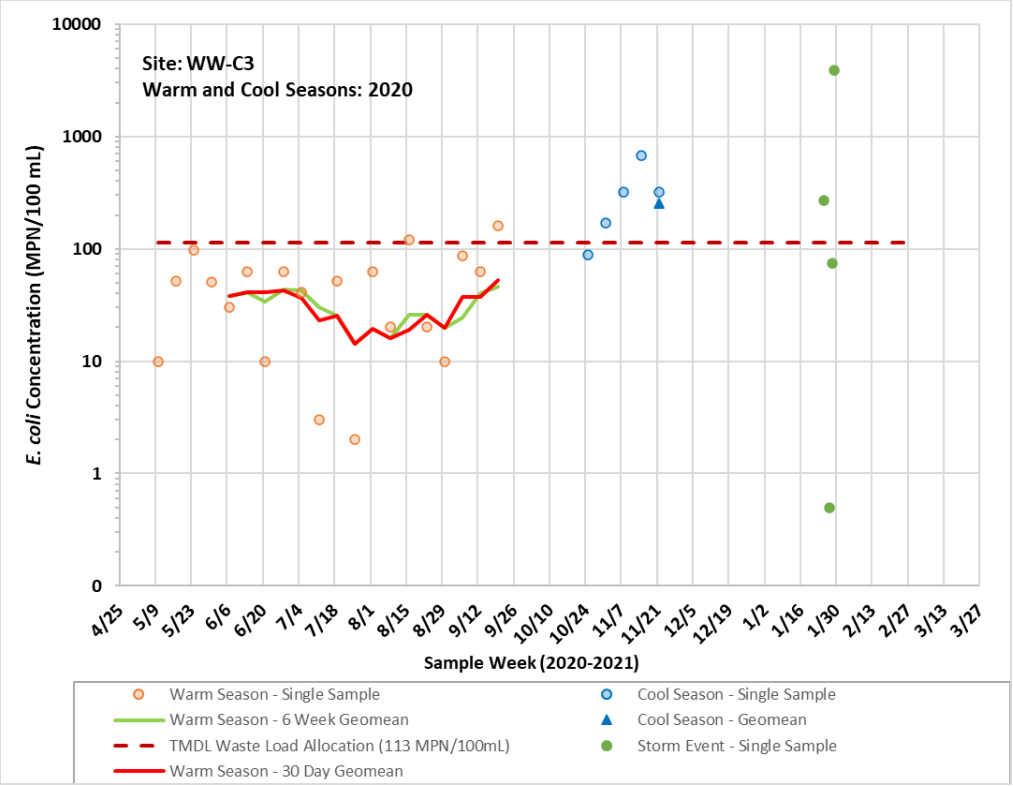

Figure 4-26. *E. coli* Concentrations and Geomeans at Prado Park Lake (WW-C3)

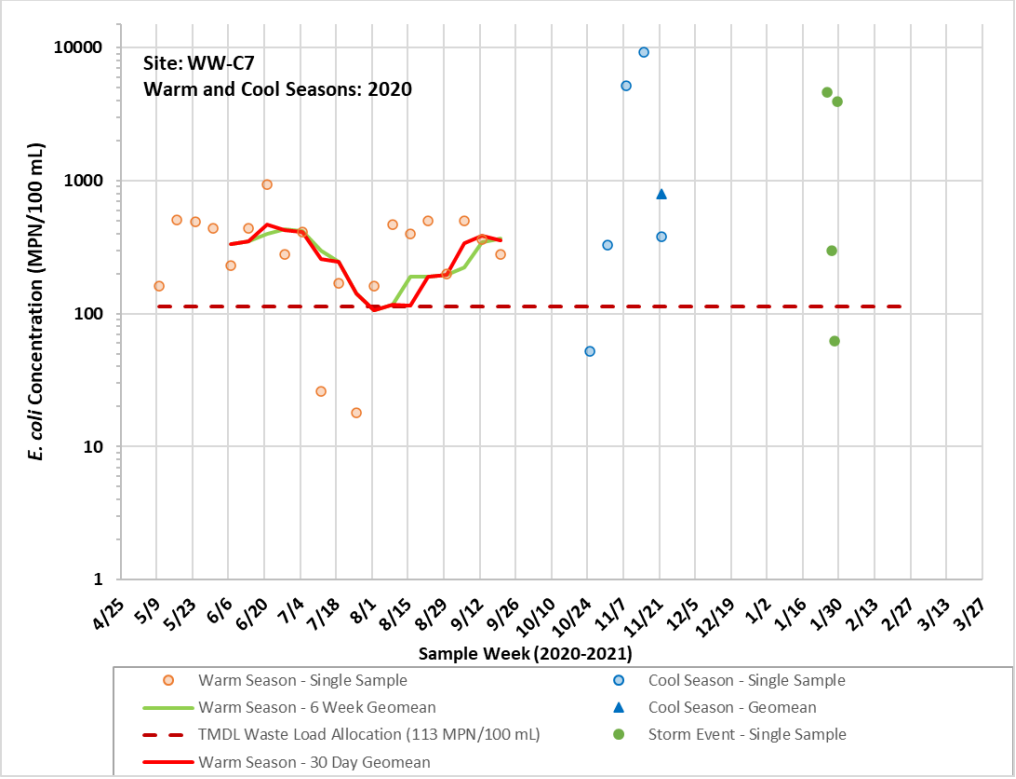

Figure 4-27. *E. coli* Concentrations and Geomeans at Chino Creek at Central Avenue (WW-C7)

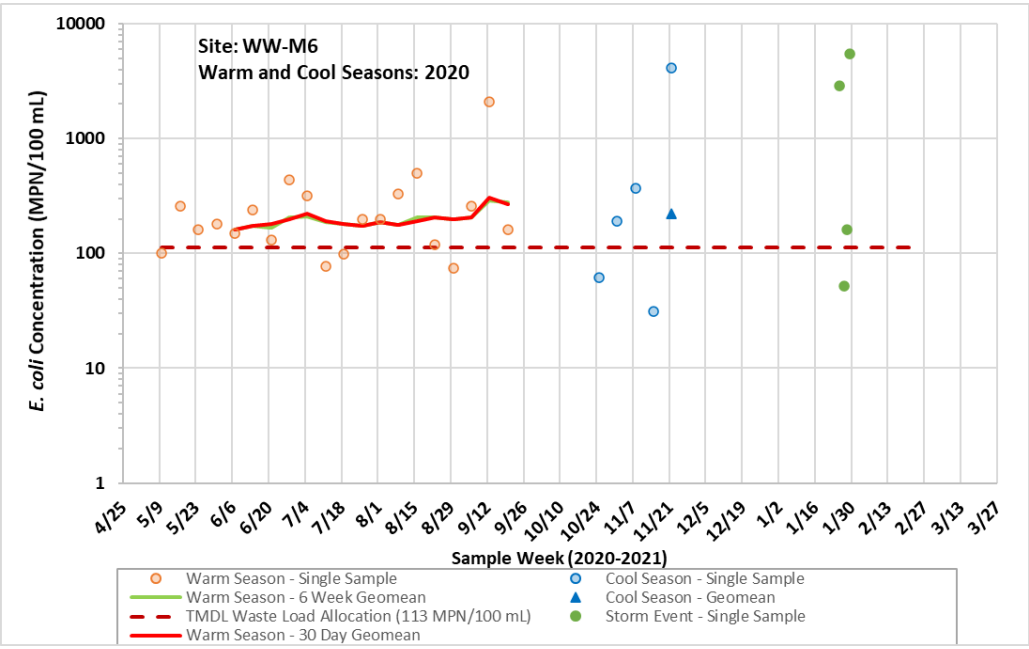

Figure 4-28. *E. coli* Concentrations and Geomeans at Mill-Cucamonga Creek Below Wetlands (WW-M6)

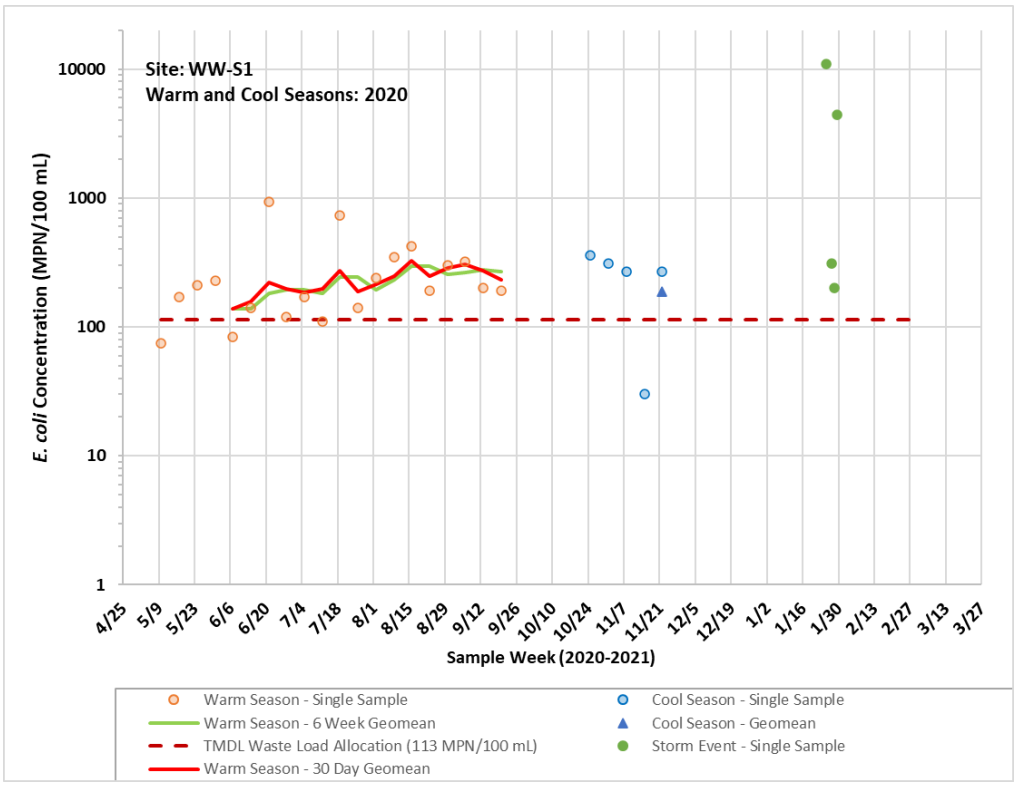

Figure 4-29. *E. coli* Concentrations and Geomeans at Santa Ana River at MWD Crossing (WW-S1)

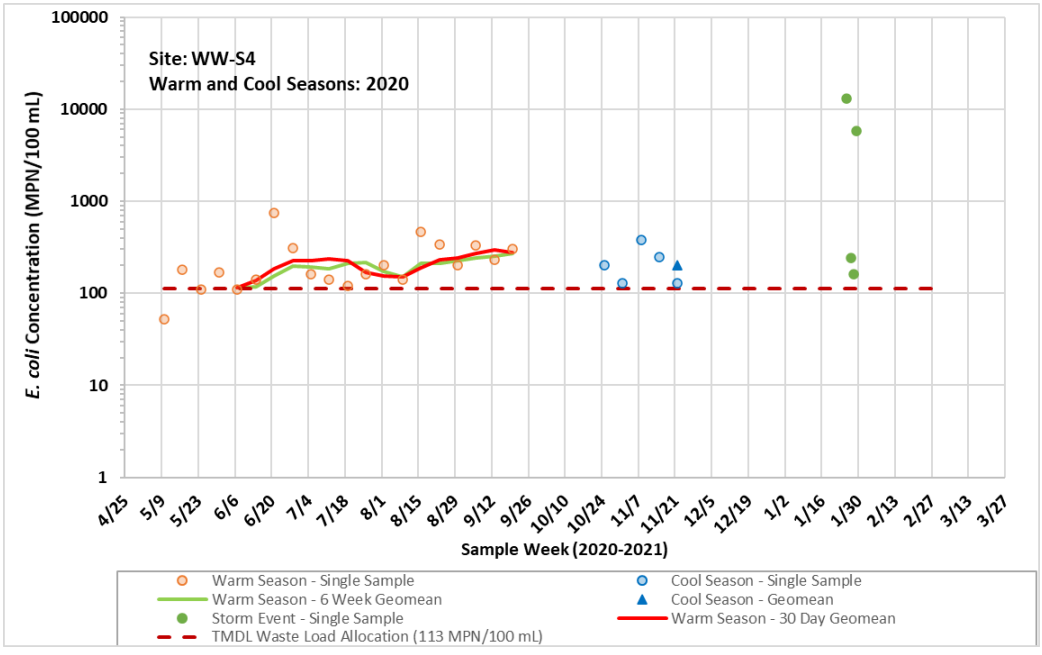

Figure 4-30. *E. coli* Concentrations and Geomeans at Santa Ana River at Pedley Avenue (WW-S4)

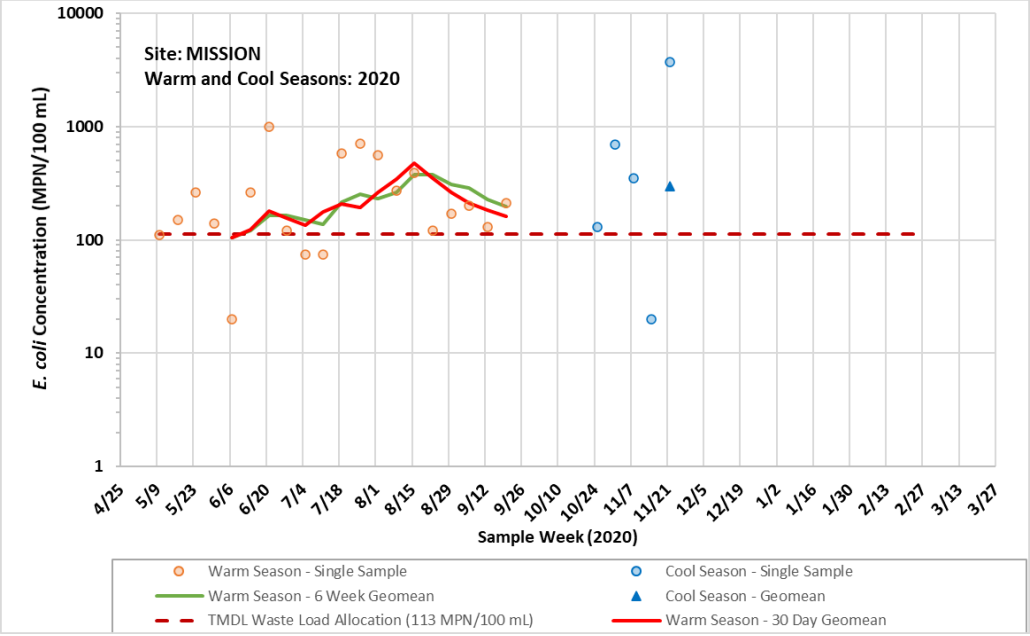

Figure 4-31. *E. coli* Concentrations and Geomeans at Santa Ana River at Mission Avenue (MISSION)

4.2.2.2 Wet Weather 2020-2021 Event

During wet weather, *E. coli* concentrations are more than one order of magnitude greater than dry weather concentrations at Prado Park Lake (Figure 4-26), Chino Creek (Figure 4-27), SAR at MWD Crossing (Figure 4-29) and SAR at Pedley Avenue (Figure 4-30). At Mill-Cucamonga Creek (Figure 4-28), peak storm concentrations are greater than most of the dry weather concentrations but similar in magnitude as peak dry weather concentrations.

Samples collected for the January 25, 2021 storm event are summarized in Table 4-5. Figures 4-32 and 4-33 display changing *E. coli* concentrations at two stations over the sampling period. The storm event was followed by another event on January 29th. As a result, the storm water sample collection period included two major flow peaks that resulted in relative maximum *E. coli* concentrations both earlier and later in the sampling period (Figure 4-32 and Figure 4-33). For example, the highest wet weather *E. coli* concentration observed at SAR at Pedley Avenue (13,000 MPN/100 mL) was recorded on January 25, 2021, the first day of the storm event. However, an additional relative maximum concentration (5,800 MPN/100 mL) was measured January 29, 2021, almost three days after the first sample. Measurements at Prado Park Lake, Chino Creek, Mill-Cucamonga Creek, and SAR at MWD Crossing display similar responses with relative maximum *E. coli* concentrations on the first and final days of the sampling period.

Table 4-5 *E. coli* Concentrations (MPN/100 mL) Observed During the 2020-2021 Storm Event

Site	1/25/2021	1/27/2021	1/28/2021	1/29/2021
Prado Park Lake (WW-C3)	270	ND	74	3,900
Chino Creek at Central Avenue (WW-C7)	4,600	300	62	3,900
Mill-Cucamonga Creek below Wetlands (WW-M6)	2,900	52	160	5,500
SAR Reach 3 at MWD Crossing (WW-S1)	11,000	310	200	4400
SAR Reach 3 at Pedley Avenue (WW-S4)	13,000	240	160	5800

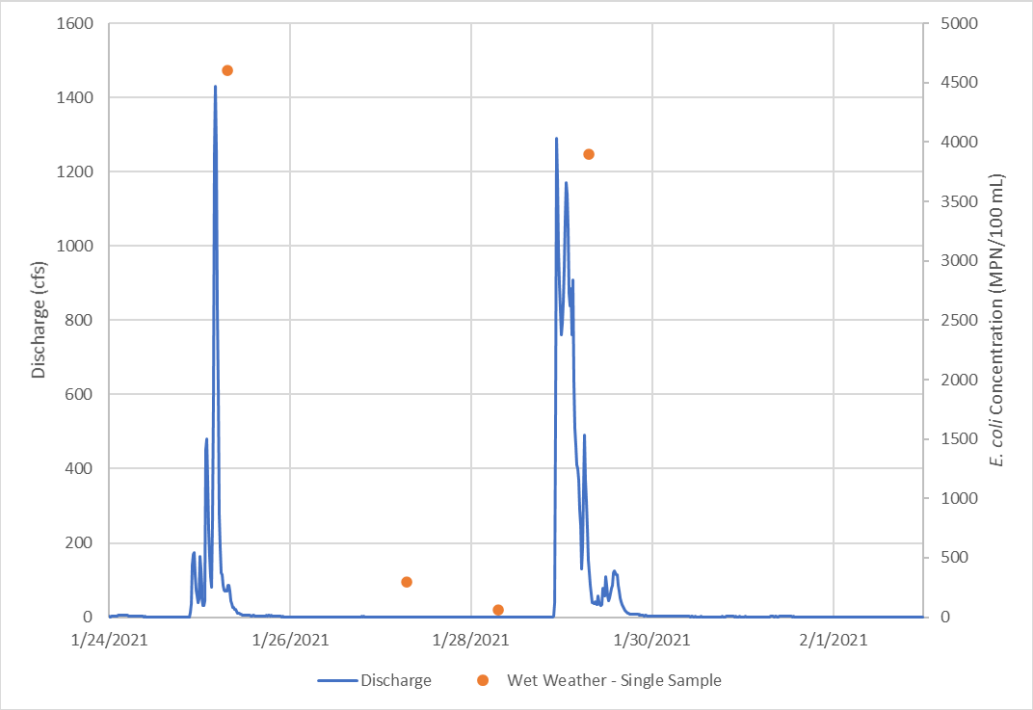

Figure 4-32. *E. coli* Concentrations Observed at Chino Creek During and After the January 25, 2021 Storm Event

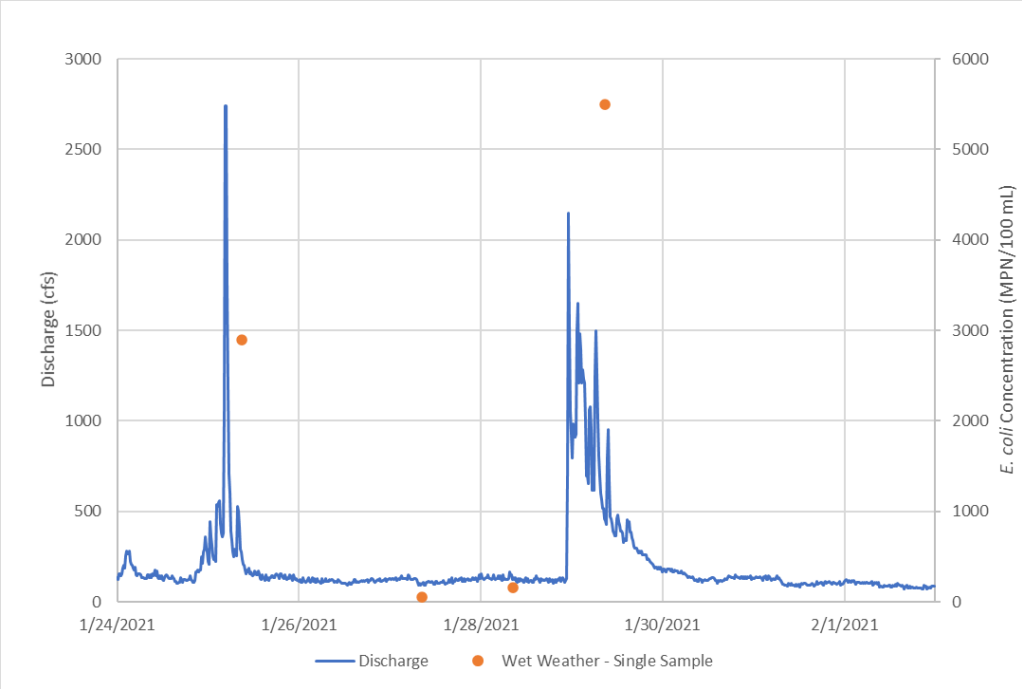

Figure 4-33. *E. coli* Concentrations Observed at Mill-Cucamonga Creek During and After the January 25, 2021 Storm Event

4.2.2.3 Analysis of Historical Wet Weather Data

One wet weather monitoring event has been completed in each wet season since the inception of the MSAR bacteria monitoring program in 2007-08. Data collected over 14 storm events at each of the MSAR TMDL compliance monitoring sites spanning the period from 2007-08 to 2020-2021 is presented and analyzed below. The once per year wet weather sampling event was included in the 2008 MSAR Water Quality Monitoring Plan to obtain data from the falling limb of the hydrograph (SAWPA, 2008). This focus differs from core wet weather monitoring by MS4 programs that aim to collect runoff from the rising limb of runoff hydrographs. Given that storm events greater than ½ inch trigger a high flow suspension of REC1 use, it is important to understand the levels of fecal bacteria impairment that may remain in the days following a storm when recreational use protection must be achieved in the MSAR TMDL waters. Ackerman and Weisberg (2003) showed that fecal bacteria concentrations in City of Los Angeles beaches remain above typical pre-event levels for as long as 3-5 days following a storm event.

The monitoring program for wet weather in MSAR TMDL waters was designed, and has been conducted, to collect samples on day 1 of a wet weather event, followed by sampling at intervals of 48, 72, and 96 hours. In many cases additional wet weather events occur during the 96 hour sampling window, therefore some of the follow-up samples may have been collected during wet weather. A detailed assessment of 15-minute interval flow records for each sampled events in past 12 years was completed to determine whether each of the four samples is representative of wet weather or post-storm conditions and to approximate the elapsed time for flow to return to pre-event levels.

The review of hydrographs was used to stratify the data into wet weather and post-storm groups. Geometric means of *E. coli* concentration were compared between wet weather and post-storm groups for each site (Figure 4-34). A significant difference in wet weather and post-storm *E. coli* concentration was found at all sites. When accounting for the increased flow rate in wet weather samples, the relative rise in *E. coli* loading during wet weather reaches 2-3 orders of magnitude. Put another way, the *E. coli* load during a typical wet weather sampling event is comparable to the total load during dry weather over the entire year.

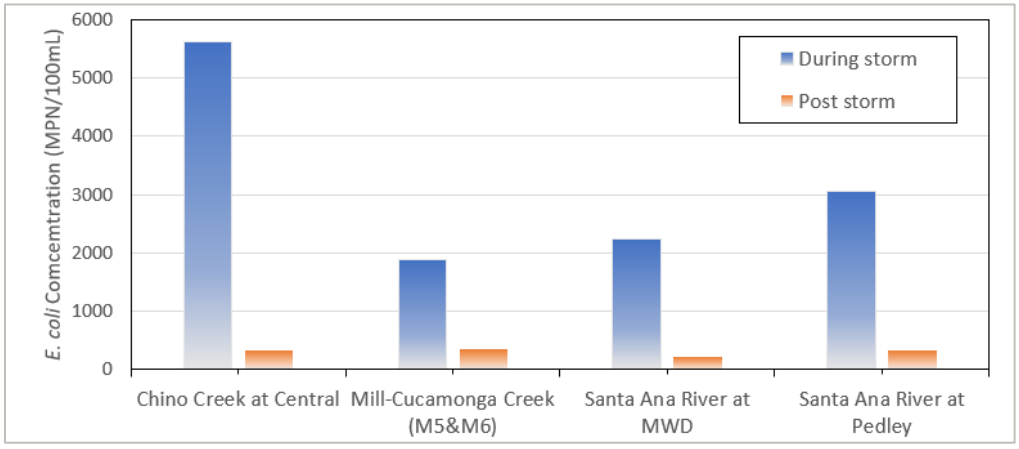

Figure 4-34. Comparison of Geometric Means of *E. coli* Concentration for Samples Collected during Wet Weather and Post-storm for TMDL Compliance Monitoring Sites on Chino Creek, Mill-Cucamonga Creek, and the Santa Ana River Reach 3

Post-storm events samples were evaluated to assess how long following a wet weather event are elevated bacteria concentrations apparent in the MSAR bacteria TMDL waterbodies; Chino Creek, Mill-Cucamonga Creek, and Santa Ana River Reach 3. Results for MSAR TMDL waters show a return to pre-event *E. coli* concentrations within 24 hours of the return to pre-event flow conditions (Figure 4-35).

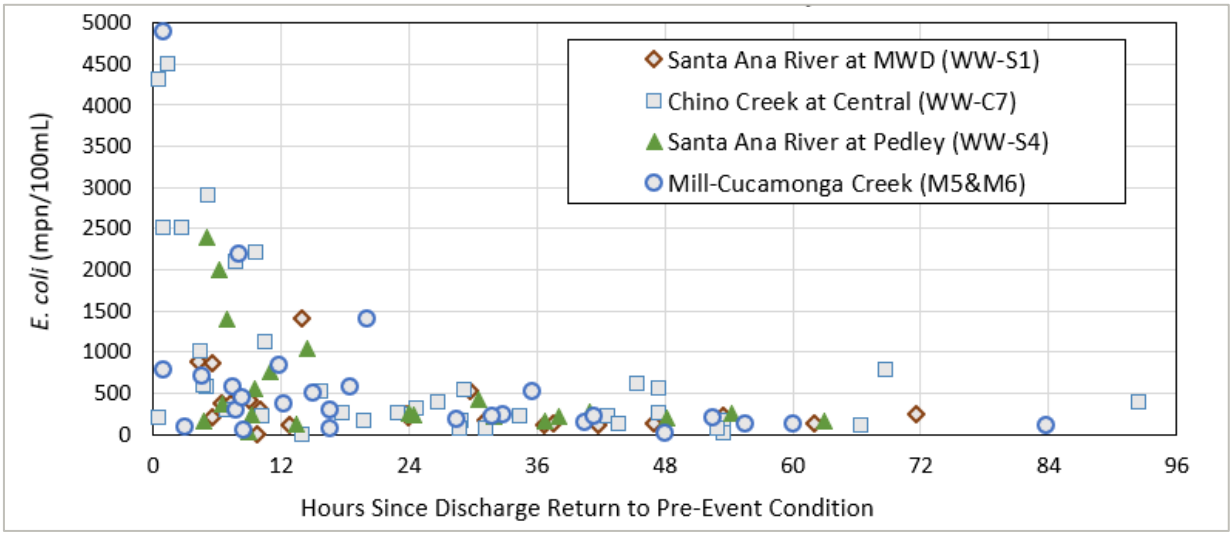

Figure 4-35. Post-storm Event *E. coli* Samples from MSAR TMDL Waters Plotted against the Time to Return to Pre-event Flow Conditions

4.2.3 Historical Trends

Figures 4-36 through 4-40 illustrate the distribution and variability of dry-weather, rolling geometric mean values for *E. coli* since 2007.[21] *E. coli* concentrations from 2007 through 2015 are presented in CFU/100 mL while 2016 and 2017 concentrations are presented in MPN/100 mL.

Figure 4-36 suggests that *E. coli* levels are improving at Prado Park Lake (WW-C3). Throughout the 2018 and 2019 warm seasons, *E. coli* geomeans for Prado Park Lake (13 to 55 MPN/100mL) are below the MSAR Bacteria TMDL WLAs/LAs of 113 MPN/100mL. This improvement was believed to be linked to the draining and repair of concrete piping underneath the lake. However, the *E. coli* concentrations gradually increased throughout the warm, dry season and that trend continued with the geomean for the cool, dry season (253 MPN/100mL) exceeding the WLA/LA. This trend has been observed in both the 2019 and 2020 dry seasons.

`There is an apparent downward trend in *E. coli* at Mill-Cucamonga Creek with geomean concentrations almost an order of magnitude less than pre-CBRP (2012) levels (Figure 4-38). This decrease can be attributed to several changes, including 1) retention of dry weather flow within
SBCFCD basins, 2) operation of Mill Creek Wetlands, 3) catch basin and outfall cleaning by the upstream cities, and 4) reduction of runoff from outdoor water uses. The reduced *E. coli* concentration has been achieved despite a significant reduction in dilution flows from IEUA RP1

[21] Results of previous sample collection activities may be obtained from seasonal reports posted at the Santa Ana Watershed Project Authority MSAR TMDL Task Force website: http://www.sawpa.org/collaboration/projects/tmdl-taskforce/

effluent over the same time period. It is possible that even greater reductions in concentration would have been observed if RP1 effluent were maintained at pre-CBRP levels.

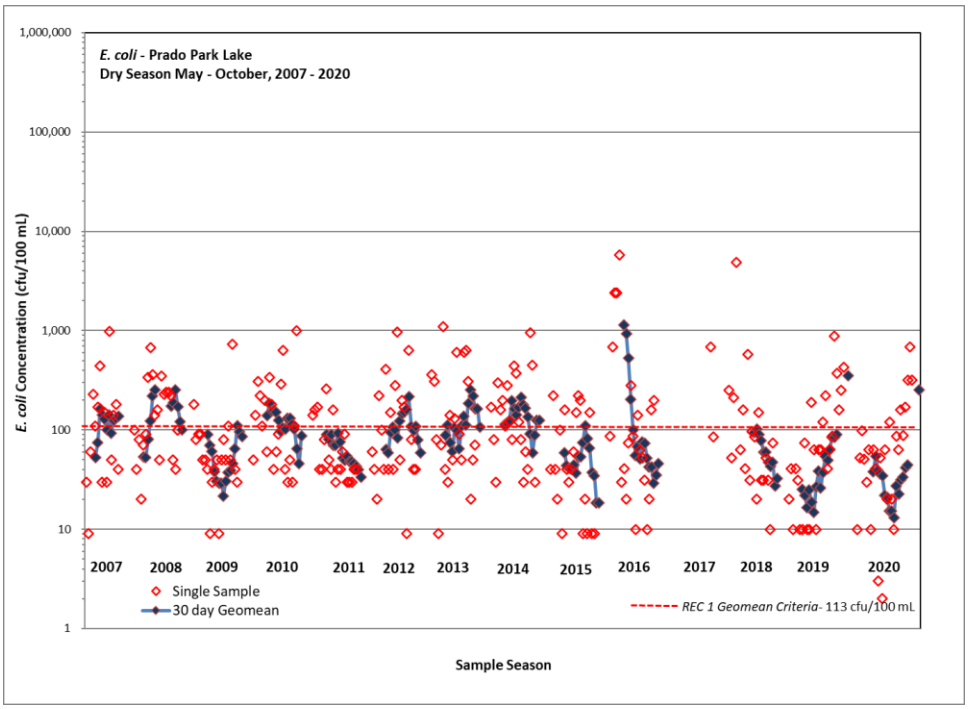

Figure 4-36. Time Series Distribution of *E. coli* Geomean Concentrations at Prado Park Lake from 2007 through 2020

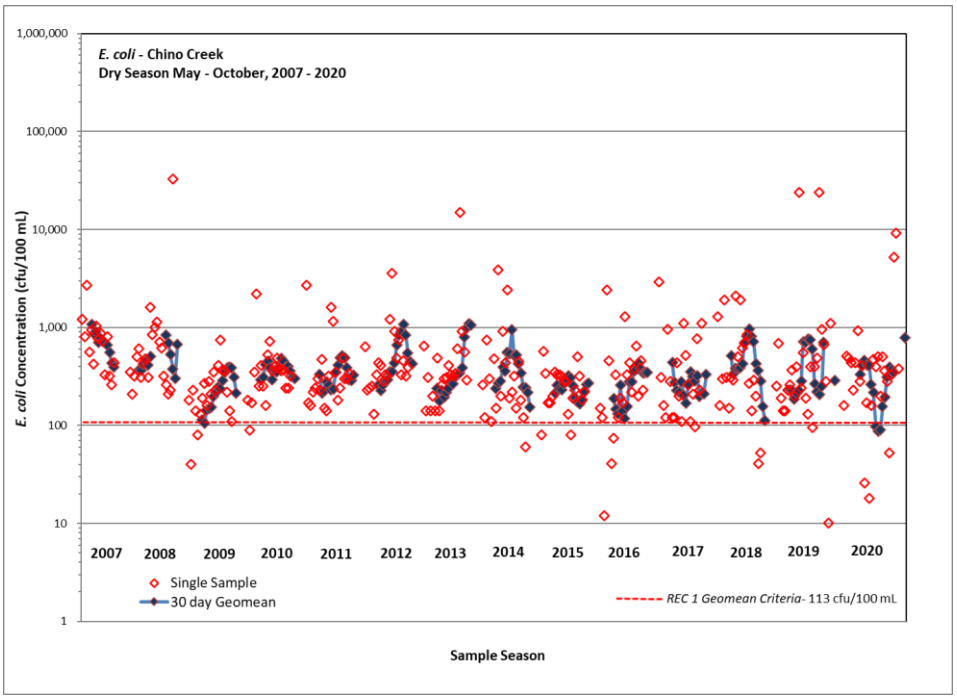

Figure 4-37. Time Series Distribution of *E. coli* Geomean Concentrations at Chino Creek from 2007 through 2020

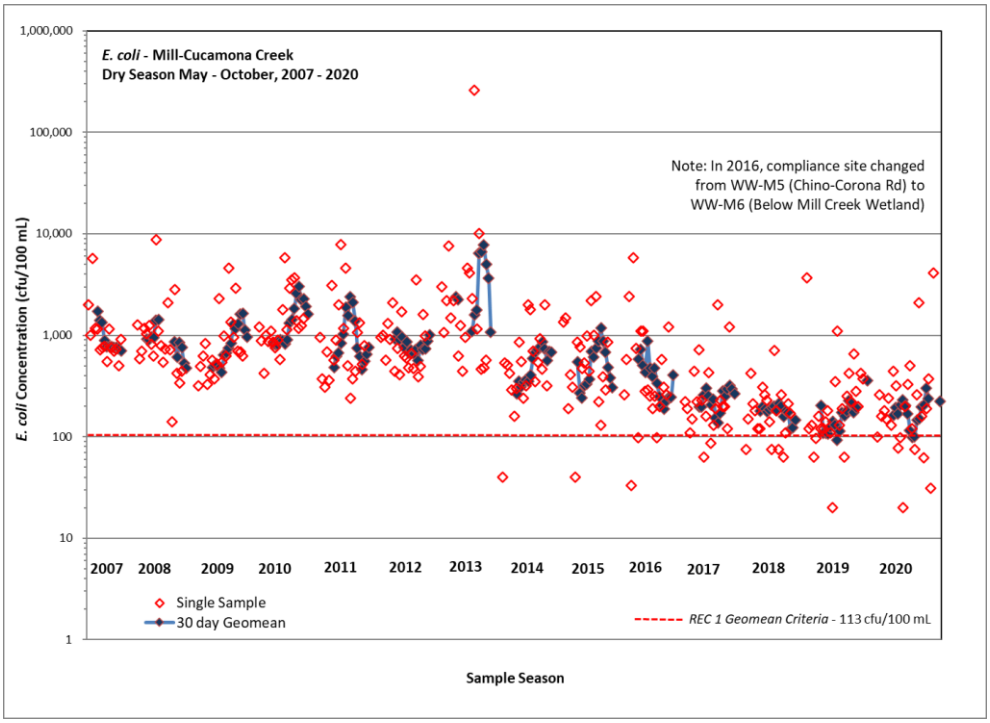

Figure 4-38. Time Series Distribution of *E. coli* Geomean Concentrations at Mill-Cucamonga Creek from 2007 through 2020

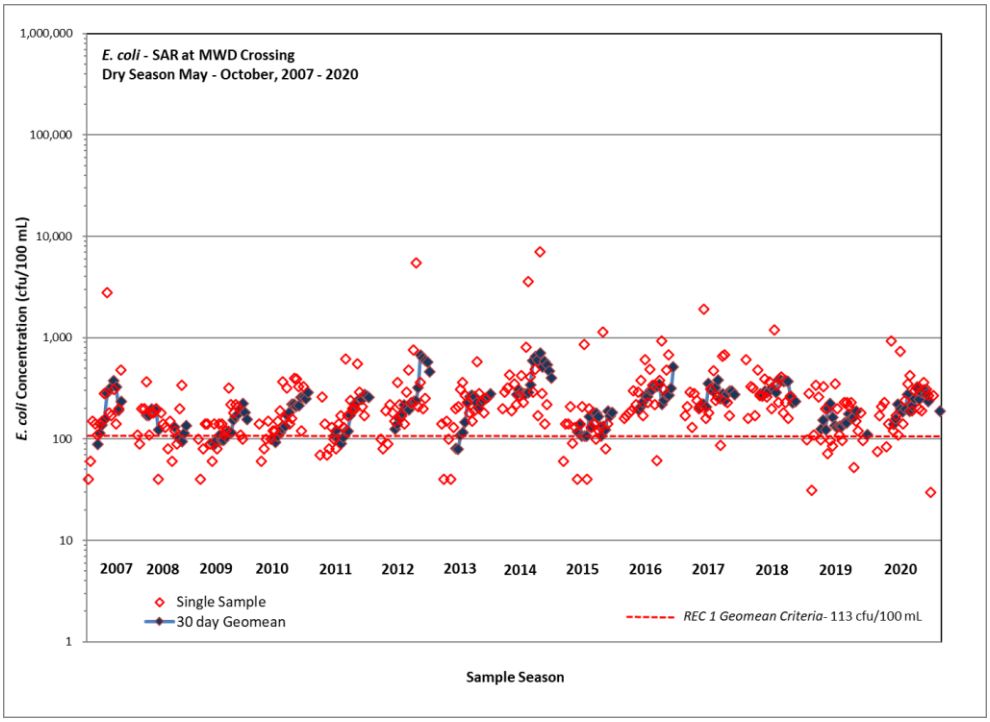

Figure 4-39. Time Series Distribution of *E. coli* Geomean Concentrations at Santa Ana River at MWD Crossing from 2007 through 2020

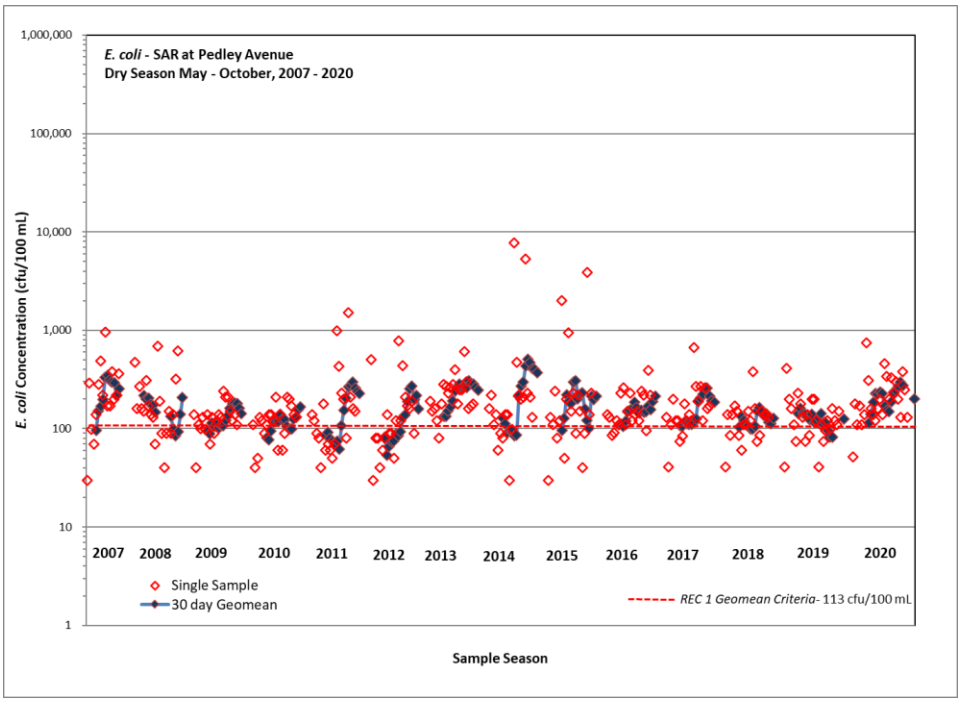

Figure 4-40. Time Series Distribution of *E. coli* Geomean Concentrations at Santa Ana River at Pedley Avenue from 2007 through 2020

4.2.4 Compliance Analysis

The compliance analysis compares the *E. coli* geomeans to the MSAR Bacteria TMDL geomean WLAs/LAs of 113 organisms/100 mL for a 5-sample/30-day geomean (Section 1.2.1). Geometric means were calculated only when at least five sample results were available from the previous 30-day period.

Most of the Priority 2 geomeans exceeded the MSAR TMDL WLAs/LAs, with all samples collected at Chino Creek exceeding the goal. At Prado Park Lake, only the cool, dry season sample exceeded the goal. All geomeans calculated during the cool, dry season except for SAR at MWD Crossing exceeded the TMDL WLAs/LAs. Table 4-6 shows the exceedance frequencies at each TMDL site.

Table 4-6. Frequency of Exceedance with MSAR TMDL WLAs/LAs for *E. coli* (113 MPN/100 mL) for the 2020 Dry Weather Samples

Site ID	Site	Warm, Dry Season Geomean WLA/LA Exceedance Frequency (%) (n=16)	Cool, Dry Season Geomean WLA/LA Exceedance Frequency (%) (n=1)
WW-C3	Prado Park Lake	0%	100%
WW-C7	Chino Creek at Central Avenue	94%	100%
WW-M6	Mill-Cucamonga Creek	100%	100%
WW-S1	Santa Ana River at MWD Crossing	100%	100%
WW-S4	Santa Ana River at Pedley Avenue	94%	100%

4.3 Priority 3

4.3.1 Water Quality Observations

Figures 4-41 through 4-47 summarize water quality field observations at Priority 3 sites (Table 4-7). Key observations are summarized below.

- Samples and measurements were not collected from Borrego Creek (P3-OC2) and Los Trancos Creek (P3-OC5) due to dry conditions. One sample from San Timoteo Creek Reach 2 (P3-SBC3), and three samples from Warm Creek (P3-SBC4) were not collected due to dry conditions. No samples were collected from Buck Gully (P3-OC3) and Morning Canyon Creek (P3-OC6). Sites where no samples were collected during the 2020-2021 dry season are not included on Figures 4-41 through 4-47.
- Figure 4-41 presents pH measurements. During the dry, warm sampling period, pH observations were generally within the allowable range (6.5 to 8.5) for Bolsa Chica Channel (P3-OC1), Peters Canyon Wash (P3-OC7), and San Diego Creek Reach 2 (P3-OC9). The upper limit was exceeded for 80 percent of samples for Serrano Creek (P3-OC11) and 100 percent of the samples at San Diego Creek Reach 1 (P3-OC8), both of the San Timoteo Creek sites (P3-SBC2 and P3-SBC3), and Warm Creek (P3-SBC4).
- Figure 4-42 shows water temperatures generally range from 12°C to 33°C with the highest temperatures (28 to 33°C) observed at both of the San Timoteo Creek sites (P3-SBC2 and P3-SBC3) and Warm Creek (P3-SBC4).
- Figure 4-43 shows that DO levels at all sites met the WQO for a minimum of 5 mg/L for WARM use except for at Peters Canyon (P3-OC7), where the observations ranged from 3.4 to 8.5 mg/L.
- Conductivity ranged from 700 to 3,400 µS/cm at Priority 3 sites (Figure 4-44). The lowest conductivity levels were observed at SAR Reach 4 (P3-SBC1). Conductivity levels were higher for sites in Orange County, ranging from 1,054 to 3,336 µS/cm. At inland sites, conductivity ranges from 402 to 2,109 µS/cm.
- Figure 4-45 shows that turbidity levels are generally low with 85 percent of measurements less than 10 NTU. The highest turbidity values were recorded at San Diego Creek Reach 1 (P3-OC8), and San Timoteo Creek Reach 2 (P3-SB3), ranging from 4 to 46 NTU.
- Similar to turbidity, Figure 4-45 shows that TSS is generally low at all sites, with the highest measurements at San Diego Creek Reach 1 (P3-OC8), and San Timoteo Creek Reach 2 (P3-SBC3), ranging from 4 to 88 mg/L.
- Figure 4-47 shows that flow was low at all of the Priority 3 sites (less than 10 cfs) except for SAR Reach 4 (P3-SBC1). Flow values were very low for the San Timoteo sites (P3-SBC2 and P3-SBC3) and Warm Creek (P3-SBC4).

Table 4-7. Priority 3 Monitoring Sites

Site ID	Site Description	County
P3-OC1	Bolsa Chica Channel upstream of Westminster Blvd/Bolsa Chica Rd	Orange
P3-OC2	Borrego Creek upstream of Barranca Parkway	Orange
P3-OC3	Buck Gully Creek Little Corona Beach at Poppy Avenue/Ocean Blvd	Orange
P3-OC5	Los Trancos Creek at Crystal Cove State Park	Orange
P3-OC6	Morning Canyon Creek at Morning Canyon Beach	Orange
P3-OC7	Peters Canyon Wash downstream of Barranca Parkway	Orange
P3-OC8	San Diego Creek downstream of Campus Drive (Reach 1)	Orange
P3-OC9	San Diego Creek at Harvard Avenue (Reach 2)	Orange
P3-OC11	Serrano Creek upstream of Barranca/Alton Parkway	Orange
P3-RC1	Goldenstar Creek at Ridge Canyon Drive	Riverside
P3-SBC1	Santa Ana River Reach 4 above S. Riverside Avenue Bridge	San Bernardino
P3-SBC2	San Timoteo Creek Reach 1A at Anderson St.	San Bernardino
P3-SBC3	San Timoteo Creek Reach 2 at San Timoteo Canyon Rd.	San Bernardino
P3-SBC4	Warm Creek below Fairway Dr.	San Bernardino

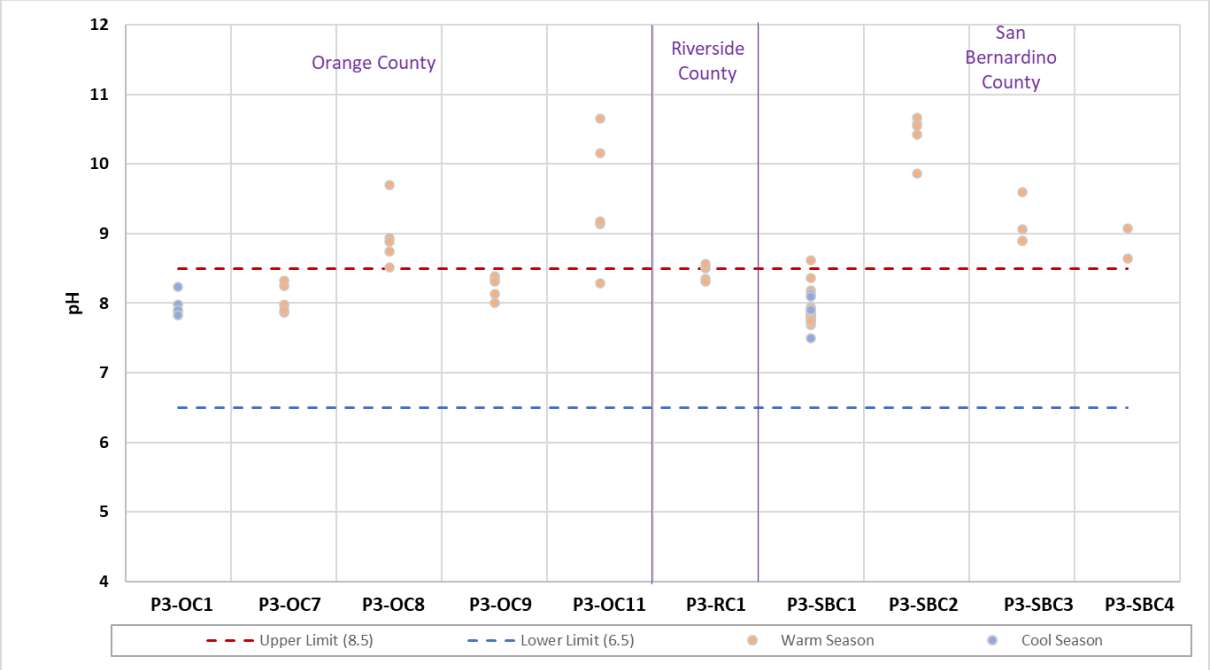

Figure 4-41. Distribution of pH Measurements at Priority 3 Sites

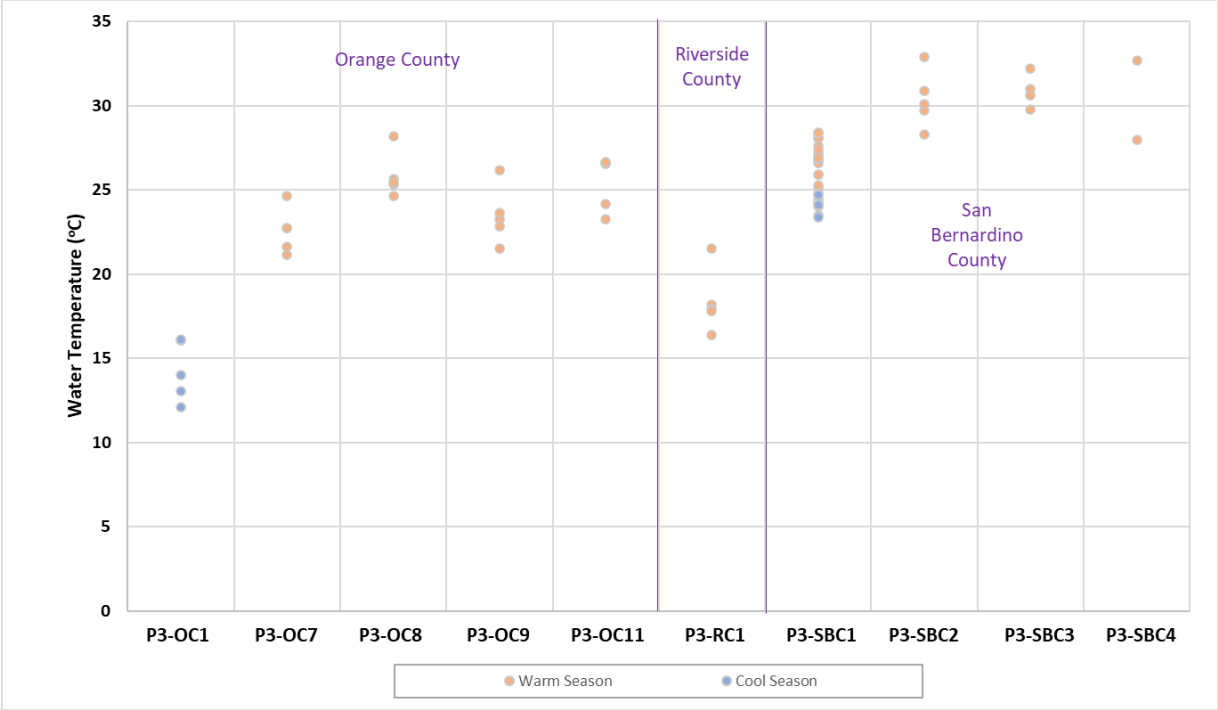

Figure 4-42. Distribution of Water Temperature Measurements at Priority 3 Sites

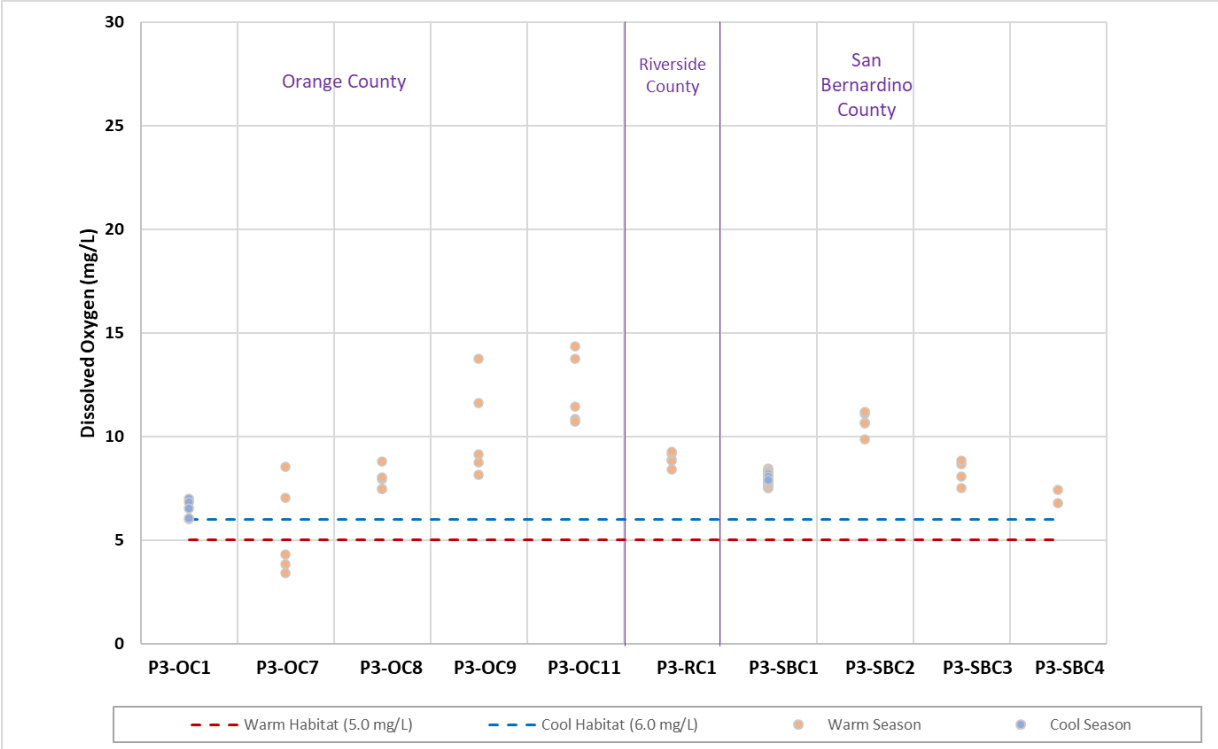

Figure 4-43. Distribution of Dissolved Oxygen Measurements at Priority 3 Sites

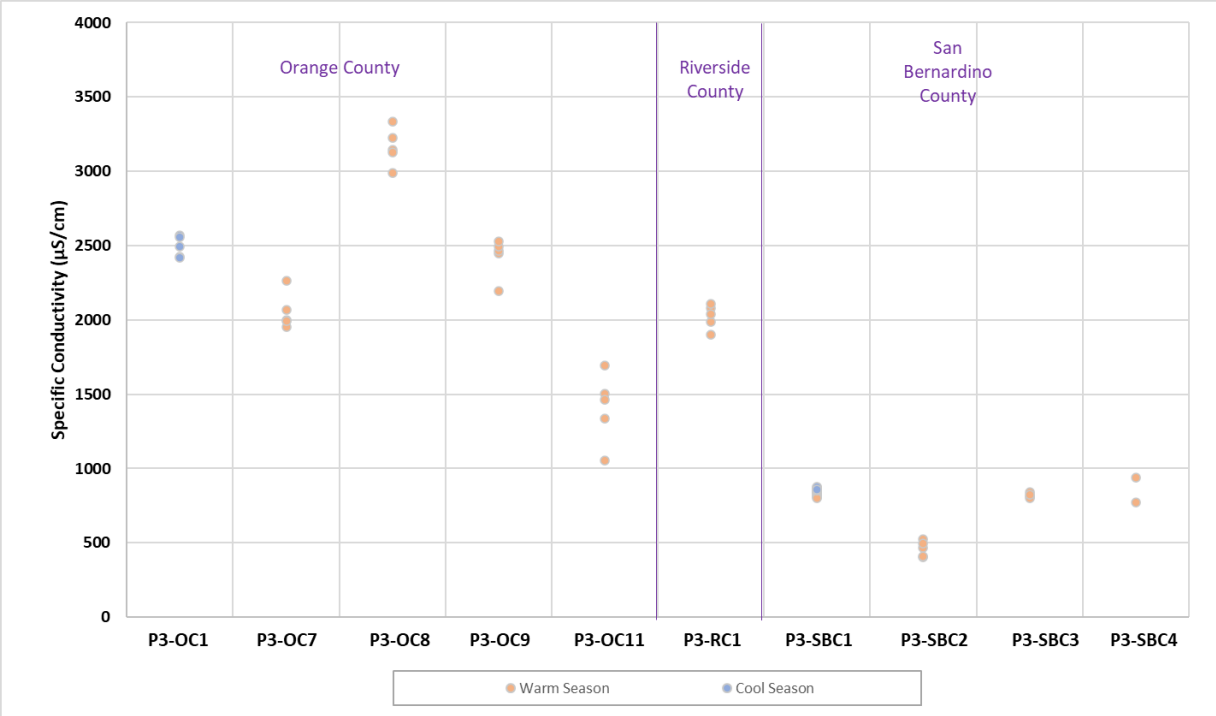

Figure 4-44. Distribution of Specific Conductivity Measurements at Priority 3 Sites

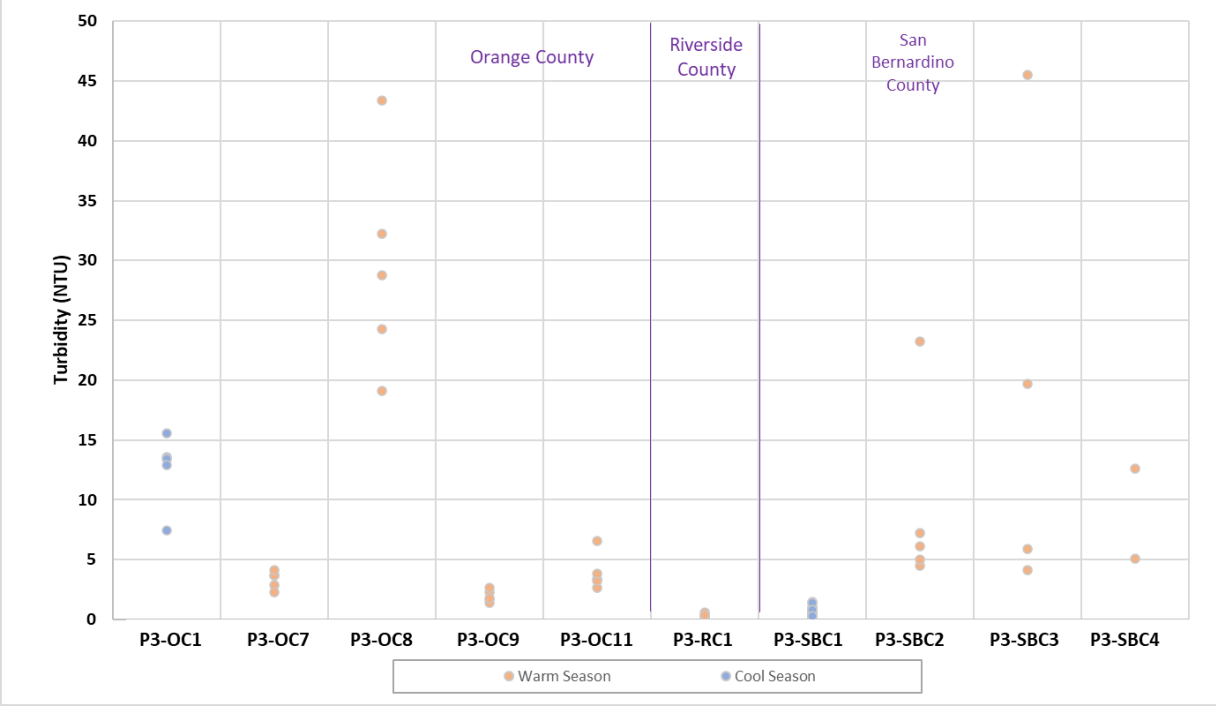

Figure 4-45. Distribution of Turbidity Measurements at Priority 3 Sites

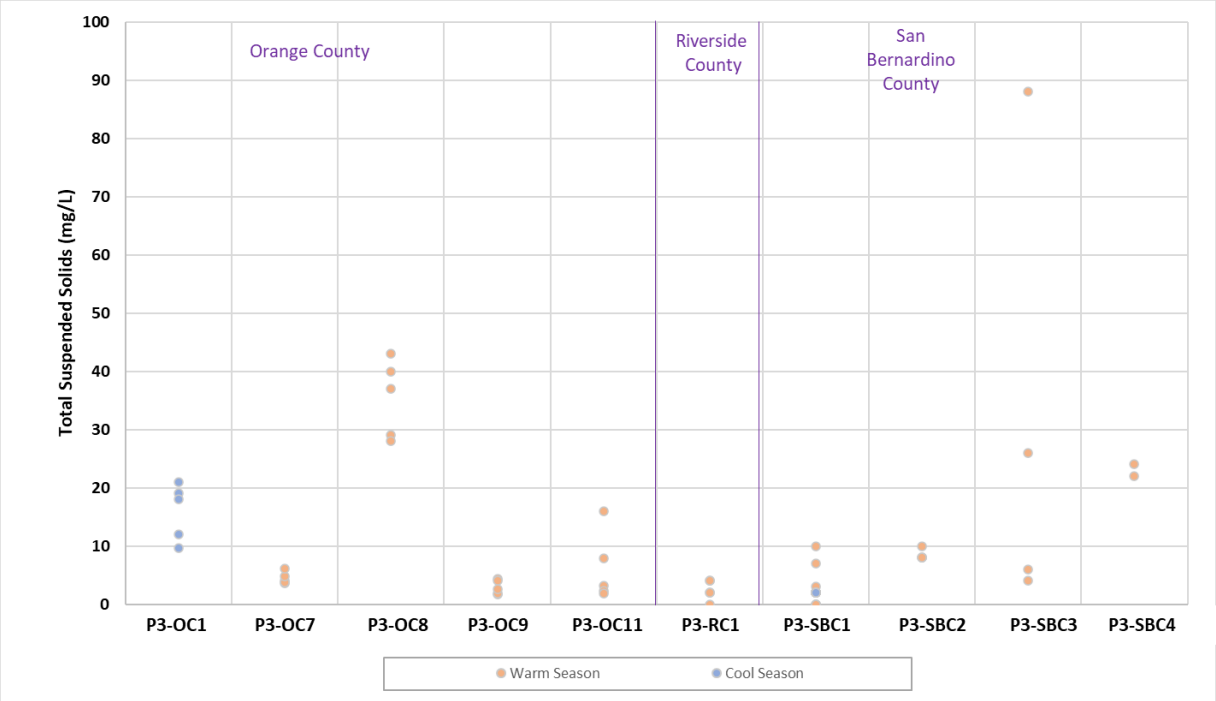

Figure 4-46. Distribution of TSS Measurements at Priority 3 Sites

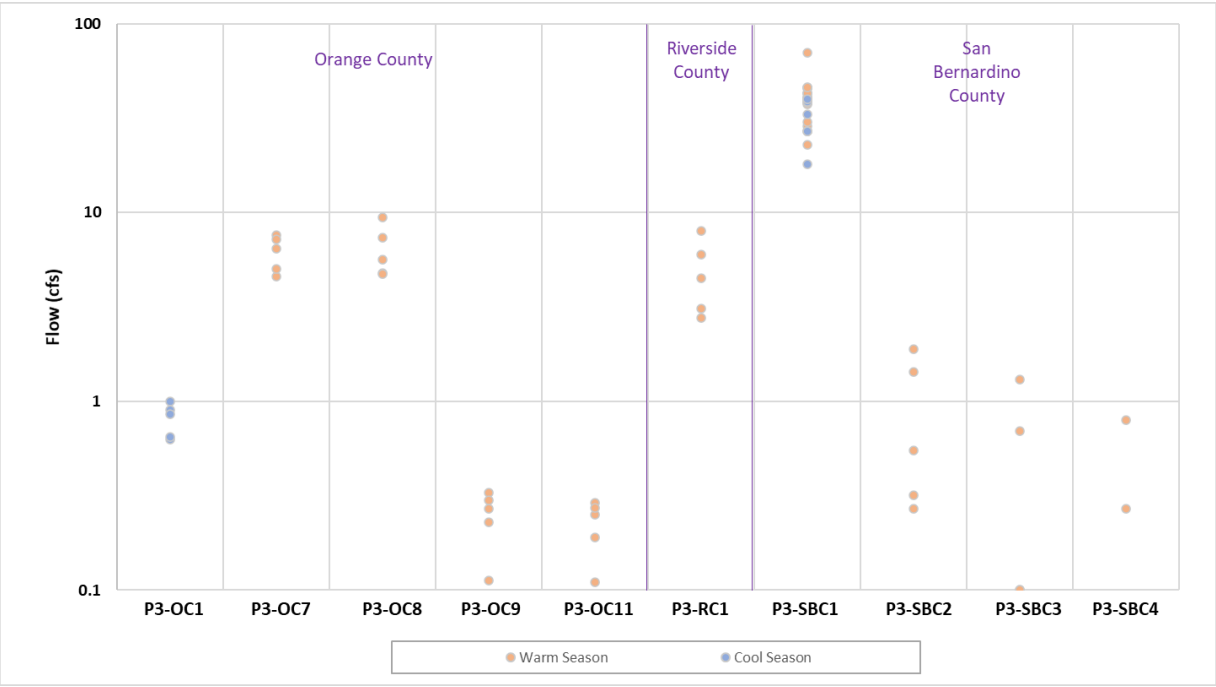

Figure 4-47. Distribution of Flow Measurements at Priority 3 Sites

4.3.2 Bacteria Characterization

Figure 4-48 summarizes the distribution of *E. coli* concentrations at Priority 3 sites during dry weather.

- Figure 4-48 shows that the 2020 5-week geomeans of *E. coli* concentrations from six Priority 3 sites were higher than the Statewide Bacteria Provision geomean WQO of 100 organisms/100 mL. The geomeans for San Diego Creek Reach 1 (P3-OC8) and San Timoteo creek Reach 1A (P3-SBC2) were the only sites that met the WQO.
- An in-depth analysis was performed to identify the current state of all Priority 3 waterbodies within the RBMP program and to develop a recommendation for actions moving forward. A summary of the analysis is provided below. More detailed analysis, including site maps and characterization of data from other studies, is provided in a separate technical memorandum (CDM Smith, 2021).[22]

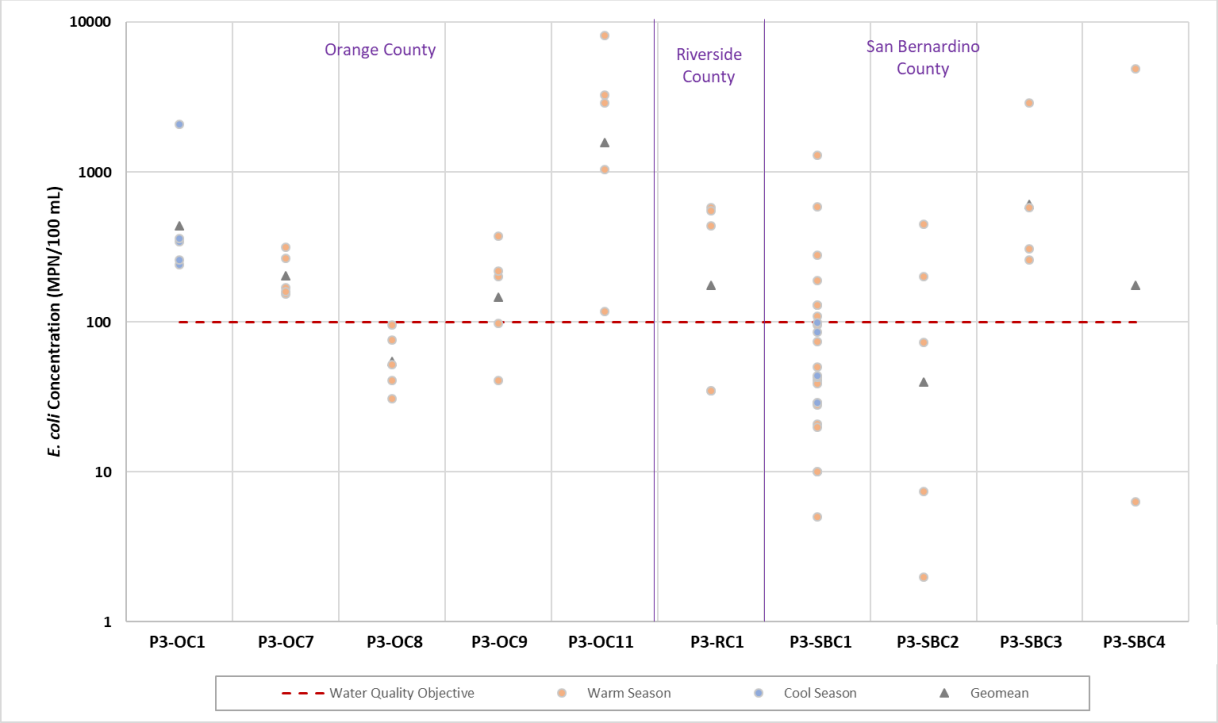

Figure 4-48. Distribution of E. Coli Concentration Measurements at Priority 3 Sites

Fecal bacteria and in-situ field measurements from the monitoring over five consecutive weeks in each dry season from 2016-2020 were analyzed to assess current conditions, apparent trends, and potential explanatory variables such as flow rate, seasonality, temperature, pH, and conductivity. A summary of ranges of data for key parameters over the monitoring period is provided in Table 4-8. No discernable trends of increasing or decreasing fecal bacteria concentrations were noted from the monitoring data.

[22] CDM Smith, 2021. Modifications to Sampling Program for Bacteria Impaired without TMDL "Priority 3" Waters. Draft Technical Memorandum dated March 26, 2021.

Table 4-8. Summary of Key Water Quality Data from RBMP Priority 3 Waters

Freshwaters on 2018 303(d) List with Bacteria Impairment [1]	Existing Site	Range of Conductivity (us/cm)	Estimate Range of Flow (cfs)	Fecal Bacteria Indicator	Geometric Mean of Sampling (mpn/100mL) [2]				
					2016	2017	2018	2019	2020
Goldenstar Creek	P3-RC1	1901 – 2272	0.4 – 8	*E. coli*	242	417	118	360	177
Santa Ana River Reach 4	P3-SBC1	240 – 892	2.6 – 70.6	*E. coli*	48	70	74	25-112	16 -247
San Timoteo Creek Reach 1A	P3-SBC2	402 – 523	0.3 – 1.9	*E. coli*	NA	NA	NA	NA	40
San Timoteo Creek Reach 2	P3-SBC3	802 – 842	0 – 1.3	*E. coli*	NA	NA	NA	NA	607 [4]
Bolsa Chica	P3-OC1	1358 – 2900	0.1 – 1.5	*E. coli*	51	534	31	60	439
				Enterococcus	NA	NA	NA	34	315
Borrego Creek	P3-OC2	NA	0	*E. coli*	Dry	Dry	Dry	Dry	Dry
Buck Gully	P3-OC3	3987 – 6884	0 – 0.9	*E. coli*	74	89	20	351	NA
				Enterococcus	NA	NA	29 [3]	544	NA
Los Trancos Creek	P3-OC5	1000 – 7933	0 – 1.1	*E. coli*	457	658	Dry	Dry	Dry
Morning Canyon Creek	P3-OC6	240 – 21446	0 – 1.0	*E. coli*	633	212	858	170	NA
				Enterococcus			526 [3]	1067	NA
Peters Canyon Channel	P3-OC7	1787 – 2760	0.9 – 9.7	*E. coli*	198	201	562	540	203
				Enterococcus				660	NA
San Diego Creek Reach 1	P3-OC8	2108 – 3742	0.2 – 9.4	*E. coli*	329	116	176	184	55
San Diego Creek Reach 2	P3-OC9	766 – 2735	0.1 – 0.8	*E. coli*	202	373	155	43	146
Serrano Creek	P3-OC11	717 – 2092	0.01 – 1.4	*E. coli*	166	1080	221	864	1572

[1] Waterbodies on the 303(d) list for bacteria impairment that are not included within priority 3 of the RBMP include Knickerbocker Creek, Mill Creek Reach 1, Mountain Home Creek, Mountain Home Creek East Fork and Newport Slough. Reasons for exclusion of these waters are presented in the RBMP Monitoring Plan and QAPP.
[2] Shaded cells indicated exceedance of geomean WQO (*E. coli* – 100 MPN/100mL and Enterococcus – 30 MPN/100mL)
[3] Sampling period extended from December 2018 to February 2019
[4] 5-sample geomeans were not able to be calculated due to channel conditions being dry during at least one of the five scheduled sample weeks

In the Santa Ana River watershed, 20 waterbodies are currently on the 303(d) List with no adopted TMDL: ten in Orange County; two in Riverside County, and eight in San Bernardino County. This list differs from the list used to create the RBMP in 2015 because multiple waters have been delisted or newly listed. Monitoring of Priority 3 waters (bacteria impairment without TMDL) during the dry season in 2016-2020 has provided sufficient data to recommend a course of action in each waterbody to either transition to source identification or continue sampling at the same station within the receiving water. Table 4-9 presents recommended course of action to transition nine of these waters from routine monitoring to source identification, continue to monitor four waterbodies that were added to 303d list in 2018. Lastly, two waterbodies were found to be persistently dry, Los Trancos and Borrego Creek. OCPW will continue to visit these sites to verify their dry (or not) condition during the dry season sampling dates.

Table 4-9. Recommendations for Continued Monitoring or Source Identification in each of the RBMP Priority 3 Waters

Waterbody	Existing Site	Recommended Action	Source Investigation Status
Bolsa Chica	P3-OC1	Transition to source investigation	OCPW developing new bottom-up sampling scheme for 2021 dry season
San Diego Creek Reach 1	P3-OC8	Transition to source investigation	Newport Bay Watershed Source Investigation expected to kick off 2021 dry season
San Diego Creek Reach 2	P3-OC9	Transition to source investigation	Newport Bay Watershed Source Investigation expected to kick off 2021 dry season
Peters Canyon Channel	P3-OC7	Transition to source investigation	Newport Bay Watershed Source Investigation expected to kick off 2021 dry season
Borrego Creek	P3-OC2	Verify persistence of dry condition	N/A
Serrano Creek	P3-OC11	Transition to source investigation	Newport Bay Watershed Source Investigation expected to kick off 2021 dry season
Buck Gully	P3-OC3	Transition to source investigation	Regional Board coordinating with City of Newport Beach
Los Trancos Creek	P3-OC5	Verify persistence of dry condition	N/A
Morning Canyon Creek	P3-OC6	Transition to source investigation	Regional Board coordinating with City of Newport Beach
Goldenstar Creek	P3-RC1	Transition to source investigation	RCFC&WCD identified this waterbody as a potential site for causal assessment activities over the next 5 years through the SMC Regional Bioassessment program
Santa Ana River Reach 4	P3-SBC1	Transition to source investigation	Mainstem sampling through MSAR TMDL Task Force, SAWPA Homeless Encampments Impacts Study
San Timoteo Creek Reach 1A	P3-SBC2	Continue monitoring at five samples/yr	N/A
San Timoteo Creek Reach 2	P3-SBC3	Continue monitoring at five samples/yr	N/A
San Timoteo Creek Reach 3	P3-RC3	Identify location for monitoring at five samples/yr	N/A
Warm Creek	P3-SBC4	Continue monitoring at five samples/yr	N/A

4.4 Priority 4

The 2015 Basin Plan Amendment includes provisions applicable to waters with completed use attainability analyses (UAAs) supporting change of beneficial use from REC 1 to REC2 Only to assure bacteria water quality conditions do not degrade from baseline levels as a result of controllable factors.[23] A statistical analysis of historical data (2002-2011) was completed to estimate a baseline of bacterial water quality including geometric mean, median, standard deviation, coefficient-of-variation, maximum value, and 75th percentile density. The 75th

[23] https://www.waterboards.ca.gov/santaana/water_issues/programs/basin_plan/recreational_standards.html

percentile density serves as the antidegradation target, meaning that 3 of 4 samples in data collected after the 2015 BPA must fall below these values to infer no degradation.

4.4.1 Water Quality Observations

Each Priority 4 site (Table 4-10) is sampled once each year to evaluate compliance with the antidegradation target established for each waterbody. Table 4-11 summarizes the water quality field parameters from each site in 2020.

Table 4-10. Priority 4 Monitoring Sites

Site ID	Site Description	County
P4-RC1	Temescal Creek at Lincoln Avenue	Riverside
P4-OC1	Santa Ana Delhi Channel Upstream of Irvine Avenue	Orange
P4-OC2	Santa Ana Delhi Channel in Tidal Prism	Orange
P4-OC3	Greenville-Banning Channel in Tidal Prism	Orange
P4-SBC1	Cucamonga Creek at Hellman Avenue	San Bernardino

Table 4-11. Summary of Water Quality Data Collected from Priority 4 Sites

Parameter	Santa Ana Delhi Channel (P4-OC1)	Santa Ana Delhi Channel in Tidal Prism (P4-OC2)	Greenville-Banning Channel in Tidal Prism (P4-OC3)	Temescal Creek at Lincoln Avenue (P4-RC2)
Sample Date	9/14/2020	9/14/2020	9/14/2020	6/24/2020
pH	7.8	7.5	8.0	9.3
Water Temperature (°C)	20.8	21.7	21.1	25.3
Dissolved Oxygen (mg/L)	7.3	4.0	2.8	9.3
Conductivity (µS/cm)	2,505	44,939	28,416	1,481
Turbidity (NTU)	1.2	4.3	5.1	3.1
TSS (mg/L)	0.9	7.9	7.4	6
Flow (cfs)	NA	NA	NA	9

4.4.2 Bacteria Characterization

Priority 4 water quality sample results were compared to site-specific single sample antidegradation targets (Table 4-12, Figure 4-49). Greenville-Banning Channel in Tidal Prism (P4-OC2) exceeded the antidegradation target of 64 MPN/100mL. As shown in Table 4-13, the three required monthly follow-up samples were all below the antidegradation target. The other three Priority 4 sites met their antidegradation targets.

In summary, all other Priority 4 sites indicator bacteria results did not exceed the antidegradation target and monitoring at these sites was considered complete for the monitoring year.

Table 4-12. Antidegradation Targets for Priority 4 Sites

Site ID	Site Description	Single Sample Antidegradation Target (MPN/100 mL)	*E.coli* Sample Result	*Enterococcus* Sample Result	Sample Date
P4-OC1	Santa Ana Delhi Channel Upstream of Irvine Avenue	1067	636		9/14/2020
P4-OC2	Santa Ana Delhi Channel in Tidal Prism	464		84	9/14/2020
P4-OC3	Greenville-Banning Channel in Tidal Prism	64		255[1]	9/14/2020
P4-RC2	Temescal Creek at Lincoln Avenue	725	130		6/24/2020
P4-SBC1[2]	Cucamonga Creek at Hellman Avenue	1385			

[1] This sample exceeded the anti-degradation target for Greenville-Banning Channel in Tidal Prism of 64 MPN/100mL and resulted in three monthly follow-up samples. Results are shown in Table 4-13.
[2] Cucamonga Creek at Hellman Avenue was sampled monthly to provide data to support updating the anti-degradation target. The background and results are further explained in Section 4.4.3.

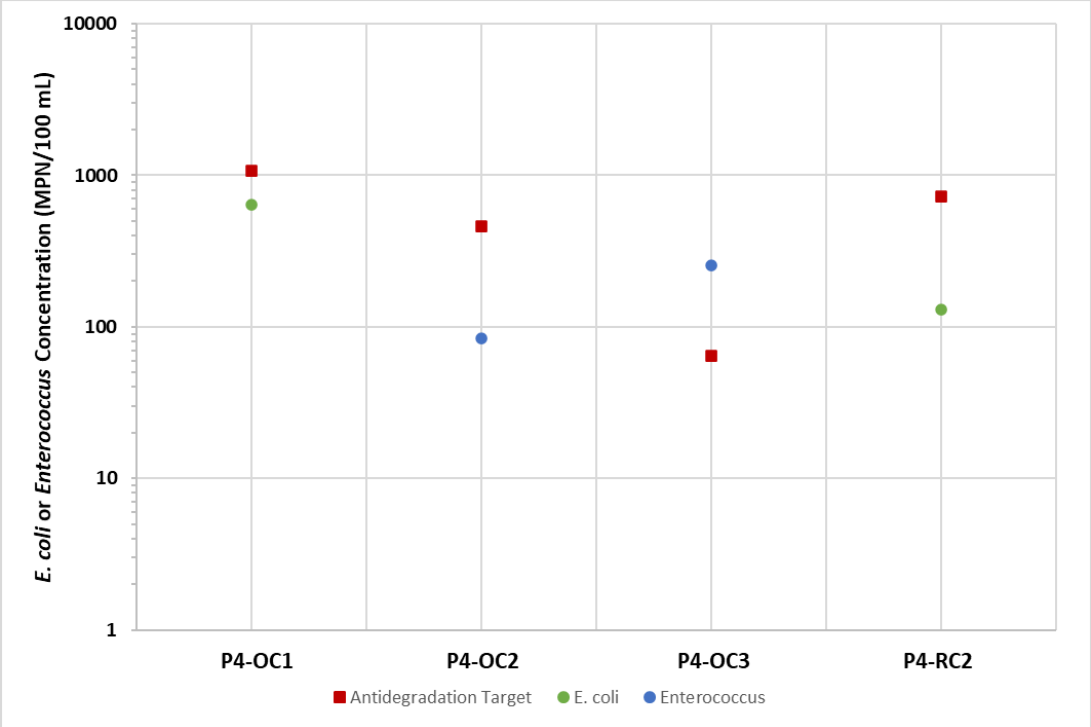

Figure 4-49. Monitoring Results and Antidegradation Targets for Priority 4 Sites

Table 4-13. Monthly Follow-Up Sampling at Greenville Banning Channel in Tidal Prism (P4-OC3)

Sample Requirement	Sample Date	*Enterococcus* Concentration (MPN/100 mL)
Original Annual Sample	9/14/2020	255[1]
Required Monthly Follow-up Samples	10/28/2020	ND
	11/24/2020	63
	12/16/2020	20

[1] This sample exceeded the anti-degradation target for Greenville-Banning Channel in Tidal Prism of 64 MPN/100mL

4.4.3 Cucamonga Creek Reach 1 Anti-Degradation Update

In Cucamonga Creek Reach 1, dry weather flow conditions have decreased dramatically since the period of fecal bacteria sample collection used to represent a baseline condition for antidegradation targets. This motivated the RBMP Task Force to increase the frequency of sampling in Cucamonga Creek at Hellman Avenue (Station P4-SBC1) to develop a sufficient dataset to reset the baseline bacteria water quality and update the antidegradation target based on data collected over 2016-2021.

4.4.3.1 Changes to Dry Weather Hydrology

Review of data from USGS gauge in Cucamonga Creek at Merrill Avenue (Station 11073495), shows flow rates on sampled days in Cucamonga Creek Reach 1 ranged from 25 to 50 cfs over the 2002-2011 period used to set the current antidegradation target of 1,385 MPN/100mL for Cucamonga Creek Reach 1. During the RBMP period of record (2016-2021), dry weather flow rates on sampled days are typically less than 15 cfs (Figure 50). The primary reason for the reduction in dry weather flow within Cucamonga Creek Reach 1 is from increased water recycling by IEUA at RP1, reducing the discharge to the creek.

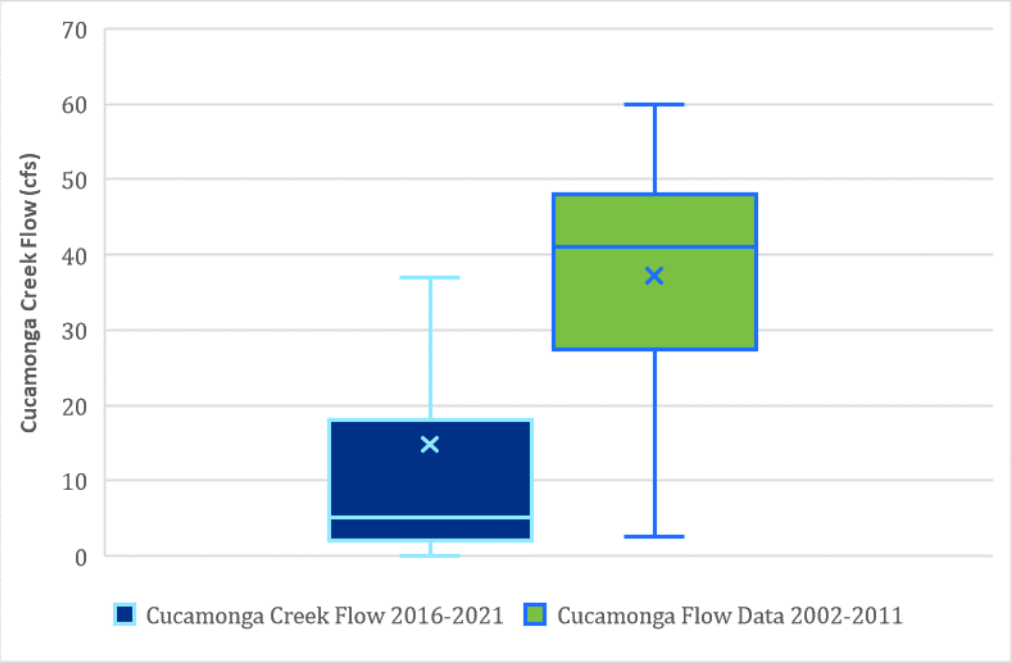

Figure 4-50. Dry Weather Flow on Sampled Dates (USGS Gage #11073495)

4.4.3.2 Baseline Bacteria Characterization and Antidegradation Threshold Recalculation

The dataset used for setting the current baseline bacteria condition and antidegradation threshold in Cucamonga Creek Reach 1 includes samples from two stations, Highway 60 and Chino-Corona Road[24]; sampling data is available from2002 through 2011. Statistics from this dataset are reported in Table 4-14. The same statistical analysis was applied to data collected

[24] Station at Chino-Corona Road is technically within Mill-Cucamonga Creek (REC1) and thus just downstream of the REC2 Only segment of Cucamonga Creek Reach 1

from Cucamonga Creek at Hellman Avenue over the 2016-2021 period of record that were pooled from several programs including Priority 4 of the RBMP, "10-week" sampling by San Bernardino County Flood Control District (SBCFCD), and Tier 1 data collection by the Middle Santa Ana River TMDL Task Force during the 2019 Synoptic Survey (Table 4-14).

The method used to calculate antidegradation thresholds as prescribed in the BPA involves fitting a dataset to a log-normal distribution to characterize the full range of potential bacteria concentrations. The standard deviation of the log-transformed data is used to estimate deviations from the mean for a target frequency of occurrence; the 75th percentile is used in Table 5-REC2 Only Targets-FW of the Basin Plan.[25] Estimating a bacteria concentration for the 75th percentile (Cp) of the fitted distribution involves use of a z-score for a standard normal distribution (z=0.675 for 75th percentile).

The value is then equal to the exponentiation of the log-mean ($\bar{y}$) plus the deviation from the log-mean ($zp\sigma$), as follows:

$$C_p = e^{(\bar{y} + z_p\sigma)}$$

Table 4-14. Recalculation of Baseline Bacteria Water Quality and Antidegradation Threshold for Cucamonga Creek Reach 1a during Dry Weather [1]

Parameter	Existing Baseline	Recalculated Baseline
Stations	Highway 60, Chino-Corona Rd	Hellman Avenue
Period of Record	2002-2011	2016-2021
n	197	62
Geomean (MPN/100mL)	509	481
Antidegradation Target: 75th Percentile Density (MPN/100mL)	1,385	1,340

[1] Dry weather is determined by daily flow <60 cfs at Mill-Cucamonga

The following provides a brief explanation of each calculated value in the table:

- n – The count of samples in the dataset.
- Geomean – The central tendency of the dataset, determined by multiplying the series of sample values together then taking the "nth" root of the product, where n is the number of samples in the dataset.
- 75th Percentile Density. This is the 75th percentile from a log-normal distribution fitted to historical data and serves as the antidegradation threshold for REC2-Only waters.

4.4.3.3 Conclusion

The current Cucamonga Creek Reach 1 anti-degradation target of 1,385 MPN/100mL was calculated using the 75th percentile density of log-normal distribution for data collected from Highway 60 and Chino-Corona Road sites over the period from 2002-2011. Recalculation using data collected from Hellman Avenue over the 2016-2021 period (the proposed revised baseline

[25] https://www.waterboards.ca.gov/santaana/water_issues/programs/basin_plan/docs/2019/New/Chapter_5_June_2019.pdf

conditions) suggests an anti-degradation target of 1,340 MPN/100mL. Figure 4-51 shows the fitted log-normal distributions of both the current 2004-2011 baseline and proposed revised baseline 2016-2021 datasets.

While flow gage analysis of Cucamonga Creek shows a significant hydrologic transformation, the bacteria concentrations have remained almost identical. This outcome differed from the RBMP Task Forces' conceptual model that a reduction in dilution from RP1 effluent would result in a rise in fecal bacteria concentrations within the downstream segment of Cucamonga Creek Reach 1. Instead, the similarities in the datasets could be explained by 1) reductions in dry weather bacteria loads from hydrologically connected urban drainage areas proportional to the reductions in diluent water or 2) longer hydraulic residence times allowing for enhanced ultraviolet irradiation of fecal bacteria in-stream, or 3) diminished extent, and shear stress upon, naturalized fecal bacteria colonies in the channel bottom.

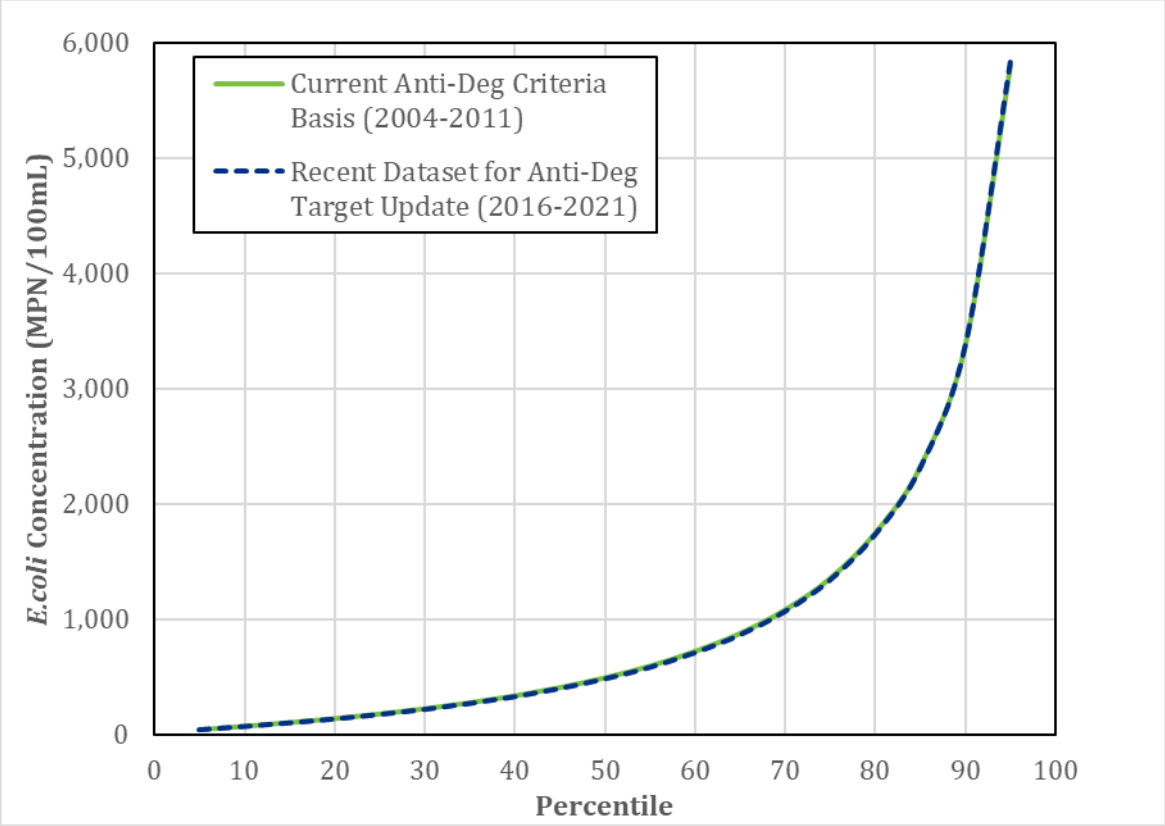

Figure 4-51. Fitted Log-normal Distribution for Current Baseline (2002-2011) and Proposed Recalculated Baseline (2016-2021) in Cucamonga Creek Reach 1 during Dry Weather Conditions

Lastly, these findings clearly indicate significant reductions of fecal bacteria loading to Mill-Cucamonga Creek downstream of Cucamonga Creek Reach 1, roughly proportional to increases in recycled water use from RP1. Mill-Cucamonga Creek is one of the MSAR bacteria TMDL waters. This conclusion is also supported by multiple studies at Tier 1 and 2 sites and analysis in the last three Triennial Review reports, which demonstrate the effectiveness of implementation of the comprehensive bacteria reduction plans (CBRPs) by the upstream MS4 permittees.

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Section 5

Recommendations for 2021-2022 Monitoring Program

This section describes recommended updates to the Monitoring Plan for the 2021-2022 monitoring year.

- The site newly listed in the 2014/2016 303(d) List of Impaired Waters, San Timoteo Creek Reach 3 (P3-RC3) will be added to the RMP.
- Static quarterly PDF reports should be replaced with interactive dashboard that is updated quarterly. The dashboard should provide interactive geographical user interface that provides critical data-driven information and will incorporate complex plots and maps to support analyses of data.
- Per recommendations in the "Modifications to Sampling Program for Bacteria Impaired without TMDL 'Priority 3' Waters", sampling at some Priority 3 waters with five years of data will conclude and be replaced by source identification efforts. Source identification will be led by jurisdictions tributary to the subject waters applying methods made in available in the QAPP for the RBMP. Key stakeholders will provide updates to the Task Force as appropriate.
- Per the conclusion in the "Re-calculation of Anti-degradation Target for Cucamonga Creek Reach 1" memo it is recommended that the anti-degradation target remain the same despite hydrologic changes.
- Conduct a special study to analyze bacteria present in the Santa Ana channel bed. This study will evaluate the extent of naturalized *E.coli* in bottom sediments or biofilms in the Santa Ana river.
- Update QAPP to reflect field QAQC sampling routine that closely matches SWAMP guidelines

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Appendix A
Data Summary

Tables A-1 through A-34 summarize the water quality results obtained for *E. coli*, Enterococci, TSS, and field measurements from Priority 1, Priority 2, and Priority 3 sites during 2020 dry weather sampling activities and 2020-2021 storm event. Data from Priority 4 sites are included in Section 4.4 and are not reproduced in this appendix. Tables A-35 through A-37 summarize the daily mean flow measured at key USGS gages in the SAR watershed.

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Table A-1. *E. coli* (MPN/100 mL) Concentrations Observed at Priority 1 Lake Sites during the 2020 Dry Season (geometric mean based on previous five weekly samples; if reported value has a < or > qualifier, the actual value was used to calculate the geomean; BDL: below detection limit)

Week Beginning Date	Canyon Lake (P1-1)		Lake Elsinore (P1-2)		Lake Perris (P1-3)		Big Bear Lake (P1-4)	
	Result	Geomean	Result	Geomean	Result	Geomean	Result	Geomeans
5/10/2020	BDL	--	20	--	2	--	2	--
5/17/2020	1	--	5.2	--	BDL	--	4.1	--
5/24/2020	2	--	3.1	--	1	--	BDL	--
5/31/2020	BDL	--	13	--	2	--	BDL	--
6/7/2020	2	1.0	21	10	1	1.1	BDL	1.0
6/14/2020	1	1.0	5.2	8	1	1.0	1	1.0
6/21/2020	BDL	0.9	8.6	9	1	1.1	0.5	0.9
6/28/2020	2	1.1	67	10	BDL	0.9	1	0.8
7/5/2020	2	1.2	7.4	11	BDL	0.9	12	1.0
7/12/2020	BDL	1.0	8.5	13	14	1.3	5.2	1.2
7/19/2020	2	1.2	2	10	BDL	1.1	1	1.5
7/26/2020	BDL	1.1	4.1	8	BDL	1.0	1	1.6
8/2/2020	5.2	1.3	5.2	8	BDL	0.9	2	1.8
8/9/2020	2	1.5	1	6	BDL	0.8	BDL	1.8
8/16/2020	5.1	1.8	14	5	8.5	1.2	130	3.6
8/23/2020	4.1	2.0	1	3	3	1.6	BDL	2.3
8/30/2020	5.1	2.7	5.2	3	BDL	1.0	1	1.8
9/6/2020	5.2	3.1	2	3	4.1	1.3	1	2.0
9/13/2020	4.1	4.2	4.1	3	2	1.6	3.1	2.1
9/20/2020	2	3.7	11	4	13	2.5	4.1	3.1
10/25/2020	13	--	23	--	1	--	89	--
11/1/2020	14	--	14[1]	--	5.2	--	75	--
11/8/2020	2	--	17	--	25	--	8.5	--
11/15/2020	2	--	14	--	9.8	--	1	--
11/22/2020	4.1	5.0	6.3	14	14	7	44	19

[1] Field blank collected at this site had a detectable value

Table A-2. *E. coli* (MPN/100 mL) Concentrations Observed at Priority 1 Stream Sites during the 2020 Dry Season (geometric mean based on previous five weekly samples; if reported value has a < or > qualifier, the actual value was used to calculate the geomean; BDL = below detection limit)

Week Beginning Date	Mill Creek Reach 2 (P1-5)		Lytle Creek (P1-6)		SAR @ MWD Crossing (WW-S1)		SAR @ Pedley Avenue (WW-S4)	
	Result	Geomean	Result	Geomean	Result	Geomean	Result	Geomean
5/10/2020	3.1	--	13	--	75	--	52	--
5/17/2020	2	--	7.4	--	170	--	180	--
5/24/2020	4.1	--	34	--	210	--	110	--
5/31/2020	4.1	--	9.8	--	230	--	170	--
6/7/2020	BDL	2.2	12	13.1	84	138.9	110	114.0
6/14/2020	1	1.9	140	19.4	140	139.1	140	118.0
6/21/2020	3.1	2.1	16	18.9	930	182.5	740	153.4
6/28/2020	4.1	2.2	8.6	17.8	120	195.1	310	197.9
7/5/2020	2	2.2	18	20.2	170	195.1	160	194.6
7/12/2020	1	2.0	5.2	17	110	181.6	140	186.8
7/19/2020	1	1.4	14	16	730	244.4	120	210.2
7/26/2020	1	1.6	46	20	140	244.4	160	215.0
8/2/2020	1	1.6	12	14	240	195.0	200	172.8
8/9/2020	3.1	1.6	32	15.3	350	233.1	140	151.4
8/16/2020	BDL	1.2	38	19.0	420	296.9	460	209.3
8/23/2020	BDL	1.0	25	19.9	190	296.9	340	209.3
8/30/2020	BDL	0.9	32	25.8	300	256.0	200	227.9
9/6/2020	NA	NA	27	28.3	320	264.3	330	240.3
9/13/2020	NA	NA	32	26.9	200	278.1	230	253.1
9/20/2020	NA	NA	26	30.0	190	269.0	300	268.2
10/25/2020	BDL	--	42	--	360	--	200	--
11/1/2020	BDL	--	41	--	310	--	130	--
11/8/2020	1	--	12	--	270	--	380	--
11/15/2020	BDL	--	311	--	30	--	250	--
11/22/2020	BDL	1	29	28	270	189	130	200

[1] Field blank collected at this site had a detectable value

Table A-3. *E. coli* (MPN/100 mL) Concentrations Observed at Priority 2 Sites during the 2020 Dry Season (geometric mean based on previous five weekly samples; if reported value has a < or > qualifier, the actual value was used to calculate the geomean)

Week Beginning Date	Prado Park Lake Outlet (WW-C3)		Chino Creek @ Central Avenue (WW-C7)		Mill-Cucamonga Creek Below Wetlands (WW-M6)		SAR @ MWD Crossing (WW-S1)		SAR @ Pedley Avenue (WW-S4)	
	Result	Geomean	Result	Geomean	Result	Geomean	Result	Geomean	Result	Geomean
5/10/2020	10	--	160	--	100	--	75	--	52	--
5/17/2020	52	--	510	--	260	--	170	--	180	--
5/24/2020	98	--	490	--	160	--	210	--	110	--
5/31/2020	51	--	440	--	180	--	230	--	170	--
6/7/2020	30	37.9	230	332.2	150	162.2	84	139	110	114
6/14/2020	63	41.2	440	348.1	240	173.2	140	139	140	118
6/21/2020	10	33.7	930	400.6	130	166.2	930	182	740	153
6/28/2020	63	43.8	280	433.9	440	205.4	120	195	310	198
7/5/2020	41	42.3	410	420.6	320	211.6	170	195	160	195
7/12/2020	3	30.4	26	297.0	77	186.5	110	182	140	187
7/19/2020	52	25.2	170	243.3	98	179.2	730	244	120	210
7/26/2020	2	14.2	18	142.8	200	173.9	140	244	160	215
8/2/2020	63	19.2	160	106.5	200	186.8	240	195	200	173
8/9/2020	20	15.9	470	116.1	330	178.1	350	233	140	151
8/16/2020	120	26.1	400	189.3	500	206.5	420	297	460	209
8/23/2020	20	26.1	500	189.3	120	206.5	190	297	340	209
8/30/2020	10	19.8	200	194.5	75	197.5	300	256	200	228
9/6/2020	86	24.4	500	222.6	260	205.4	320	264	330	240
9/13/2020	63	40.0	360	341.5	2100	287.5	200	278	230	253
9/20/2020	160	45.7	280	369.9	160	278.4	190	269	300	268
10/25/2020	88	--	52	--	62	--	360	--	200	--
11/1/2020	170	--	330	--	190	--	310	--	130	--
11/8/2020	320	--	5200	--	370	--	270	--	380	--
11/15/2020	680	--	9200	--	31	--	30	--	250	--
11/22/2020	320	253.2	380	792.2	4100	223.2	270	189	130	200

Table A-4. *E. coli* (MPN/100 mL) Concentrations Observed at Priority 3 Orange County Sites during the 2020 Dry Season (geometric mean based on previous five weekly samples ["SSV"]; if reported value has a < or > qualifier, the actual value was used to calculate the geomean ["GM"]) (Note: samples were not collected at Buck Gully, Los Trancos, or Morning Canyon Creek. Borrego creek was dry during each site visit)

Week Beginning Date	Bolsa Chica Channel (P3-OC1)		Peters Canyon Wash (P3-OC7)		San Diego Creek Reach 1 (P3-OC8)		San Diego Creek Reach 2 (P3-OC9)		Serrano Creek (P3-OC11)	
	Result	Geomean	Result	Geomean	Result	Geomean	Result	Geomean	Result	Geomean
5/10/2020	--	--	--	--	--	--	--	--	--	--
5/17/2020	--	--	--	--	--	--	--	--	--	--
5/24/2020	--	--	--	--	--	--	--	--	--	--
5/31/2020	--	--	--	--	--	--	--	--	--	--
6/7/2020	--	--	--	--	--	--	--	--	--	--
6/14/2020	--	--	--	--	--	--	--	--	--	--
6/21/2020	--	--	--	--	--	--	--	--	--	--
6/28/2020	--	--	--	--	--	--	--	--	--	--
7/5/2020	--	--	--	--	--	--	--	--	--	--
7/12/2020	--	--	--	--	--	--	--	--	--	--
7/19/2020	--	--	169	--	41	--	98	--	2909	--
7/26/2020	--	--	314	--	31	--	201	--	8164	--
8/2/2020	--	--	154	--	52	--	41	--	118	--
8/9/2020	--	--	265	--	76	--	218	--	1043	--
8/16/2020	--	--	159	203	96	55	373	146	3281	1572
8/23/2020	--	--	--	--	--	--	--	--	--	--
8/30/2020	--	--	--	--	--	--	--	--	--	--
9/6/2020	--	--	--	--	--	--	--	--	--	--
9/13/2020	--	--	--	--	--	--	--	--	--	--
9/20/2020	--	--	--	--	--	--	--	--	--	--
10/25/2020	241	--	--	--	--	--	--	--	--	--
11/1/2020	259	--	--	--	--	--	--	--	--	--
11/8/2020	345	--	--	--	--	--	--	--	--	--
11/15/2020	359	--	--	--	--	--	--	--	--	--
11/22/2020	2098	439	--	--	--	--	--	--	--	--

Table A-5. *E. coli* (MPN/100 mL) Concentrations Observed at Priority 3 Riverside County and San Bernardino County Sites during the 2020 Dry Season (geometric mean based on previous five weekly samples; if reported value has a < or > qualifier, the actual value was used to calculate the geomean)

Week Beginning Date	SAR Reach 4 (P3-SBC1)		Goldenstar Creek (P3-RC1)		San Tim Reach 1A (P3-SBC2)		San Tim Reach 2 (P3-SBC3)		Warm Creek (P3-SBC4)	
	Result	Geomeans	Result	Geomeans	Result	Geomean	Result	Geomean	Result	Geomean
5/10/2020	41	--	--	--	--	--	--	--	--	--
5/17/2020	1300	--	--	--	--	--	--	--	--	--
5/24/2020	110	--	--	--	--	--	--	--	--	--
5/31/2020	590	--	--	--	--	--	--	--	--	--
6/7/2020	39	168	--	--	--	--	--	--	--	--
6/14/2020	280	247	--	--	--	--	--	--	--	--
6/21/2020	130	156	--	--	--	--	--	--	--	--
6/28/2020	130	161	--	--	--	--	--	--	--	--
7/5/2020	50	98	--	--	200	--	310	--	4900	--
7/12/2020	74	112	--	--	7.4	--	260	--	NA	--
7/19/2020	190	104	--	--	450	--	2900	--	NA	--
7/26/2020	ND	98	--	--	2	--	NA	--	6	--
8/2/2020	96	91	--	--	73	40	580	607	NA	176
8/9/2020	21	73	--	--	--	--	--	--	--	--
8/16/2020	5	37	--	--	--	--	--	--	--	--
8/23/2020	29	23	580	--	--	--	--	--	--	--
8/30/2020	10	20	550	--	--	--	--	--	--	--
9/6/2020	10	12	440	--	--	--	--	--	--	--
9/13/2020	20	12	35	--	--	--	--	--	--	--
9/20/2020	28	17	35	177	--	--	--	--	--	--
10/25/2020	86	22	--	--	--	--	--	--	--	--
11/1/2020	43	29	--	--	--	--	--	--	--	--
11/8/2020	29	36	--	--	--	--	--	--	--	--
11/15/2020	99	50	--	--	--	--	--	--	--	--
11/22/2020	44	54	--	--	--	--	--	--	--	--

Table A-6. *Enterococci* (MPN/100 mL) Concentrations Observed at Priority 1 Stream Sites during the 2020 Dry Season

Week Beginning Date	Lake Elsinore (P1-2)	
	Results	Geomean
5/10/2020	18	--
5/17/2020	7.3	--
5/24/2020	8.5	--
5/31/2020	2	--
6/7/2020	5.2	6.5
6/14/2020	6.2	6.5
6/21/2020	4.1	5.0
6/28/2020	4.1	4.6
7/5/2020	3.0	3.8
7/12/2020	8.5	4.9
7/19/2020	2400.0	13.6
7/26/2020	11.0	15.0
8/2/2020	4.1	15.0
8/9/2020	1.0	11.8
8/16/2020	20.0	16.2
8/23/2020	15.0	17.9
8/30/2020	2.0	5.5
9/6/2020	3.0	4.4
9/13/2020	2.0	3.9
9/20/2020	4.1	5.0
10/25/2020	5.2	--
11/1/2020	13	--
11/8/2020	6.2	--
11/15/2020	2	--
11/22/2020	6.3	5.6

Table A-7. Total Suspended Solids (mg/L) Concentrations Observed at Priority 1 Sites during the 2020 Dry Season (BDL: below detection limit)

Week Beginning Date	Canyon Lake	Lake Elsinore	Lake Perris	Big Bear Lake	Mill Creek Reach 2	Lytle Creek	SAR @ MWD Crossing	SAR @ Pedley Avenue
	(P1-1)	(P1-2)	(P1-3)	(P1-4)	(P1-5)	(P1-6)	(WW-S1)	(WW-S4)
5/10/2020	4	20	BDL	24	2	4	4	14
5/17/2020	13	24	4	32	BDL	2	9	8
5/24/2020	8	32	BDL	11	BDL	BDL	5	14
5/31/2020	5	26	4	5	BDL	2	7	13
6/7/2020	6	80	14	10	BDL	BDL	4	8
6/14/2020	8	30	8	12	BDL	2	7	10
6/21/2020	7	23	10	18	BDL	BDL	10	8
6/28/2020	7	35	8	46	2	BDL	7	8
7/5/2020	5	27	8[1]	40	BDL	BDL	16	11
7/12/2020	3	46	4	16	BDL	2	13	6
7/19/2020	5	36	3	16	BDL	BDL	18	12
7/26/2020	6	19	4	10	BDL	BDL	8	5
8/2/2020	6	20	4	49	BDL	BDL	18	12
8/9/2020	4	27	BDL	61.5	2	2	6	6
8/16/2020	6	22	4[1]	12	BDL	BDL	4	4
8/23/2020	2	21	2	10	BDL	BDL	4	8
8/30/2020	3	18	BDL	20	BDL	BDL	3	6
9/6/2020	2	19	BDL	8	NA	BDL	6	4
9/13/2020	2	18	2	4	NA	9	3	4
9/20/2020	5	18	2	BDL	NA	BDL[1]	6	4
10/25/2020	3	22	2	14	BDL	2	2[1]	4
11/1/2020	6	87	2	6	2	BDL	BDL	2
11/8/2020	5	19	2	2	BDL	BDL	3	4
11/15/2020	23	8	4	2	BDL	BDL	8	6
11/22/2020	4	19	6	2	BDL	BDL	7	4

[1] Field blank collected at this site had a detectable value

Table A-8. Total Suspended Solids (mg/L) Concentrations Observed at Priority 2 Sites during the 2020 Dry Season (BDL: below detection limit)

Week Beginning Date	Prado Park Lake Outlet (WW-C3)	Chino Creek @ Central Avenue (WW-C7)	Mill-Cucamonga Creek Below Wetlands (WW-M6)	SAR @ MWD Crossing (WW-S1)	SAR @ Pedley Avenue (WW-S4)	SAR @ Mission (WW-MISSION)
5/10/2020	24	4	18	4	14	9.0
5/17/2020	24	4	6	9	8	9.0
5/24/2020	16	4	8	5	14	10.0
5/31/2020	42	4	7	7	13	34.0
6/7/2020	47	2	6	4	8	10.0
6/14/2020	22	6	8	7	10	12.0
6/21/2020	28	8	5	10	8	10.0
6/28/2020	38	4	24	7	8	20.0
7/5/2020	20	35	6	16	11	18.0
7/12/2020	18	14	10	13	6	18.0
7/19/2020	28	14	8	18	12	33.0
7/26/2020	30	5	8	8	5	24.0
8/2/2020	23	6	5[1]	18	12	41.0
8/9/2020	18	3[1]	5	6	6	18.0
8/16/2020	30	9	12	4	4	18.0
8/23/2020	22	4	8	4	8	21.0
8/30/2020	24	3	3	3	6	30.0
9/6/2020	14	4	9	6	4	25.0
9/13/2020	18	4	33	3	4	16.0
9/20/2020	30	7	10	6	4	12.0
10/25/2020	8	BDL	11	2	4	8.0
11/1/2020	6	2	6	BDL	2	6.0
11/8/2020	16	2	5	3	4	7.0
11/15/2020	16	4	5	8	6	18.0
11/22/2020	10	2	4	7	4	7.0

[1] Field blank collected at this site had a detectable value

Table A-9. Total Suspended Solids (mg/L) Concentrations Observed at Priority 3 Sites in Orange County during the 2020 Dry Season (Note: samples were not collected at Buck Gully, Los Trancos, or Morning Canyon Creek. Borrego creek was dry during each site visit)

Week Beginning Date	Bolsa Chica Channel	Peters Canyon Wash	San Diego Creek Reach 1	San Diego Creek Reach 2	Serrano Creek
	(P3-OC1)	(P3-OC7)	(P3-OC8)	(P3-OC9)	(P3-OC11)
5/10/2020	--	--	--	--	--
5/17/2020	--	--	--	--	--
5/24/2020	--	--	--	--	--
5/31/2020	--	--	--	--	--
6/7/2020	--	--	--	--	--
6/14/2020	--	--	--	--	--
6/21/2020	--	--	--	--	--
6/28/2020	--	--	--	--	--
7/5/2020	--	--	--	--	--
7/12/2020	--	--	--	--	--
7/19/2020	--	3.6	43	4.3	7.9
7/26/2020	--	4.1	29	1.7	3.2
8/2/2020	--	3.8	28	1.9	2.3
8/9/2020	--	4.8	40	2.6	1.9
8/16/2020	--	6.1	37	4	16
8/23/2020	--	--	--	--	--
8/30/2020	--	--	--	--	--
9/6/2020	--	--	--	--	--
9/13/2020	--	--	--	--	--
9/20/2020	--	--	--	--	--
10/25/2020	21	--	--	--	--
11/1/2020	19	--	--	--	--
11/8/2020	9.6	--	--	--	--
11/15/2020	12	--	--	--	--
11/22/2020	18	--	--	--	--

Table A-10. Total Suspended Solids (mg/L) Concentrations Observed at Priority 3 Sites in Riverside County and San Bernardino County during the 2020 Dry Season

Week Beginning Date	SAR Reach 4 (P3-SBC1)	Goldenstar Creek (P3-RC1)	San Tim Reach 1A (P3-SBC2)	San Tim Reach 2 (P3-SBC3)	Warm Creek (P3-SBC4)
5/10/2020	2	--	--	--	--
5/17/2020	2	--	--	--	--
5/24/2020	2	--	--	--	--
5/31/2020	2	--	--	--	--
6/7/2020	2	--	--	--	--
6/14/2020	2	--	--	--	--
6/21/2020	7	--	--	--	--
6/28/2020	2	--	--	--	--
7/5/2020	2	--	8	26	24
7/12/2020	2	--	10	88	NA
7/19/2020	0	--	110	6	NA
7/26/2020	0	--	8[1]	NA	22.0
8/2/2020	3	--	8	4	NA
8/9/2020	2	--	--	--	--
8/16/2020	0	--	--	--	--
8/23/2020	2	2	--	--	--
8/30/2020	0	4	--	--	--
9/6/2020	2	2	--	--	--
9/13/2020	2	0	--	--	--
9/20/2020	10	4	--	--	--
10/25/2020	2	--	--	--	--
11/1/2020	2	--	--	--	--
11/8/2020	2	--	--	--	--
11/15/2020	2	--	--	--	--
11/22/2020	2	--	--	--	--

[1] Field blank collected at this site had a detectable value

Table A-11. Dissolved Oxygen (mg/L) Concentrations Observed at Priority 1 Sites during the 2020 Dry Season

Week Beginning Date	Canyon Lake (P1-1)	Lake Elsinore (P1-2)	Lake Perris (P1-3)	Big Bear Lake (P1-4)	Mill Creek Reach 2 (P1-5)	Lytle Creek (P1-6)	SAR @ MWD Crossing (WW-S1)	SAR @ Pedley Avenue (WW-S4)
5/10/2020	9.7	3.6	8.9	7.0	9.0	9.7	8.7	8.9
5/17/2020	12.2	7.9	9.2	7.8	9.1	9.8	8.7	8.8
5/24/2020	7.5	13.3	8.8	8.3	8.9	9.7	8.7	8.6
5/31/2020	10.7	11.4	8.8	8.2	8.7	9.6	8.5	8.4
6/7/2020	9.9	10.0	8.6	9.9	8.9	9.8	8.7	8.6
6/14/2020	10.2	7.1	8.8	7.5	8.5	9.2	8.5	8.4
6/21/2020	16.8	6.5	9.6	7.7	8.5	9.7	8.4	8.3
6/28/2020	8.8	5.8	9.9	8.4	8.5	9.6	8.4	8.2
7/5/2020	8.4	7.7	9.3	6.6	8.6	9.5	8.2	8.3
7/12/2020	7.8	6.6	9.8	9.5	8.6	9.5	8.5	8.4
7/19/2020	8.9	5.5	9.5	9.9	8.7	9.5	8.4	8.3
7/26/2020	9.5	5.7	8.6	9.8	8.5	9.4	8.3	8.1
8/2/2020	8.4	5.2	8.2	10.0	8.3	9.4	8.2	8.0
8/9/2020	8.4	4.1	8.0	9.5	8.8	9.6	8.2	8.0
8/16/2020	8.5	3.5	7.7	8.1	8.6	9.4	8.0	7.8
8/23/2020	7.4	4.2	7.9	9.8	8.4	9.3	8.2	8.0
8/30/2020	6.8	2.3	7.6	10.6	8.6	9.6	8.2	8.1
9/6/2020	6.9	4.3	7.6	11.5	--	9.6	8.8	8.2
9/13/2020	6.9	4.7	8.0	11.0	--	9.8	8.6	8.3
9/20/2020	6.9	6.1	7.9	10.9	--	9.8	8.7	8.6
10/25/2020	3.2	5.6	7.2	9.9	9.0	10.4	9.0	9.0
11/1/2020	7.2	7.7	8.0	10.0	8.9	9.7	9.0	8.8
11/8/2020	0.7	6.9	7.2	9.6	8.8	9.8	9.1	NA
11/15/2020	0.5	122.2	7.6	10.8	9.3	10.1	9.2	9.2
11/22/2020	1.0	7.8	7.2	10.3	9.2	9.7	9.1	9.0

Table A-12. Dissolved Oxygen (mg/L) Concentrations Observed at Priority 2 Sites during the 2020 Dry Season

Week Beginning Date	Prado Park Lake Outlet (WW-C3)	Chino Creek @ Central Avenue (WW-C7)	Mill-Cucamonga Creek Below Wetlands (WW-M6)	SAR @ MWD Crossing (WW-S1)	SAR @ Pedley Avenue (WW-S4)	SAR @ Mission (WW-MISSION)
5/10/2020	9.06	7.0	6.9	8.7	8.9	8.1
5/17/2020	9.45	7.5	6.8	8.7	8.8	8.3
5/24/2020	7.1	6.6	6.1	8.7	8.6	8.3
5/31/2020	9.54	5.0	6.9	8.5	8.4	8.2
6/7/2020	10.7	7.0	6.4	8.7	8.6	8.3
6/14/2020	7.63	6.5	6.9	8.5	8.4	8.2
6/21/2020	9.65	7.3	6.1	8.4	8.3	8.2
6/28/2020	8.71	5.8	7.0	8.4	8.2	8.2
7/5/2020	8.34	5.1	6.4	8.2	8.3	7.8
7/12/2020	5.95	3.8	5.7	8.5	8.4	8.1
7/19/2020	8.73	4.9	5.7	8.4	8.3	8.1
7/26/2020	7.17	5.4	6.3	8.3	8.1	7.9
8/2/2020	7.85	4.39	5.55	8.2	8.0	7.9
8/9/2020	8.01	5.8	6.3	8.2	8.0	7.8
8/16/2020	8.75	3.6	5.0	8.0	7.8	7.8
8/23/2020	7.56	4.7	5.6	8.2	8.0	7.8
8/30/2020	8.25	5.2	6.2	8.2	8.1	7.7
9/6/2020	8.02	5.3	5.9	8.8	8.2	8.4
9/13/2020	9.9	6.8	6.6	8.6	8.3	8.3
9/20/2020	9.8	5.6	6.2	8.7	8.6	8.1
10/25/2020	6.1	8.2	8.5	9.0	9.0	8.7
11/1/2020	5.5	7.8	8.0	9.0	8.8	8.4
11/8/2020	7.1	8.0	8.6	9.1	NA	8.7
11/15/2020	9.3	6.6	8.5	9.2	9.2	8.7
11/22/2020	8.9	6.5	8.3	9.1	9.0	8.7

Table A-13. Dissolved Oxygen (mg/L) Concentrations Observed at Priority 3 Sites in Orange County during the 2020 Dry Season (Note: samples were not collected at Buck Gully, Los Trancos, or Morning Canyon Creek. Borrego creek was dry during each site visit)

Week Beginning Date	Bolsa Chica Channel (P3-OC1)	Peters Canyon Wash (P3-OC7)	San Diego Cr. Reach 1 (P3-OC8)	San Diego Cr. Reach 2 (P3-OC9)	Serrano Creek (P3-OC11)
5/10/2020	--	--	--	--	--
5/17/2020	--	--	--	--	--
5/24/2020	--	--	--	--	--
5/31/2020	--	--	--	--	--
6/7/2020	--	--	--	--	--
6/14/2020	--	--	--	--	--
6/21/2020	--	--	--	--	--
6/28/2020	--	--	--	--	--
7/5/2020	--	--	--	--	--
7/12/2020	--	--	--	--	--
7/19/2020	--	8.56	7.49	11.63	10.85
7/26/2020	--	4.32	7.47	8.74	11.46
8/2/2020	--	7.04	7.92	13.77	14.37
8/9/2020	--	3.82	8.02	9.13	13.75
8/16/2020	--	3.42	8.78	8.15	10.7
8/23/2020	--	--	--	--	--
8/30/2020	--	--	--	--	--
9/6/2020	--	--	--	--	--
9/13/2020	--	--	--	--	--
9/20/2020	--	--	--	--	--
10/25/2020	7.0	--	--	--	--
11/1/2020	6.8	--	--	--	--
11/8/2020	6.5	--	--	--	--
11/15/2020	6.0	--	--	--	--
11/22/2020	6.1	--	--	--	--

Table A-14. Dissolved Oxygen (mg/L) Concentrations Observed at Priority 3 Sites in Riverside County and San Bernardino County during the 2020 Dry Season

Week Beginning Date	SAR Reach 4 (P3-SBC1)	Goldenstar Creek (P3-RC1)	San Tim Reach 1A (P3-SBC2)	San Tim Reach 2 (P3-SBC3)	Warm Creek (P3-SBC4)
5/10/2020	8.46	--	--	--	--
5/17/2020	8.31	--	--	--	--
5/24/2020	8.4	--	--	--	--
5/31/2020	8.35	--	--	--	--
6/7/2020	8.18	--	--	--	--
6/14/2020	8	--	--	--	--
6/21/2020	8.37	--	--	--	--
6/28/2020	8.32	--	--	--	--
7/5/2020	8.12	--	11.09	8.08	6.78
7/12/2020	7.91	--	11.17	7.52	NA
7/19/2020	8.0	--	10.69	8.7	NA
7/26/2020	7.8	--	9.85	NA	7.43
8/2/2020	7.6	--	10.62	8.8	NA
8/9/2020	7.7	--	--	--	--
8/16/2020	7.5	--	--	--	--
8/23/2020	7.53	8.4	--	--	--
8/30/2020	7.55	8.9	--	--	--
9/6/2020	7.82	8.8	--	--	--
9/13/2020	7.68	9.2	--	--	--
9/20/2020	7.83	9.3	--	--	--
10/25/2020	7.98	--	--	--	--
11/1/2020	8.19	--	--	--	--
11/8/2020	7.84	--	--	--	--
11/15/2020	8.07	--	--	--	--
11/22/2020	7.88	--	--	--	--

Table A-15. pH (standard units) Observed at Priority 1 Sites during the 2020 Dry Season

Week Beginning Date	Prado Park Lake Outlet (WW-C3)	Chino Creek @ Central Avenue (WW-C7)	Mill-Cucamonga Creek Below Wetlands (WW-M6)	SAR @ MWD Crossing (WW-S1)	SAR @ Pedley Avenue (WW-S4)	SAR @ MISSION (WW-MISSION)
5/10/2020	9.43	7.6	8.1	8.1	8.1	8.1
5/17/2020	9.65	7.8	8.3	8.0	8.0	8.2
5/24/2020	7.91	7.8	7.7	8.0	8.3	8.2
5/31/2020	9.9	7.7	8.1	8.1	8.3	8.3
6/7/2020	9.89	7.7	8.1	8.5	8.4	8.4
6/14/2020	8.93	8.2	8.6	8.6	8.8	8.5
6/21/2020	10.35	8.3	8.2	8.3	8.7	8.1
6/28/2020	10.07	8.4	8.3	8.5	9.0	8.3
7/5/2020	9.33	8.4	7.9	8.8	8.9	8.7
7/12/2020	7.79	7.5	7.1	8.0	8.2	8.2
7/19/2020	9.91	7.7	7.7	8.0	8.2	8.3
7/26/2020	8.51	7.7	7.8	8.0	8.1	8.2
8/2/2020	9.14	7.7	7.7	8.0	8.1	8.3
8/9/2020	8.63	7.7	8.2	8.1	8.1	8.3
8/16/2020	9.72	7.6	7.9	8.1	8.2	8.2
8/23/2020	8.99	7.8	7.9	8.1	8.2	8.2
8/30/2020	9.47	7.7	7.8	8.1	8.1	8.2
9/6/2020	9.51	7.8	8.0	7.9	8.0	8.1
9/13/2020	9.2	7.9	7.8	7.8	8.0	8.2
9/20/2020	9.6	7.9	7.8	8.1	8.2	8.3
10/25/2020	7.4	7.2	7.6	7.6	7.7	8.0
11/1/2020	7.6	7.5	7.5	7.8	8.0	8.2
11/8/2020	8.1	8.0	8.0	8.1	7.7	8.1
11/15/2020	7.6	7.2	7.0	7.6	7.6	8.1
11/22/2020	7.5	7.2	7.1	7.9	7.7	8.0

Table A-16. pH (standard units) Observed at Priority 2 Sites during the 2020 Dry Season

Week Beginning Date	Prado Park Lake Outlet (WW-C3)	Chino Creek @ Central Avenue (WW-C7)	Mill-Cucamonga Creek Below Wetlands (WW-M6)	SAR @ MWD Crossing (WW-S1)	SAR @ Pedley Avenue (WW-S4)	SAR @ MISSION (WW-MISSION)
5/10/2020	9.43	7.6	8.1	8.1	8.1	8.1
5/17/2020	9.65	7.8	8.3	8.0	8.0	8.2
5/24/2020	7.91	7.8	7.7	8.0	8.3	8.2
5/31/2020	9.9	7.7	8.1	8.1	8.3	8.3
6/7/2020	9.89	7.7	8.1	8.5	8.4	8.4
6/14/2020	8.93	8.2	8.6	8.6	8.8	8.5
6/21/2020	10.35	8.3	8.2	8.3	8.7	8.1
6/28/2020	10.07	8.4	8.3	8.5	9.0	8.3
7/5/2020	9.33	8.4	7.9	8.8	8.9	8.7
7/12/2020	7.79	7.5	7.1	8.0	8.2	8.2
7/19/2020	9.91	7.7	7.7	8.0	8.2	8.3
7/26/2020	8.51	7.7	7.8	8.0	8.1	8.2
8/2/2020	9.14	7.7	7.7	8.0	8.1	8.3
8/9/2020	8.63	7.7	8.2	8.1	8.1	8.3
8/16/2020	9.72	7.6	7.9	8.1	8.2	8.2
8/23/2020	8.99	7.8	7.9	8.1	8.2	8.2
8/30/2020	9.47	7.7	7.8	8.1	8.1	8.2
9/6/2020	9.51	7.8	8.0	7.9	8.0	8.1
9/13/2020	9.2	7.9	7.8	7.8	8.0	8.2
9/20/2020	9.6	7.9	7.8	8.1	8.2	8.3
10/25/2020	7.4	7.2	7.6	7.6	7.7	8.0
11/1/2020	7.6	7.5	7.5	7.8	8.0	8.2
11/8/2020	8.1	8.0	8.0	8.1	7.7	8.1
11/15/2020	7.6	7.2	7.0	7.6	7.6	8.1
11/22/2020	7.5	7.2	7.1	7.9	7.7	8.0

Table A-17. pH (standard units) Observed at Priority 3 Sites in Orange County during the 2020 Dry Season

Week Beginning Date	Bolsa Chica Channel	Borrego Creek	Buck Gully Creek	Los Trancos Creek	Morning Canyon Creek	Peters Canyon Wash	San Diego Creek Reach 1	San Diego Creek Reach 1	Serrano Creek
	(P3-OC1)	(P3-OC2)	(P3-OC3)	(P3-OC5)	(P3-OC6)	(P3-OC7)	(P3-OC8)	(P3-OC9)	(P3-OC11)
5/10/2020	--	--	--	--	--	--	--	--	--
5/17/2020	--	--	--	--	--	--	--	--	--
5/24/2020	--	--	--	--	--	--	--	--	--
5/31/2020	--	--	--	--	--	--	--	--	--
6/7/2020	--	--	--	--	--	--	--	--	--
6/14/2020	--	--	--	--	--	--	--	--	--
6/21/2020	--	--	--	--	--	--	--	--	--
6/28/2020	--	--	--	--	--	--	--	--	--
7/5/2020	--	--	--	--	--	--	--	--	--
7/12/2020	--	--	--	--	--	--	--	--	--
7/19/2020	--	--	--	--	--	8.24	8.74	8.35	9.14
7/26/2020	--	--	--	--	--	7.86	8.51	8.01	9.17
8/2/2020	--	--	--	--	--	7.98	8.93	8.38	10.65
8/9/2020	--	--	--	--	--	8.32	9.7	8.31	10.16
8/16/2020	--	--	--	--	--	7.9	8.88	8.13	8.29
8/23/2020	--	--	--	--	--	--	--	--	--
8/30/2020	--	--	--	--	--	--	--	--	--
9/6/2020	--	--	--	--	--	--	--	--	--
9/13/2020	--	--	--	--	--	--	--	--	--
9/20/2020	--	--	--	--	--	--	--	--	--
10/25/2020	8.0	--	--	--	--	--	--	--	--
11/1/2020	8.2	--	--	--	--	--	--	--	--
11/8/2020	7.9	--	--	--	--	--	--	--	--
11/15/2020	7.9	--	--	--	--	--	--	--	--
11/22/2020	7.8	--	--	--	--	--	--	--	--

Note: Borrego Creek and Los Trancos were dry during all sample events

Table A-18. pH (standard units) Observed at Priority 3 Sites in Riverside County and San Bernardino County during the 2020 Dry Season

Week Beginning Date	SAR Reach 4 (P3-SBC1)	Goldenstar Creek (P3-RC1)	San Tim Reach 1A (P3-SBC2)	San Tim Reach 2 (P3-SBC3)	Warm Creek (P3-SBC4)
5/10/2020	7.9	--	--	--	--
5/17/2020	7.8	--	--	--	--
5/24/2020	7.7	--	--	--	--
5/31/2020	7.9	--	--	--	--
6/7/2020	8.4	--	--	--	--
6/14/2020	8.18	--	--	--	--
6/21/2020	8.11	--	--	--	--
6/28/2020	7.94	--	--	--	--
7/5/2020	8.61	--	10.57	9.6	8.64
7/12/2020	7.73	--	10.42	9.06	NA
7/19/2020	7.84	--	9.86	8.9	NA
7/26/2020	7.8	--	10.66	NA	9.1
8/2/2020	7.76	--	10.55	8.9	NA
8/9/2020	7.84	--	--	--	--
8/16/2020	7.89	--	--	--	--
8/23/2020	7.84	8.51	--	--	--
8/30/2020	7.89	8.35	--	--	--
9/6/2020	7.82	8.31	--	--	--
9/13/2020	7.75	8.5	--	--	--
9/20/2020	7.89	8.57	--	--	--
10/25/2020	7.9	--	--	--	--
11/1/2020	8.13	--	--	--	--
11/8/2020	8.09	--	--	--	--
11/15/2020	7.9	--	--	--	--
11/22/2020	7.5	--	--	--	--

Table A-19. Turbidity (NTU) Observed at Priority 1 Sites during the 2020 Dry Season

Week Beginning Date	Canyon Lake (P1-1)	Lake Elsinore (P1-2)	Lake Perris (P1-3)	Big Bear Lake (P1-4)	Mill Creek Reach 2 (P1-5)	Lytle Creek (P1-6)	SAR @ MWD Crossing (WW-S1)	SAR @ Pedley Avenue (WW-S4)
5/10/2020	3.6	19	2.0	7.4	0.3	0.6	1.6	2.5
5/17/2020	11.3	23	1.4	7.6	0.3	0.2	1.9	1.3
5/24/2020	4.8	22	1.0	8	0.2	0.2	2.3	2.2
5/31/2020	2.8	20	3.5	5.3	0.3	0.3	1.6	1.9
6/7/2020	2.8	24	3.8	6	0.4	0.6	1.7	1.7
6/14/2020	4.4	30	1.1	10	0.0	0.0	2.4	2.2
6/21/2020	4.7	26	3.4	13.0	0.3	0.1	2.8	2.4
6/28/2020	2.8	25	3.5	19	0.2	0.3	3.3	2.7
7/5/2020	2.0	28	3.9	27.8	0.4	0.7	3.6	2.9
7/12/2020	1.3	26	7.1	18	0.1	2.5	3.3	2.2
7/19/2020	1.0	29	1.6	12	0	0.1	3.9	2.6
7/26/2020	2.9	25	0.9	11	0.1	1.0	4.9	2.3
8/2/2020	2.1	24	3.9	32	0.1	0.4	4.2	2.1
8/9/2020	1.0	23	0.2	11	0.4	0.1	2.5	1.6
8/16/2020	0.5	19	0.9	5	0.2	0.5	2.3	2.3
8/23/2020	0.8	21	1.4	7.2	0.2	0.2	2.5	1.6
8/30/2020	1.1	19	2.7	7.4	0.2	0.2	2.5	1.4
9/6/2020	1.1	18	0.9	3.4	--	0.2	2.4	1.1
9/13/2020	0.5	16	0.1	7.0	--	4.1	1.9	1.5
9/20/2020	0.9	16	0.7	7	--	0.3	2.2	1.3
10/25/2020	3.0	16	0.3	3.9	0.8	0.6	0.7	1.2
11/1/2020	1.3	23	0.4	3.1	0.2	0.2	0.9	1.4
11/8/2020	2.1	18	0.8	4.3	0.1	0.4	2.8	1.5
11/15/2020	2.0	16	0.3	1	0.3	0.4	3.7	2.0
11/22/2020	4.6	15	2.4	9	0.4	0.2	2.1	2.0

Table A-20. Turbidity (NTU) Observed at Priority 2 Sites during the 2020 Dry Season

Week Beginning Date	Prado Park Lake Outlet (WW-C3)	Chino Creek @ Central Avenue (WW-C7)	Mill-Cucamonga Creek Below Wetlands (WW-M6)	SAR @ MWD Crossing (WW-S1)	SAR @ Pedley Avenue (WW-S4)
5/10/2020	9.5	1.0	2.4	1.8	1.7
5/17/2020	9.1	1.8	1.4	252.7	233.2
5/24/2020	9.6	16.8	2.9	21.7	22.2
5/31/2020	10.3	0.3	1.9	24.1	19.3
6/7/2020	9.6	0.0	2.5	16.9	14.9
6/14/2020	4.2	1.9	4.8	3.9	5.4
6/21/2020	6.3	0.0	0.0	4.8	8.9
6/28/2020	8.3	1.8	1.9	4.4	4.8
7/5/2020	5.2	2.3	0.9	1.6	2.9
7/12/2020	4.7	0.4	2.2	2.4	4.6
7/19/2020	4.4	3.6	0.6	0.7	2.8
7/26/2020	3.7	1.2	1.5	2.5	2.5
8/2/2020	5.6	0.4	1.4	2.2	2.6
8/9/2020	3.5	1.3	3.7	2.0	0.6
8/16/2020	3.3	0.8	1.1	2.0	1.5
8/23/2020	4.5	0.8	1.2	2.5	1.5
8/30/2020	5	1.6	0.7	2.2	2.3
9/6/2020	8.5	1.5	4.5	3.6	1.7
9/13/2020	12.6	1.4	2.0	1.9	0.8
9/20/2020	11.9	1.4	1.8	1.3	0.8
10/25/2020	33.2	6.3	2.1	0.1	0.6
11/1/2020	14.1	15.7	2.1	1.3	1.1
11/8/2020	8.3	9.0	1.1	1.8	1.6
11/15/2020	6.9	1.4	0.6	0.7	0.5
11/22/2020	13.3	2.2	1.0	1.4	0.9

Table A-21. Turbidity (NTU) Observed at Priority 3 Sites in Orange County during the 2020 Dry Season (Note: Borrego Creek and Los Trancos Creek were dry during all sample events)

Week Beginning Date	Bolsa Chica Channel (P3-OC1)	Buck Gully Creek (P3-OC2)	Buck Gully Creek (P3-OC3)	Los Trancos Creek (P3-OC5)	Morning Canyon Creek (P3-OC6)	Peters Canyon Wash (P3-OC7)	San Diego Cr. Reach 1 (P3-OC8)	San Diego Cr. Reach 2 (P3-OC9)	Serrano Creek (P3-OC11)
5/10/2020	--	--	--	--	--	--	--	--	--
5/17/2020	--	--	--	--	--	--	--	--	--
5/24/2020	--	--	--	--	--	--	--	--	--
5/31/2020	--	--	--	--	--	--	--	--	--
6/7/2020	--	--	--	--	--	--	--	--	--
6/14/2020	--	--	--	--	--	--	--	--	--
6/21/2020	--	--	--	--	--	--	--	--	--
6/28/2020	--	--	--	--	--	--	--	--	--
7/5/2020	--	--	--	--	--	--	--	--	--
7/12/2020	--	--	--	--	--	--	--	--	--
7/19/2020	--	--	--	--	--	3.66	43.4	2.26	6.56
7/26/2020	--	--	--	--	--	2.87	24.3	1.71	2.65
8/2/2020	--	--	--	--	--	2.28	19.1	2.63	3.42
8/9/2020	--	--	--	--	--	3.66	32.2	1.44	3.25
8/16/2020	--	--	--	--	--	4.17	28.8	1.77	3.83
8/23/2020	--	--	--	--	--	--	--	--	--
8/30/2020	--	--	--	--	--	--	--	--	--
9/6/2020	--	--	--	--	--	--	--	--	--
9/13/2020	--	--	--	--	--	--	--	--	--
9/20/2020	--	--	--	--	--	--	--	--	--
10/25/2020	13.6	--	--	--	--	--	--	--	--
11/1/2020	16	--	--	--	--	--	--	--	--
11/8/2020	7	--	--	--	--	--	--	--	--
11/15/2020	13	--	--	--	--	--	--	--	--
11/22/2020	13	--	--	--	--	--	--	--	--

Table A-22. Turbidity (NTU) Observed at Priority 3 Sites in Riverside County and San Bernardino County during the 2020 Dry Season

Week Beginning Date	SAR Reach 4 (P3-SBC1)	Goldenstar Creek (P3-RC1)	San Tim Reach 1A (P3-SBC2)	San Tim Reach 2 (P3-SBC3)	Warm Creek (P3-SBC4)
5/10/2020	0.4	--	--	--	--
5/17/2020	1.0	--	--	--	--
5/24/2020	0.0	--	--	--	--
5/31/2020	0.2	--	--	--	--
6/7/2020	0.3	--	--	--	--
6/14/2020	0.3	--	--	--	--
6/21/2020	0.7	--	--	--	--
6/28/2020	0.3	--	--	--	--
7/5/2020	0.7	--	7.2	19.7	12.6
7/12/2020	0.1	--	4.5	45.5	NA
7/19/2020	0.2	--	23.2	4.1	NA
7/26/2020	0.5	--	6.1	NA	5.1
8/2/2020	0.6	--	5	5.9	NA
8/9/2020	0	--	--	--	--
8/16/2020	1.5	--	--	--	--
8/23/2020	0.5	0.3	--	--	--
8/30/2020	0.4	0.6	--	--	--
9/6/2020	1	0.3	--	--	--
9/13/2020	0.4	0.2	--	--	--
9/20/2020	0.7	0.4	--	--	--
10/25/2020	0.7	--	--	--	--
11/1/2020	0.2	--	--	--	--
11/8/2020	1.4	--	--	--	--
11/15/2020	0.8	--	--	--	--
11/22/2020	0.3	--	--	--	--

Table A-23. Water Temperature (°C) Concentrations Observed at Priority 1 Sites during the 2020 Dry Season

Week Beginning Date	Canyon Lake (P1-1)	Lake Elsinore (P1-2)	Lake Perris (P1-3)	Big Bear Lake (P1-4)	Mill Creek Reach 2 (P1-5)	Lytle Creek (P1-6)	SAR @ MWD Crossing (WW-S1)	SAR @ Pedley Avenue (WW-S4)
5/10/2020	23.3	21.3	22	16.6	12.5	12.1	19.4	18.6
5/17/2020	22.3	20.8	20.7	16.5	12.4	12.1	19.6	19.0
5/24/2020	25.8	25.6	23.2	18.2	14.5	13.0	19.6	20.0
5/31/2020	25.5	24.8	25.4	19.0	13.6	12.8	20.8	20.9
6/7/2020	24.2	23.9	23	17.2	13.0	11.8	19.4	19.8
6/14/2020	24.0	23.6	22.1	20.2	16.8	15.7	19.7	20.5
6/21/2020	26.3	23.8	24.4	21.3	15.9	12.9	20.9	22.1
6/28/2020	24.8	24.2	23.4	16.9	14.4	12.7	20.7	21.7
7/5/2020	26.1	25.2	25.8	21.6	14.0	12.5	22.9	22.5
7/12/2020	27.3	25.8	26.8	22.3	14.6	13.9	21.1	21.5
7/19/2020	27.8	25.9	26.2	21.4	13.8	13.1	20.6	21.6
7/26/2020	27.8	26.0	26.2	21.6	15.8	13.9	22.0	22.3
8/2/2020	27.8	26.1	26.4	21.7	12.5	14.2	22.2	22.8
8/9/2020	27.3	25.3	26.1	20.7	13.9	12.6	22.5	23.5
8/16/2020	29.1	27.5	27.7	20.9	13.1	13.3	22.8	24.2
8/23/2020	29.3	27.2	28.2	22.9	15.5	14.6	22.3	23.1
8/30/2020	27.4	25.5	25.8	18.7	12.9	12.3	22.3	22.7
9/6/2020	27.3	26.4	25.3	14.9	--	12.3	17.6	18.4
9/13/2020	23.9	23.1	23.3	15.1	--	11.9	18.8	19.7
9/20/2020	23.5	21.9	23.2	16.0	--	11.5	19.7	20.2
10/25/2020	18.0	16.0	18.7	4.2	9.0	8.5	14.5	14.0
11/1/2020	18.2	16.8	19.1	8.4	11.4	13.2	15.6	17.1
11/8/2020	17.0	15.5	17.6	6.0	10.0	11.2	15.0	14.7
11/15/2020	15.0	14.5	16.1	5.2	11.0	10.9	15.1	15.3
11/22/2020	15.9	16.8	16.6	7.9	11.3	13.1	15.5	16.2

Table A-24. Water Temperature (°C) Concentrations Observed at Priority 2 Sites during the 2020 Dry Season

Week Beginning Date	Prado Park Lake Outlet (WW-C3)	Chino Creek @ Central Avenue (WW-C7)	Mill-Cucamonga Creek Below Wetlands (WW-M6)	SAR @ MWD Crossing (WW-S1)	SAR @ Pedley Avenue (WW-S4)
5/10/2020	22.3	17.3	19.4	19.4	18.6
5/17/2020	21.8	17.5	19.5	19.6	19.0
5/24/2020	21.6	20.0	23.5	19.6	20.0
5/31/2020	25.4	18.9	21.0	20.8	20.9
6/7/2020	23.4	18.6	20.2	19.4	19.8
6/14/2020	20.9	19.7	20.5	19.7	20.5
6/21/2020	24.3	19.0	22.2	20.9	22.1
6/28/2020	23.6	18.5	20.5	20.7	21.7
7/5/2020	23.9	19.6	23.4	22.9	22.5
7/12/2020	22.7	20.3	22.1	21.1	21.5
7/19/2020	25.6	20.1	22.3	20.6	21.6
7/26/2020	22.8	19.6	21.5	22.0	22.3
8/2/2020	25.2	20.7	23.4	22.2	22.8
8/9/2020	23.1	18.4	22.5	22.5	23.5
8/16/2020	27.2	23.2	24.6	22.8	24.2
8/23/2020	25.4	22.0	24.1	22.3	23.1
8/30/2020	25.2	19.1	20.2	22.3	22.7
9/6/2020	25.5	22.0	23.6	17.6	18.4
9/13/2020	21.6	16.9	19.4	18.8	19.7
9/20/2020	22.3	18.0	19.2	19.7	20.2
10/25/2020	16.8	12.0	11.7	14.5	14.0
11/1/2020	17.7	15.2	15.6	15.6	17.1
11/8/2020	16.1	17.6	12.8	15.0	14.7
11/15/2020	14.7	13.1	14.3	15.1	15.3
11/22/2020	14.6	15.1	13.3	15.5	16.2

Table A-25. Water Temperature (°C) Concentrations Observed at Priority 3 Sites in Orange County during the 2020 Dry Season

Week Beginning Date	Bolsa Chica Channel (P3-OC1)	Borrego Creek (P3-OC2)	Buck Gully Creek (P3-OC3)	Los Trancos Creek (P3-OC5)	Morning Canyon Creek (P3-OC6)	Peters Canyon Wash (P3-OC7)	San Diego Cr. Reach 1 (P3-OC8)	San Diego Cr. Reach 2 (P3-OC9)	Serrano Creek (P3-OC11)
5/10/2020	--	--	--	--	--	--	--	--	--
5/17/2020	--	--	--	--	--	--	--	--	--
5/24/2020	--	--	--	--	--	--	--	--	--
5/31/2020	--	--	--	--	--	--	--	--	--
6/7/2020	--	--	--	--	--	--	--	--	--
6/14/2020	--	--	--	--	--	--	--	--	--
6/21/2020	--	--	--	--	--	--	--	--	--
6/28/2020	--	--	--	--	--	--	--	--	--
7/5/2020	--	--	--	--	--	--	--	--	--
7/12/2020	--	--	--	--	--	--	--	--	--
7/19/2020	--	--	--	--	--	21.15	25.33	23.26	26.6
7/26/2020	--	--	--	--	--	21.63	24.65	21.54	23.28
8/2/2020	--	--	--	--	--	22.74	25.65	23.65	26.56
8/9/2020	--	--	--	--	--	22.75	25.46	22.84	24.15
8/16/2020	--	--	--	--	--	24.64	28.2	26.16	26.64
8/23/2020	--	--	--	--	--	--	--	--	--
8/30/2020	--	--	--	--	--	--	--	--	--
9/6/2020	--	--	--	--	--	--	--	--	--
9/13/2020	--	--	--	--	--	--	--	--	--
9/20/2020	--	--	--	--	--	--	--	--	--
10/25/2020	12.1	--	--	--	--	--	--	--	--
11/1/2020	16.1	--	--	--	--	--	--	--	--
11/8/2020	13.0	--	--	--	--	--	--	--	--
11/15/2020	16.1	--	--	--	--	--	--	--	--
11/22/2020	14.0	--	--	--	--	--	--	--	--

Note: Borrego Creek and Los Trancos Creek were dry during all sample events

Table A-26. Water Temperature (°C) Concentrations Observed at Priority 3 Sites in Riverside County and San Bernardino County during the 2020 Dry Season

Week Beginning Date	SAR Reach 4 (P3-SBC1)	Goldenstar Creek (P3-RC1)	San Tim Reach 1A (P3-SBC2)	San Tim Reach 2 (P3-SBC3)	Warm Creek (P3-SBC4)
5/10/2020	24.3	--	--	--	--
5/17/2020	24.2	--	--	--	--
5/24/2020	24.0	--	--	--	--
5/31/2020	25.1	--	--	--	--
6/7/2020	25.3	--	--	--	--
6/14/2020	24.5	--	--	--	--
6/21/2020	25.9	--	--	--	--
6/28/2020	24.8	--	--	--	--
7/5/2020	27.2	--	29.7	31	28
7/12/2020	26.6	--	30.9	32.2	NA
7/19/2020	27	--	28.3	29.8	NA
7/26/2020	27.6	--	32.9	NA	32.7
8/2/2020	27.4	--	30.1	30.6	NA
8/9/2020	28.1	--	--	--	--
8/16/2020	28.1	--	--	--	--
8/23/2020	28.4	21.5	--	--	--
8/30/2020	28.4	18.2	--	--	--
9/6/2020	25.9	17.9	--	--	--
9/13/2020	26.8	17.8	--	--	--
9/20/2020	26.9	16.4	--	--	--
10/25/2020	24.7	--	--	--	--
11/1/2020	23.5	--	--	--	--
11/8/2020	24.2	--	--	--	--
11/15/2020	23.4	--	--	--	--
11/22/2020	24.1	--	--	--	--

Table A-27. Conductivity (µS/cm) Observed at Priority 1 Sites during the 2020 Dry Season

Week Beginning Date	Canyon Lake (P1-1)	Lake Elsinore (P1-2)	Lake Perris (P1-3)	Big Bear Lake (P1-4)	Mill Creek Reach 2 (P1-5)	Lytle Creek (P1-6)	SAR @ MWD Crossing (WW-S1)	SAR @ Pedley Avenue (WW-S4)
5/10/2020	510	2923	489	407	184	242	991	1044
5/17/2020	516	295	498	400	184	242	963	1048
5/24/2020	532	2968	500	407	188	249	1017	1050
5/31/2020	541	2974	506	407	189	249	1032	1072
6/7/2020	555	3008	503	389	184	243	1010	1064
6/14/2020	556	3003	503	406	185	253	1028	1056
6/21/2020	535	3032	509	405	184	254	1023	1048
6/28/2020	558	3033	504	408	189	253	1016	1040
7/5/2020	558	2948	491	384	184	244	999	1014
7/12/2020	585	2977	503	373	186	249	1021	1039
7/19/2020	601	3090	509	368	161	254	1019	1049
7/26/2020	608	3102	509	368	185	252	1026	1049
8/2/2020	617	3142	513	357	176	261	1032	1063
8/9/2020	612	3068	502	336	185	249	993	1048
8/16/2020	638	3171	520	351	184	256	1054	1075
8/23/2020	635	3122	510	343	185	252	1000	1040
8/30/2020	660	3220	523	345	188	257	1018	1061
9/6/2020	652	3147	510	341	--	245	970	1019
9/13/2020	645	3109	502	353	--	242	970	998
9/20/2020	647	3073	491	375	--	243	925	1010
10/25/2020	710	3333	521	387	195	261	1027	1071
11/1/2020	719	3366	526	387	198	269	1023	1059
11/8/2020	720	3354	517	399	200	260	1008	1051
11/15/2020	732	3384	518	412	200	263	996	1050
11/22/2020	718	3297	505	403	205	254	982	1013

Table A-28. Conductivity (µS/cm) Observed at Priority 2 Sites during the 2020 Dry Season

Week Beginning Date	Prado Park Lake Outlet	Chino Creek @ Central Avenue	Mill-Cucamonga Creek Below Wetlands	SAR @ MWD Crossing	SAR @ Pedley Avenue
	(WW-C3)	(WW-C7)	(WW-M6)	(WW-S1)	(WW-S4)
5/10/2020	933	1297	857	991	1044
5/17/2020	914	1047	980	963	1048
5/24/2020	2220	1307	1051	1017	1050
5/31/2020	948	1340	1002	1032	1072
6/7/2020	911	1204	1138	1010	1064
6/14/2020	1656	1245	1181	1028	1056
6/21/2020	949	1088	1036	1023	1048
6/28/2020	940	1208	851	1016	1040
7/5/2020	1303	1323	1331	999	1014
7/12/2020	1778	1337	1105	1021	1039
7/19/2020	924	1385	963	1019	1049
7/26/2020	1590	1403	884	1026	1049
8/2/2020	1170	1401	869	1032	1063
8/9/2020	1272	1331	893	993	1048
8/16/2020	920	1386	899	1054	1075
8/23/2020	1199	1361	946	1000	1040
8/30/2020	926	1290	1167	1018	1061
9/6/2020	899	1210	961	970	1019
9/13/2020	1060	1181	938	970	998
9/20/2020	973	1302	898	925	1010
10/25/2020	1776	1138	1000	1027	1071
11/1/2020	1864	1175	1215	1023	1059
11/8/2020	1618	967	858	1008	1051
11/15/2020	1121	1082	907	996	1050
11/22/2020	1280	1043	973	982	1013

Table A-29. Conductivity (µS/cm) Observed at Priority 3 Sites in Orange County during the 2020 Dry Season

Week Beginning Date	Bolsa Chica Channel	Borrego Creek	Buck Gully Creek	Los Trancos Creek	Morning Canyon Creek	Peters Canyon Wash	San Diego Creek Reach 1	San Diego Creek Reach 1	Serrano Creek
	(P3-OC1)	(P3-OC2)	(P3-OC3)	(P3-OC5)	(P3-OC6)	(P3-OC7)	(P3-OC8)	(P3-OC9)	(P3-OC11)
5/10/2020	--	--	--	--	--	--	--	--	--
5/17/2020	--	--	--	--	--	--	--	--	--
5/24/2020	--	--	--	--	--	--	--	--	--
5/31/2020	--	--	--	--	--	--	--	--	--
6/7/2020	--	--	--	--	--	--	--	--	--
6/14/2020	--	--	--	--	--	--	--	--	--
6/21/2020	--	--	--	--	--	--	--	--	--
6/28/2020	--	--	--	--	--	--	--	--	--
7/5/2020	--	--	--	--	--	--	--	--	--
7/12/2020	--	--	--	--	--	--	--	--	--
7/19/2020	--	--	--	--	--	2261.6	3226.5	2192.8	1502.2
7/26/2020	--	--	--	--	--	2068.3	3336	2447.2	1693.3
8/2/2020	--	--	--	--	--	1954.4	3144.2	2467.6	1464.2
8/9/2020	--	--	--	--	--	2000	3128.01	2495.8	1053.55
8/16/2020	--	--	--	--	--	1992	2989	2526	1337
8/23/2020	--	--	--	--	--	--	--	--	--
8/30/2020	--	--	--	--	--	--	--	--	--
9/6/2020	--	--	--	--	--	--	--	--	--
9/13/2020	--	--	--	--	--	--	--	--	--
9/20/2020	--	--	--	--	--	--	--	--	--
10/25/2020	2569	--	--	--	--	--	--	--	--
11/1/2020	2492	--	--	--	--	--	--	--	--
11/8/2020	2426	--	--	--	--	--	--	--	--
11/15/2020	2558	--	--	--	--	--	--	--	--
11/22/2020	2419	--	--	--	--	--	--	--	--

Note: Borrego Creek and Los Trancos Creek were dry during all sample events)

Table A-30. Conductivity (µS/cm) observed at Priority 3 sites in Riverside County and San Bernardino County during the 2020 Dry Season

Week Beginning Date	SAR Reach 4	Goldenstar Creek	San Tim Reach 1A	San Tim Reach 2	Warm Creek
	(P3-SBC1)	(P3-RC1)	(P3-SBC2)	(P3-SBC3)	(P3-SBC4)
5/10/2020	847	--	--	--	--
5/17/2020	845	--	--	--	--
5/24/2020	843	--	--	--	--
5/31/2020	849	--	--	--	--
6/7/2020	851	--	--	--	--
6/14/2020	850	--	--	--	--
6/21/2020	850	--	--	--	--
6/28/2020	846	--	--	--	--
7/5/2020	821	--	468	813	942
7/12/2020	842	--	402	802	NA
7/19/2020	845	--	523	842.0	NA
7/26/2020	845	--	496	NA	772.0
8/2/2020	855	--	408	825	NA
8/9/2020	831	--	--	--	--
8/16/2020	850	--	--	--	--
8/23/2020	833	2079	--	--	--
8/30/2020	847	2109	--	--	--
9/6/2020	807	1986	--	--	--
9/13/2020	810	2040	--	--	--
9/20/2020	804	1901	--	--	--
10/25/2020	855	--	--	--	--
11/1/2020	864	--	--	--	--
11/8/2020	874	--	--	--	--
11/15/2020	876	--	--	--	--
11/22/2020	861	--	--	--	--

Table A-31. Flow (cfs) Observed at Priority 1 Sites during the 2020 Dry Season

Week Beginning Date	Canyon Lake (P1-1)	Lake Elsinore (P1-2)	Lake Perris (P1-3)	Big Bear Lake (P1-4)	Mill Creek Reach 2 (P1-5)	Lytle Creek (P1-6)	SAR @ MWD Crossing (WW-S1)	SAR @ Pedley Avenue (WW-S4)
5/10/2020	NA	NA	NA	NA	25	22	36	95
5/17/2020	NA	NA	NA	NA	22	18	64	94
5/24/2020	NA	NA	NA	NA	26	25	25	37
5/31/2020	NA	NA	NA	NA	30	10	28	59
6/7/2020	NA	NA	NA	NA	11	16	27	55
6/14/2020	NA	NA	NA	NA	14	14	34	46
6/21/2020	NA	NA	NA	NA	24	12	32	71
6/28/2020	NA	NA	NA	NA	23	12	25	53
7/5/2020	NA	NA	NA	NA	12.2	9.0	18	49
7/12/2020	NA	NA	NA	NA	13.9	7.1	26	72
7/19/2020	NA	NA	NA	NA	23	8.6	26	54
7/26/2020	NA	NA	NA	NA	8	1.3	43	53
8/2/2020	NA	NA	NA	NA	5.4	10	38	42
8/9/2020	NA	NA	NA	NA	7	13.1	34	69
8/16/2020	NA	NA	NA	NA	7	12	66	111
8/23/2020	NA	NA	NA	NA	4.2	9.3	35	82
8/30/2020	NA	NA	NA	NA	3.7	9.3	45	72
9/6/2020	NA	NA	NA	NA	--	7.1	34	60
9/13/2020	NA	NA	NA	NA	--	7.8	34	35
9/20/2020	NA	NA	NA	NA	--	6.2	26	81
10/25/2020	NA	NA	NA	NA	1.9	4.1	25	16
11/1/2020	NA	NA	NA	NA	2.6	3.1	55	84
11/8/2020	NA	NA	NA	NA	2.8	16.7	36	23
11/15/2020	NA	NA	NA	NA	2.4	7.5	32	78
11/22/2020	NA	NA	NA	NA	2.0	5.8	56	68

Table A-32. Flow (cfs) Observed at Priority 2 Sites during the 2020 Dry Season

Week Beginning Date	Prado Park Lake Outlet	Chino Creek @ Central Avenue	Mill-Cucamonga Creek Below Wetlands	SAR @ MWD Crossing	SAR @ Pedley Avenue
	(WW-C3)	(WW-C7)	(WW-M6)	(WW-S1)	(WW-S4)
5/10/2020	1.4	24.5	NA	36	95
5/17/2020	1.2	7.4	NA	64	94
5/24/2020	1.1	5.5	NA	25	37
5/31/2020	4	11.0	8.0	28	59
6/7/2020	3.5	12.7	4.2	27	55
6/14/2020	2.2	18	6.9	34	46
6/21/2020	3.9	10.2	4.4	32	71
6/28/2020	8.6	15	20.9	25	53
7/5/2020	10.9	10.9	7.2	18	49
7/12/2020	1.4	6.7	12.4	26	72
7/19/2020	5.4	16.5	7	26	54
7/26/2020	2.2	13	14.7	43	53
8/2/2020	6.6	4.8	12.3	38	42
8/9/2020	27	4.4	14.5	34	69
8/16/2020	3.6	12.5	8	66	111
8/23/2020	4.2	18.0	6	35	82
8/30/2020	11	12.7	12	45	72
9/6/2020	3	6.5	13.2	34	60
9/13/2020	5.6	4.0	22.3	34	35
9/20/2020	7.1	9.9	7.7	26	81
10/25/2020	1.3	4.0	21.8	25	16
11/1/2020	1.5	6.7	5	55	84
11/8/2020	2.2	33.9	51	36	23
11/15/2020	6.4	5.3	35	32	78
11/22/2020	5.3	5.4	22	56	68

Table A-33. Flow (cfs) Observed at Priority 3 sites in Orange County during the 2020 Dry Season

Week Beginning Date	Bolsa Chica Channel (P3-OC1)	Borrego Creek (P3-OC2)	Buck Gully Creek (P3-OC3)	Los Trancos Creek (P3-OC5)	Morning Canyon Creek (P3-OC6)	Peters Canyon Wash (P3-OC7)	San Diego Creek Reach 1 (P3-OC8)	San Diego Creek Reach 1 (P3-OC9)	Serrano Creek (P3-OC11)
5/10/2020	--	--	--	--	--	--	--	--	--
5/17/2020	--	--	--	--	--	--	--	--	--
5/24/2020	--	--	--	--	--	--	--	--	--
5/31/2020	--	--	--	--	--	--	--	--	--
6/7/2020	--	--	--	--	--	--	--	--	--
6/14/2020	--	--	--	--	--	--	--	--	--
6/21/2020	--	--	--	--	--	--	--	--	--
6/28/2020	--	--	--	--	--	--	--	--	--
7/5/2020	--	--	--	--	--	--	--	--	--
7/12/2020	--	--	--	--	--	--	--	--	--
7/19/2020	--	--	--	--	--	4.57	4.77	0.33	0.19
7/26/2020	--	--	--	--	--	5.03	7.4	0.23	0.25
8/2/2020	--	--	--	--	--	6.43	4.74	0.27	0.11
8/9/2020	--	--	--	--	--	7.56	5.61	0.3	0.29
8/16/2020	--	--	--	--	--	7.22	9.43	0.113	0.273
8/23/2020	--	--	--	--	--	--	--	--	--
8/30/2020	--	--	--	--	--	--	--	--	--
9/6/2020	--	--	--	--	--	--	--	--	--
9/13/2020	--	--	--	--	--	--	--	--	--
9/20/2020	--	--	--	--	--	--	--	--	--
10/25/2020	1.0	--	--	--	--	--	--	--	--
11/1/2020	0.9	--	--	--	--	--	--	--	--
11/8/2020	0.9	--	--	--	--	--	--	--	--
11/15/2020	0.6	--	--	--	--	--	--	--	--
11/22/2020	0.7	--	--	--	--	--	--	--	--

Note: Borrego Creek and Los Trancos Creek were dry during all sample events

Table A-34. Flow (cfs) Observed at Priority 3 Sites in Riverside County and San Bernardino County during the 2020 Dry Season

Week Beginning Date	SAR Reach 4 (P3-SBC1)	Goldenstar Creek (P3-RC1)	San Tim Reach 1A (P3-SBC2)	San Tim Reach 2 (P3-SBC3)	Warm Creek (P3-SBC4)
5/10/2020	28.8	--	--	--	--
5/17/2020	38.3	--	--	--	--
5/24/2020	27.0	--	--	--	--
5/31/2020	30.2	--	--	--	--
6/7/2020	70.4	--	--	--	--
6/14/2020	26.9	--	--	--	--
6/21/2020	40.7	--	--	--	--
6/28/2020	40.2	--	--	--	--
7/5/2020	39.2	--	1.43	0.7	0.8
7/12/2020	43	--	0.55	1.3	NA
7/19/2020	37.5	--	1.9	0.1	NA
7/26/2020	40.8	--	0.32	NA	0.3
8/2/2020	38.3	--	0.27	0.1	NA
8/9/2020	45.5	--	--	--	--
8/16/2020	45.5	--	--	--	--
8/23/2020	46	2.76	--	--	--
8/30/2020	42.7	8	--	--	--
9/6/2020	42.9	3.1	--	--	--
9/13/2020	22.8	6	--	--	--
9/20/2020	46	4.5	--	--	--
10/25/2020	33.2	--	--	--	--
11/1/2020	38.6	--	--	--	--
11/8/2020	27	--	--	--	--
11/15/2020	39.7	--	--	--	--
11/22/2020	18	--	--	--	--

Table A-35. Water Quality Data from Priority 2 Sites during the 2020-2021 Storm Event

Date	*E. coli* (MPN/100 mL)	TSS (mg/L)	Conductivity (µS/cm)	Dissolved Oxygen (mg/L)	Flow (cfs)	pH	Water Temperature (°C)	Turbidity (NTU)
Prado Park Lake (WW-C3)								
1/25/2021	270	38	1110	10.2	6	8.7	12.4	12
1/27/2021	ND	28	1629	9.8	4	8.3	12.7	7
1/28/2021	74	29	967	12.1	3	9.1	12.1	9
1/29/2021	3900	260	771	10.5	13	8.4	11	187
Chino Creek at Central Avenue (WW-C7)								
1/25/2021	4600	32	182	11.1	NA	7.4	8.9	26
1/27/2021	300	2	986	8.3	9	7.8	13.7	1
1/28/2021	62	2	963	8.5	8	7.7	15.9	1
1/29/2021	3900	23	153	10.7	NA	7.7	11	22
Mill-Cucamonga Creek below Treatment Wetlands (WW-M6)								
1/25/2021	2900	170	281	10.2	NA	7.9	11	70
1/27/2021	52	13	781	9.1	65	7.8	14.7	4
1/28/2021	160	7	843	8.8	48	7.8	15.1	5
1/29/2021	5500	90	192	10.5	NA	8	10.9	63
SAR at MWD Crossing (WW-S1)								
1/25/2021	11,000	1100	134	10.8	NA	8.3	9.5	361
1/27/2021	310	18	901	8.7	59	8	15	8
1/28/2021	200	13	957	8.9	53	8.1	15.1	7
1/29/2021	4400	640	149	10.7	NA	8	9.3	318
SAR at Pedley Avenue (WW-S4)								
1/25/2021	13000	1500	180	9.9	NA	8.2	10.1	511
1/27/2021	240	23	876	9.3	108	8.2	14.1	12
1/28/2021	160	34	902	9.4	99	8.2	13.8	15
1/29/2021	5800	720	141	10.4	NA	8	10.4	325

Table A-36. 2020 Daily Mean Flow (cfs), Chino Creek at Schaeffer Avenue, as Measured by the USGS (Data are provisional)

Date	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	0.36	0.27	0.70	0.39	0.39	0.45	0.46	0.36	0.44	0.54	0.35	0.36
2	0.46	0.28	0.46	0.38	0.35	0.48	0.39	0.65	0.44	0.57	0.51	0.35
3	0.43	0.30	0.10	0.37	0.36	0.41	0.39	0.36	0.41	0.66	0.39	0.55
4	0.40	0.26	0.11	0.37	0.36	0.53	0.38	0.38	0.44	0.45	0.42	0.47
5	0.33	0.25	0.13	0.39	0.37	0.64	0.33	0.37	0.45	0.54	0.37	0.25
6	0.41	0.33	0.26	275	0.40	0.51	0.32	0.44	0.45	0.47	0.90	0.68
7	0.37	0.29	0.12	71.0	0.41	0.90	0.31	0.34	0.58	0.56	72.6	0.75
8	0.31	0.31	0.14	101	0.38	0.57	0.36	0.85	0.68	0.51	0.84	0.36
9	0.38	0.41	0.18	158	0.32	0.51	0.34	1.07	0.87	0.53	0.47	0.42
10	0.32	0.23	99.5	55.8	0.32	0.36	0.42	0.42	0.81	0.49	1.74	0.39
11	0.33	0.20	0.55	1.60	0.31	0.35	1.92	0.46	0.78	0.41	0.48	0.52
12	0.32	0.24	322	1.39	0.30	0.52	0.82	0.63	0.73	0.52	0.90	0.34
13	0.37	0.24	107	3.40	0.28	0.36	0.43	0.73	0.72	0.57	0.41	0.29
14	0.57	0.23	2.68	0.92	0.35	0.89	0.78	0.35	0.78	0.48	0.33	0.40
15	0.45	0.22	2.84	0.86	0.31	0.46	0.38	0.38	0.55	0.51	0.30	0.39
16	0.52	0.26	30.5	0.76	0.28	0.40	0.37	0.39	0.42	0.40	0.66	0.34
17	9.43	0.24	3.33	0.73	0.28	0.42	0.34	0.39	0.42	0.41	0.31	0.42
18	0.49	0.30	0.36	1.26	20.6	0.39	0.35	0.42	0.50	0.44	0.38	0.41
19	0.42	0.31	163	0.65	0.63	0.45	0.66	0.44	0.41	0.84	0.73	0.26
20	0.37	0.23	4.07	0.65	0.56	0.36	0.32	0.58	0.40	0.50	0.58	0.28
21	0.40	0.24	0.52	0.68	0.52	0.37	0.39	0.57	0.46	0.95	0.42	0.33
22	0.53	0.42	195	0.77	0.50	0.58	0.38	0.49	0.54	0.52	0.41	0.37
23	0.35	0.28	87.2	0.71	0.46	1.80	0.41	0.54	0.48	0.69	0.49	0.38
24	0.35	0.22	1.04	0.70	0.47	1.37	0.36	0.48	0.58	0.66	0.70	0.48
25	0.40	0.22	0.75	0.74	0.42	0.80	0.38	0.43	0.49	0.44	0.39	0.52
26	0.48	0.25	0.54	0.72	0.43	1.20	0.39	0.47	0.49	0.44	0.45	0.46
27	0.43	0.23	0.43	0.58	0.43	1.31	0.35	0.55	0.48	0.59	0.40	0.59
28	0.31	0.21	0.38	0.44	0.44	1.13	0.45	0.47	0.52	0.52	0.40	445
29	0.29	0.20	0.36	0.54	0.45	1.24	0.42	0.47	0.54	1.03	0.33	1.92
30	0.30		0.35	0.42	0.45	0.36	0.40	0.49	0.52	1.35	1.07	0.68
31	0.27		0.39		0.46		0.37	0.48		0.53		0.55
COUNT	**31**	**29**	**31**	**30**	**31**	**30**	**31**	**31**	**30**	**31**	**30**	**31**
MAX	**9.43**	**0.42**	**322**	**275**	**20.6**	**1.80**	**1.92**	**1.07**	**0.87**	**1.35**	**72.6**	**445**
MIN	**0.27**	**0.20**	**0.10**	**0.37**	**0.28**	**0.35**	**0.31**	**0.34**	**0.40**	**0.40**	**0.30**	**0.25**

[P] Data is considered "Provisional data subject to revision"

Table A-37. 2020 Daily Mean Flow (cfs), Cucamonga Creek near Mira Loma, as Measured by the USGS (Data are provisional)

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	30.0	54.1	36.6	54.4	25.0	29.1	0.92	16.2	2.64	13.1	31.4	23.3
2	27.6	55.4	41.2	54.7	24.4	6.86	1.80	12.4	4.21	6.32	32.0	18.7
3	32.6	57.7	38.0	50.5	29.5	16.7	1.01	22.0	4.24	4.30	37.0	21.9
4	29.9	61.1	34.3	58.0	44.3	9.40	1.46	9.85	4.64	14.5	30.6	11.9
5	33.7	60.6	22.6	53.5	33.7	12.2	1.12	3.87	5.56	9.61	38.5	29.9
6	31.1	54.5	2.84	611	26.8	12.3	1.14	8.12	7.49	6.80	44.2	34.3
7	26.9	52.8	5.30	363	25.4	24.7	1.23	5.48	9.07	19.9	135	25.6
8	15.5	58.7	6.63	178	25.1	15.3	1.13	4.46	8.43	30.8	113	19.5
9	23.3	75.2	7.15	263	30.0	13.3	1.96	4.82	13.4	12.2	79.3	20.6
10	20.9	53.4	70.9	269	38.2	13.0	1.93	17.3	21.3	17.5	80.6	35.3
11	21.9	42.3	4.80	28.5	36.1	15.6	2.07	8.82	33.7	7.75	83.5	32.2
12	12.2	21.6	376	18.2	39.0	10.0	1.97	8.16	57.8	13.0	82.8	32.1
13	32.9	16.6	48.5	25.1	35.4	8.15	1.40	11.2	58.7	28.2	75.5	36.2
14	61.3	12.9	7.57	18.4	33.2	12.9	9.58	7.69	49.8	14.4	83.6	41.4
15	55.0	17.8	0.73	41.3	25.9	9.49	5.99	5.95	62.4	13.5	85.9	32.7
16	54.9	17.8	43.4	59.1	21.7	12.9	2.20	9.66	67.3	15.7	80.0	23.4
17	55.1	16.1	44.6	76.4	29.5	20.5	4.51	10.5	42.2	12.4	72.7	22.8
18	46.7	20.4	20.6	79.5	76.9	17.8	6.38	12.7	40.4	7.81	71.3	43.2
19	45.8	19.8	55.7	66.6	76.9	10.5	7.43	14.1	44.3	14.8	52.3	42.7
20	47.0	18.1	48.0	27.8	53.0	13.4	7.02	13.5	46.0	4.56	24.5	41.9
21	47.8	23.1	36.1	15.0	23.3	15.2	3.15	10.1	36.1	3.40	29.5	59.3
22	52.0	34.9	128	16.7	20.4	12.4	1.26	10.4	36.6	6.93	32.0	89.4
23	49.8	35.9	144	20.9	42.5	21.2	3.25	15.6	31.1	36.7	18.2	107
24	56.2	35.9	55.0	23.7	26.8	14.9	4.85	6.04	25.5	70.9	52.1	121
25	56.6	33.7	59.0	30.2	22.6	19.6	6.36	5.07	9.91	37.3	53.5	70.4
26	57.4	29.7	59.9	27.4	21.9	20.2	18.1	5.46	9.37	53.5	70.0	41.6
27	58.0	26.8	62.0	29.7	22.4	18.0	15.4	4.86	10.3	44.5	38.4	51.5
28	56.7	25.8	51.8	31.7	18.3	24.4	7.75	2.86	14.0	40.6	68.3	593
29	57.1	29.9	54.8	28.2	17.8	16.9	14.1	5.79	16.7	28.5	60.2	156
30	54.8		60.2	27.0	16.9	8.36	12.1	3.23	7.11	29.2	44.1	128
31	53.2		59.1		27.0		20.8	2.81		33.1		119
COUNT	**31**	**29**	**31**	**30**	**31**	**30**	**31**	**31**	**30**	**31**	**30**	**31**
MAX	**61.3**	**75.2**	**376**	**611**	**76.9**	**29.1**	**20.8**	**22.0**	**67.3**	**70.9**	**135**	**593**
MIN	**12.2**	**12.9**	**0.73**	**15.0**	**16.9**	**6.86**	**0.92**	**2.81**	**2.64**	**3.40**	**18.2**	**11.9**

Table A-38. 2020 Daily Mean Flow (cfs), Santa Ana River at MWD Crossing, as Measured by the USGS (Data are provisional)

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	104	55.7	66.9	83.5	60.6	39.1	35.1	27.3	35.0	30.9	42.5	38.2
2	90.4	54.6	74.0	81.4	58.2	36.6	34.7	24.1	34.7	30.3	43.5	36.9
3	79.7	52.7	58.9	80.3	57.4	37.4	32.1	24.2	33.5	29.4	43.8	36.0
4	69.1	53.4	60.8	81.6	57.3	35.0	31.8	27.1	33.2	29.4	44.1	36.3
5	60.4	53.4	58.2	80.2	53.9	37.4	32.1	27.7	31.8	30.0	44.4	37.6
6	53.0	52.0	57.0	798	50.6	39.2	27.9	28.8	30.5	31.6	43.7	38.2
7	52.1	54.4	56.6	943	50.5	38.5	28.1	28.7	29.2	33.0	113	39.5
8	53.0	53.7	56.9	662	49.5	38.0	28.6	27.1	32.5	36.2	51.7	39.8
9	60.5	57.1	59.0	652	53.3	36.4	28.7	26.8	31.5	37.5	57.5	39.6
10	48.5	55.5	298	795	49.0	37.4	28.7	31.7	33.9	38.4	49.8	42.5
11	47.5	56.5	103	285	46.1	37.0	28.3	28.9	34.6	37.8	46.9	44.6
12	47.7	53.3	1,370	146	47.2	35.7	27.0	32.2	36.1	34.5	44.5	46.7
13	47.1	55.1	634	115	47.6	35.2	25.1	29.3	36.9	34.5	43.3	47.0
14	51.2	52.7	245	90.8	48.1	38.4	25.9	25.7	35.9	33.3	43.1	47.9
15	50.8	50.8	103	82.2	48.2	34.9	24.4	25.2	37.3	33.0	41.9	48.5
16	51.2	50.6	86.8	76.9	46.7	38.3	24.9	25.9	36.9	30.8	40.4	49.4
17	61.7	49.6	152	72.3	45.1	39.8	25.3	25.0	34.4	31.6	40.5	51.0
18	56.8	48.2	91.7	70.3	43.0	37.6	29.5	27.2	35.4	30.9	38.8	50.3
19	55.7	47.9	148	69.0	43.5	41.5	29.8	28.4	33.6	33.0	50.2	50.1
20	55.4	47.9	154	68.3	43.8	38.9	30.4	28.3	34.0	35.0	43.9	48.0
21	55.7	49.1	104	63.4	39.8	42.0	30.8	30.2	32.1	35.7	41.9	47.3
22	55.2	58.2	101	59.2	40.4	36.3	28.7	29.5	33.3	36.3	42.8	47.6
23	53.4	63.2	519	54.2	39.4	39.2	29.9	29.2	32.7	38.0	42.3	48.1
24	56.3	55.9	178	54.3	39.7	40.2	30.7	27.6	33.6	37.4	41.7	50.1
25	56.5	53.9	132	57.8	39.8	36.0	27.9	32.4	33.9	40.1	43.2	49.6
26	57.6	51.4	125	53.7	40.1	38.3	27.4	32.4	35.0	39.7	42.0	47.4
27	56.8	49.9	120	56.1	39.3	34.6	28.1	32.1	35.0	39.8	40.2	49.5
28	54.9	49.8	115	55.3	36.0	34.8	25.4	31.7	33.6	40.3	40.0	854
29	58.1	52.5	111	59.6	37.3	35.2	26.2	35.0	32.7	38.8	38.9	272
30	57.9		96.3	57.3	36.7	34.9	26.9	35.3	32.0	41.9	37.8	52.2
31	56.3		84.6		40.4		24.2	35.4		42.2		49.4
COUNT	**31**	**29**	**31**	**30**	**31**	**30**	**31**	**31**	**30**	**31**	**30**	**31**
MAX	**104**	**63.2**	**1,370**	**943**	**60.6**	**42.0**	**35.1**	**35.4**	**37.3**	**42.2**	**113**	**854**
MIN	**47.1**	**47.9**	**56.6**	**53.7**	**36.0**	**34.6**	**24.2**	**24.1**	**29.2**	**29.4**	**37.8**	**36.0**

Appendix B
QA/QC Summary

Introduction

This section provides the Quality Assurance/Quality Control (QA/QC) evaluation for samples and data collected during the period covered by this report, which includes the 2020 dry weather monitoring and 2020-2021 storm monitoring. The basis for this evaluation is the approved QAPP.[26]

Field measurements were made for the following constituents: conductivity, dissolved oxygen, pH, turbidity, water temperature, and flow. Field data were checked to ensure that all required data were gathered and recorded. This check included a data review to ensure correct units of measurements were reported and that reported values were within expected ranges.

Laboratory analyses were conducted for three constituents: *E. coli*, Enterococcus, and TSS. Data validation included a check to ensure that samples were delivered to laboratories within required holding times and that all sample handling and custody protocols were followed. Field/equipment blank and duplicate results were evaluated against various reporting requirements and data were checked to ensure correct units of measurement were reported.

The following sections summarize the results of the QA/QC evaluation for the period covered by this report.

Field Measured Parameters

Completeness

Table B-1 shows number of the dry weather field measurements collected during 2020. Completeness is summarized as follows:

- Due to dry conditions at Borrego Creek and Los Trancos Creek during the monitoring events, no field measurements or water quality samples were collected, resulting in 10 uncollected measurements for each parameter.
- Samples were not collected from Buck Gully Creek, Los Trancos Creek, and Morning Canyon due to ongoing coordination efforts between the Regional Board and the City of Newport.
- An additional sample was collected at Goldenstar Creek (P3-RC1) to support a more robust geomean calculation.
- There are fewer planned flow measurements as flow is measured in stream sites only. As four Priority 1 sites are in lakes and two Priority 4 sites are in the tidal zone, there are 238 planned flow measurements (97 less than other field parameters). Ten flow measurements

[26] SAR RMP QAPP, Version 1.0, February 2016

were not collected due to dry conditions. One measurement was not collected due to tidal influence and one was not collected due to time constraints.

- Additional samples were collected at Santa Ana River Reach 4 (P3-SBC1) to support future potential de-listing.
- Additional samples were collected Cucamonga Creek at Hellman Avenue (P4-SBC1) to provide data to support updating the anti-degradation target.

Table B-1. Dry Weather Field Parameter Completeness Summary

Parameter	Planned[1]	Collected	% Complete
Conductivity	411	392	95.4%
Dissolved Oxygen	411	392	95.4%
Flow[2]	311	292	93.9%
pH	371	365	98.4%
Temperature	411	392	95.4%
Turbidity	411	392	95.4%

[1] Planned represents the number of samples planned based on SAR RMP Monitoring Plan and does not include special investigations that arise based on results of the routine monitoring program.
[2] Flow is not measured at lake sites and sites located in tides.

Accuracy and Precision

Field staff used a Horiba multi-parameter probe (or equivalent) to collect in situ field measurements for conductivity, dissolved oxygen, pH, and water temperature at all sample locations during each sample event. Turbidity and flow were measured with a Hach Turbidity meter and Marsh-McBirney Flo-Mate meter with top-setting rod, respectively. Field staff calibrated each of the water quality meters prior to each sample event to ensure accuracy and precision of the measurements. Table B-2 summarizes the accuracy and repeatability associated with the use of each meter. All field measurement accuracy expectations met the requirements as listed in the QAPP.

Table B-2. Summary of Accuracy and Repeatability Expectations for Field Measurement Meters

Water Quality Constituent	Accuracy	Repeatability
Dissolved Oxygen	± 0.2 mg/L	± 0.1 mg/L
pH	± 0.1 units	± 0.05 units
Conductivity	± 1%	± 0.05%
Water Temperature	± 0.3 °C	±0.1 °C
Turbidity	± 2%	± 1%
Flow	± 2%	N/A

Laboratory Constituents

Table B-3 describes the number of grab water samples planned versus actual samples collected. During the 2020 dry weather season, 25 weeks of sampling at eight Priority 1 sites and five Priority 2 sites was planned from the week of May 10, 2020, through the week of November 22, 2020. During the same period, 5 weeks of sampling at eleven Priority 3 sites, with additional sampling frequency at SAR Reach 4, and one week of sampling at five Priority 4 sites are also planned with additional sampling frequency at Cucamonga Creek at Hellman Avenue. This results in 428 dry weather samples. This Annual Report also encompasses monitoring of a wet weather storm events at the five Priority 2 sites. This results in 20 wet weather samples (5 sites/event and 4 samples per site) for a total of 448 samples during the entire monitoring period covered in this 2020-2021 Annual Report.

Holding time requirements for TSS (7 days), *E. coli* (6 hours), and *enterococci* (6 hours) were not exceeded for any samples collected during the 2020-2021 sampling year.

Field/Equipment Blanks

The QAPP calls for a field/equipment blank to be collected during each day of sampling. One field/equipment blank sample is also required during each storm event. This results in a frequency of 26 percent, well above the typically required frequency. Per the QAPP, the reporting target limits for TSS and bacterial indicators were 2.0 mg/L and 10 MPN/100 mL, respectively. These method sensitivity guidelines were met. All but two field/equipment blank results were below detectable counts (< 10 MPN/100 mL) for *E. coli*. The two blanks above detectable counts were 14 and 12 MPN/100 mL. For TSS, 9 field blanks were reported at or above the reporting limit. Of those 9, only one was above the reporting limit at 4 mg/L.

Field Duplicates

Field staff collected at least one field duplicate during each sample event for a total of 114 TSS field duplicates and 113 indicator bacteria field duplicates. As a result, the frequency of field duplicate collection was 27 percent, well above the required frequency.

Table B-3. Summary of Grab Sample Collection Activity for Dry and Wet Weather Sample Events and Regularly Sampled Sites

Sample ID	Sample Location	Planned	Collected	Missed
P1-1	Canyon Lake at Holiday Harbor	25	25	0
P1-2	Lake Elsinore	25	25	0
P1-3	Lake Perris	25	25	0
P1-4	Big Bear Lake at Swim Beach	25	25	0
P1-5	Mill Creek Reach 2	25	22	3
P1-6	Lytle Creek (Middle Fork)	25	25	0
WW-M6	Mil-Cucamonga Creek below Wetlands	29	29	0
WW-C7	Chino Creek at Central Avenue	29	29	0
WW-C3	Prado Park Lake	29	29	0
WW-S1	Santa Ana River Reach 3 at MWD Crossing	29	29	0
WW-S4	Santa Ana River Reach 3 at Pedley Avenue	29	29	0
MISSION	Santa Ana River at Mission Blvd. Bridge	25	25	0
P3-OC1	Bolsa Chica Channel	5	5	0
P3-OC2[1]	Borrego Creek	5	0	5
P3-OC3[2]	Buck Gully Creek	5	0	5
P3-OC5[2]	Los Trancos Creek	5	0	5
P3-OC6[2]	Morning Canyon Creek	5	0	5
P3-OC7	Peters Canyon Wash	5	5	0
P3-OC8	San Diego Creek Reach 1	5	5	0
P3-OC9	San Diego Creek Reach 1	5	5	0
P3-OC11	Serrano Creek	5	5	0
P3-RC1	Goldenstar Creek	5	6	0
P3-SBC1	Santa Ana River Reach 4	30	30	0
P3-SBC2	San Timoteo Creek Reach 1A	5	5	0
P3-SBC3	San Timoteo Creek Reach 2	5	5	0
P3-SBC4	Warm Creek	5	5	0
P4-RC2	Temescal Creek at Lincoln Avenue	1	1	0
P4-OC1	Santa Ana Delhi Channel Upstream of Irvine Avenue	1	1	0
P4-OC2	Santa Ana Delhi Channel in Tidal Prism	1	1	0
P4-OC3[3]	Greenville-Banning Channel in Tidal Prism	1	4	0
P4-SBC1	Cucamonga Creek at Hellman Avenue	12	12	0
Total		431	412	23

[1] Borrego Creek was dry during all five sample vents.
[2] Buck Gully Creek, Los Trancos Creek, and Morning Canyon Creek were not sampled due to ongoing coordination efforts between the Regional Board and the city of Newport Beach
[3] Additional samples were collected at Greenville-Banning Channel in Tidal Prism due to an exceedance of the anti-degradation target

Each duplicate sample was analyzed for the same parameters as its paired field sample. Results of the field duplicate analyses can be used to assess adherence to field sampling collection protocols and laboratory precision. Table B-4 summarizes the field duplicate analysis results for TSS. Twelve duplicate pairs exceeded the QAPP's relative percent difference (RPD) goal of ± 25 percent. Three pairs of duplicate samples, collected at Lake Perris on June 28, 2020, Mill Creek Reach 2 on July 12th, 2020, and Bolsa Chica Channel on November 19th, 2020have a significant RPD resulting in a large difference in concentration (34 v 8 mg/L, 22 v 16 mg/L, and 7.2 v 12 mg/L). This is 3 percent of all QA/QC samples and is within a normal frequency. Nine pairs with RPD exceeding ± 25 percent are due to low TSS values; maximum TSS concentration in those pairs is 18 mg/L and the maximum difference in the eight pairs is 16 mg/L. Dividing by the low TSS values artificially results in high RPD values.

To determine the precision of the duplicate analysis for each bacterial indicator the following method was used:[27]

- Calculate the logarithm of each sample and associated duplicate ("laboratory pair")
- Determine the range for each laboratory pair (R_{log})
- Calculate the mean of the ranges (Mean R_{log})
- Calculate the precision criterion, where the precision criteria = 3.27 * Mean R_{log}
- Compare R_{log} for each duplicate pair with the calculated precision criterion for the data set to determine if R_{log} is less than the precision criterion.

Tables B-5 summarizes the field duplicate analysis results for *E. coli*, respectively. Two samples exceeded precision criterion.

[27] Standard Methods, Section 9020B, 18th, 19th, or 20th Editions

Table B-4. Results of Field Duplicate Analysis for TSS

Week Beginning Date	Site ID	Site Location	Duplicate Result (mg/L)	Sample Result (mg/L)	RPD (%)
5/10/2020	P1-4	Big Bear Lake	28	24	15%
5/17/2020	WW-C7	Chino Creek at Central Avenue	2	4	67%
5/24/2020	P1-3	Lake Perris	<2	<2	0%
5/31/2020	P3-SBC1	Santa Ana River Reach 4	2	2	0%
6/7/2020	P1-5	Mill Creek Reach 2	<2	<2	0%
6/14/2020	WW-S4	Santa Ana River Reach 3 at Pedley Avenue	8	10	22%
6/21/2020	MISSION	Santa Ana River Reach 3 at Mission Avenue	12	10	18%
6/28/2020	P1-3	Lake Perris	34	8	124%
7/5/2020	WW-S4	San Diego Creek Reach 1	12	11	9%
7/12/2020	P1-5	Mill Creek Reach 2	22	16	32%
7/19/2020	P1-2	Lake Elsinore	38	36	5%
7/26/2020	P3-SBC2	Santa Ana River Reach 4	10	8	22%
8/2/2020	WW-S1	SAR at MWD Crossing	2	18	160%
8/9/2020	P1-2	Lake Elsinore	27	27	0%
8/16/2020	P1-6	Lytle Creek	<2	<2	0%
8/23/2020	WW-M6	Mil-Cucamonga Creek below Wetlands	4	3	29%
8/30/2020	WW-C7	Chino Creek at Central Avenue	4	3	29%
9/6/2020	P1-2	Lake Elsinore	22	19	15%
9/13/2020	P1-4	Big Bear Lake	<2	<2	0%
9/20/2020	WW-C7	Chino Creek at Central Avenue	7	7	0%
10/25/2020	P1-1	Canyon Lake	4	3	29%
11/1/2020	P1-4	Big Bear Lake	3	2	40%
11/8/2020	WW-C7	Chino Creek at Central Avenue	2	2	0%
11/15/2020	P1-6	Lytle Creek	<2	<2	0%
11/22/2020	WW-M6	Mil-Cucamonga Creek below Wetlands	4	4	0%
10/28/2020	P3-OC1	Bolsa Chica Channel	21	21	0%
11/5/2020	P3-OC1	Bolsa Chica Channel	20	19	5%
11/12/2020	P3-OC1	Bolsa Chica Channel	9.7	9.6	1%
11/19/2020	P3-OC1	Bolsa Chica Channel	7.2	12	50%
11/24/2020	P3-OC11	Serrano Creek	18	18	0%
7/19/2020	P3-OC7	Peters Canyon Wash	40	43	7%
7/26/2020	P3-OC7	Peters Canyon Wash	3.9	4.1	5%
8/2/2020	P3-OC9	San Diego Creek Reach 1	1.9	1.3	38%
8/9/2020	P3-OC9	San Diego Creek Reach 1	2.6	1.9	31%
8/16/2020	P3-OC9	San Diego Creek Reach 1	4	1.3	102%

Note: Values with a "<" qualifier reflect results that are below detection limits. For calculation purposes, the value was represented by the detection limit.

Table B-5. Results of Field Duplicate Analysis for *E. coli*

Sample Date	Site ID	Site Location	Duplicate Result (MPN/100 mL)	Sample Result (MPN/100 mL)	Log of Duplicate Result (L_1)	Log of Sample Result (L_2)	Range of Logs (L_1 - L_2) or (R_{log})
5/10/2020	P1-4	Big Bear Lake	3.1	2	0.4914	0.3010	0.1903
5/17/2020	WW-C7	Chino Creek at Central Avenue	260	510	2.4150	2.7076	0.2926
5/24/2020	P1-3	Lake Perris	1	1	0.0000	0.0000	0.0000
5/31/2020	P3-SBC1	Santa Ana River Reach 4	41	590	1.6128	2.7709	1.1581
6/7/2020	P1-5	Mill Creek Reach 2	<1	<1	0.0000	0.0000	0.0000
6/14/2020	WW-S4	Santa Ana River Reach 3 at Pedley Avenue	180	140	2.2553	2.1461	0.1091
6/21/2020	MISSION	Santa Ana River Reach 3 at Mission Avenue	210	1000	2.3222	3.0000	0.6778
6/28/2020	P1-3	Lake Perris	66	<1	1.8195	0.0000	1.8195
7/5/2020	WW-S4	San Diego Creek Reach 1	110	160	2.0414	2.2041	0.1627
7/12/2020	P1-5	Mill Creek Reach 2	16	1	1.2041	0.0000	1.2041
7/19/2020	P1-2	Lake Elsinore	1	2	0.0000	0.3010	0.3010
7/26/2020	P3-ST5	Santa Ana River Reach 4	<1	2	0.0000	0.3010	0.3010
8/2/2020	WW-S1	SAR at MWD Crossing	230	240	2.3617	2.3802	0.0000
8/9/2020	P1-2	Lake Elsinore	1	1	0.0000	0.0000	0.0000
8/16/2020	P1-6	Lytle Creek	54	38	1.7324	1.5798	0.1526
8/23/2020	WW-M6	Mil-Cucamonga Creek below Wetlands	230	120	2.3617	2.0792	0.0000
8/30/2020	WW-C7	Chino Creek at Central Avenue	290	200	2.4624	2.3010	0.1614
9/6/2020	P1-2	Lake Elsinore	1	2	0.0000	0.3010	0.3010
9/13/2020	P1-4	Big Bear Lake	4.1	3.1	0.6128	0.4914	0.1214
9/20/2020	WW-C7	Chino Creek at Central Avenue	530	280	2.7243	2.4472	0.2771
10/25/2020	P1-1	Canyon Lake	11	13	1.0414	1.1139	0.0726
11/1/2020	P1-4	Big Bear Lake	68	75	1.8325	1.8751	0.0426
11/8/2020	WW-C7	Chino Creek at Central Avenue	7300	5200	3.8633	3.7160	0.1473
11/15/2020	P1-6	Lytle Creek	28	31	1.4472	1.4914	0.0442

Sample Date	Site ID	Site Location	Duplicate Result (MPN/100 mL)	Sample Result (MPN/100 mL)	Log of Duplicate Result (L_1)	Log of Sample Result (L_2)	Range of Logs (L_1 - L_2) or (R_{log})
11/22/2020	WW-M6	Mil-Cucamonga Creek below Wetlands	3700	4100	3.5682	3.6128	0.0446
10/25/2020	P3-OC1	Bolsa Chica Channel	253	241	2.4031	2.3820	0.0211
11/1/2020	P3-OC1	Bolsa Chica Channel	262	259	2.4183	2.4133	0.0050
11/15/2020	P3-OC1	Bolsa Chica Channel	435	359	2.6385	2.5551	0.0834
11/22/2020	P3-OC1	Bolsa Chica Channel	1722	2098	3.2360	3.3218	0.0858
7/19/2020	P3-OC9	San Diego Creek Reach 1	20	41	1.3010	1.6128	0.3118
7/26/2020	P3-OC7	Peters Canyon Wash	146	314	2.1644	2.4969	0.3326
8/2/2020	P3-OC9	San Diego Creek Reach 1	97	41	1.9868	1.6128	0.3740
8/9/2020	P3-OC11	Serrano Creek	771	1043	2.8871	3.0183	0.1312
8/16/2020	P3-OC7	Peters Canyon Wash	174	159	2.2405	2.2014	0.0392
						Sum of R_{log}	8.9651
						Mean R_{log}	0.2637
						Precision Criterion (3.27*Mean R_{log})	0.8622

Appendix C

Laboratory QA/QC Reports

BABCOCK Laboratories, Inc.
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Quality Assurance / Certification Statement

CDM Smith – SAR Monitoring Program

There were a total of 573 samples submitted, which includes 371 site samples, 101 field duplicate samples and 101 field blanks. Samples were analyzed for Total Suspended Solids, Total Coliform, e. Coli and enterococcus as requested. The sampling period spanned January 2020 through December 2020.

All samples were received in good condition, meeting temperature guidelines of <10 ° C for bacteria testing, <6 ° C for solids testing, or having been sampled and placed on ice immediately and received within 6 hours.

All samples were received within acceptable holding times for the analyses requested.

The samples received under this project were analyzed with Good Laboratory Practices. The following items listed pertain to all samples submitted to our laboratory.

1) The method specified QC was performed on all batches containing project samples.
2) All sample parameters requested were reported, unless otherwise notified.
3) All batch acceptance criteria was met prior to reporting results, except as noted below.

Exceptions to Standard Quality Control Procedures

This report is organized into three sections:

Section I details Batch QC failures. An analytical batch includes the analysis of Method Blanks and Blank Spikes as applicable, also known as Laboratory Control Samples. If a batch has been qualified due to this type of failure, the end user should weigh the results associated with the batch according to its intended use. Often, the presence of trace contamination will have little to no effect on the usefulness of the reported result. Failed Blank Spikes are flagged with "Data Suspect".

Section II lists the qualifiers associated with samples that have been fortified with known quantities of target and/or non-target surrogate compounds, whose purpose is to monitor analyte recovery in "real-world' samples and to note any matrix interference. Also included in this section is precision information provided by duplicate analyses and/or fortified-sample duplicate analyses. Since the information included in this section is unique to each individual sample, the acceptance of the analytical batch is not controlled by the results of these bias and precision parameters.

Section III of the report identifies individual samples that have been qualified for various reasons. Missed holding times, improper sample preservation, etc. must carefully be evaluated using professional judgement regarding the acceptability of the data for its intended use.

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Section 1

All Method Blanks and Laboratory Control Samples analyzed for Total Suspended Solids were within acceptance criteria. All Method Blanks analyzed for Total Coliform and E. Coli were within acceptance criteria.

Section II

All project source samples used for duplicates met acceptance criteria for precision, with the following exception.

Sample Name	Lab ID	Analyte	Source Result	Duplicate Result	RPD	RPD Control Limit
P1-2	C0G3830-01	Total Suspended Solids	19 mg/l	26 mg/l	31	25

Analyte concentration was below range for valid RPD determination.

Field Blanks

The following field blank samples were above the detection limit for the associated analytical method:

Sample Name	Lab Sample ID	Sample Date/Time	Analyte	Result	Units
20200305SAWPAFB	C0C0882-02	03/05/2020 10:45:00	Total Suspended Solids	2	mg/L
20190222SAWPAFB	C0C1270-07	03/10/2020 10:00:00	Total Suspended Solids	2	mg/L
20190224SAWPAFB	C0C1792-07	03/12/2020 10:00:00	Total Coliform	110	MPN/100ml
20200513SAWPAFB	C0E1492-04	05/13/2020 07:40:00	Total Coliform	1.0	MPN/100ml
20200514SAWPAFB	C0E1790-05	05/14/2020 09:30:00	Total Coliform	86	MPN/100ml
20200518SAWPAFB	C0E2033-04	05/18/2020 10:12:00	Total Coliform	1.0	MPN/100ml
20200520SAWPAFB	C0E2972-04	05/27/2020 09:00:00	Total Suspended Solids	2	mg/L
20200708SAWPAFB	C0G0958-04	07/08/2020 08:45:00	Total Suspended Solids	2	mg/L
20200722SAWPAFB	C0G2888-04	07/22/2020 07:10:00	Total Coliform	64	MPN/100ml
20200728SAWPAFB	C0G3669-06	07/28/2020 11:20:00	Total Suspended Solids	2	mg/L
20200804SAWPAFB	C0H0273-06	08/04/2020 09:05:00	Total Suspended Solids	2	mg/L
20200806SAWPAFB	C0H0789-05	08/06/2020 08:45:00	Total Suspended Solids	2	mg/L
20200811SAWPAFB	C0H1261-04	08/11/2020 07:40:00	Total Suspended Solids	4	mg/L
20200811SAWPAFB	C0H1261-04	08/11/2020 07:40:00	Total Coliform	1.0	MPN/100ml
20200819SAWPAFB	C0H2426-04	08/19/2020 08:35:00	Total Suspended Solids	2	mg/L
20200820SAWPAFB	C0H2666-05	08/20/2020 09:00:00	Total Coliform	1.0	MPN/100ml
20200921SAWPAFB	C0I2566-03	09/21/2020 08:15:00	Total Suspended Solids	2	mg/L
20201027SAWPAFB	C0J3357-04	10/27/2020 09:30:00	Total Coliform	9.8	MPN/100ml
20201028SAWPAFB	C0J3501-05	10/28/2020 08:40:00	Total Coliform	25	MPN/100ml
20201029SAWPAFB	C0J3796-06	10/29/2020 11:00:00	Total Suspended Solids	2	mg/L
20201104SAWPAFB	C0K0456-04	11/04/2020 08:00:00	Total Coliform	>2400	MPN/100ml
20201104SAWPAFB	C0K0456-04	11/04/2020 08:00:00	E. coli	14	MPN/100ml
20201116SAWPAFB	C0K1807-04	11/16/2020 10:30:00	Total Coliform	280	MPN/100ml
20201116SAWPAFB	C0K1807-04	11/16/2020 10:30:00	E. coli	12	MPN/100ml
20201117SAWPAFB	C0K1920-04	11/17/2020 09:30:00	Total Coliform	240	MPN/100ml
20201117SAWPAFB	C0K1920-04	11/17/2020 09:30:00	E. coli	3.1	MPN/100ml
20201124SAWPAFB	C0K2735-04	11/24/2020 08:20:00	Total Coliform	46	MPN/100ml
20201124SAWPAFB	C0K2735-04	11/24/2020 08:20:00	E. coli	1.0	MPN/100ml

Field Duplicates

Field duplicate precision was not calculated, due to source samples not identified.

Section III

All sample holding times were met. All samples received had proper preservation. No other sample or data qualifiers were necessary for project samples.

The qualifiers contained in the reported results are for informational use. The results associated have been evaluated and believed to be useful in the decision-making process.

All reports were prepared and all analyses were performed in accordance with a system designed to assure that qualified personnel perform the analyses, use specified EPA approved methods and review the data before it is reported.

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PUBLIC HEALTH SERVICES
PUBLIC HEALTH WATER QUALITY LABORATORY

DATE: **May 11, 2021**

TO: **Orange County Public Works – OC Watersheds**

FROM: Joseph Guzman, Water Lab Supervisor

SUBJECT: **SAR Bacterial Monitoring Program**
QA/QC E. coli and Enterococcus analysis
Season: July 2020 – December 2020

There were 12 sampling events for the 2020 SAR monitoring. A total of 56 water samples were submitted, including 31 site samples (26 for E. coli and 5 for Enterococcus), 12 field blanks, and 13 field replicates.

I. Sample Transport Conditions

Acceptable transport conditions for this monitoring program per QAPP is ≤ 4°C for each sampling event. Standard Methods (SM) 9060B 1.a indicates transport conditions should be ≤10°C if transport time will be > 1 hour. SM 9060B 1.a sets no temperature requirements if samples are received in the lab ≤ 1 hour of collection. The table below breaks down the transport conditions for the 56 samples.

Transport Conditions at time of sample receipt	No. of samples	Quality Assurance Criteria Applied	Samples accepted and processed
≤ 4°C	28	QAPP	Yes
>4°C but ≤10°C transport time > 1hr	14	SM 9060B 1.a	Yes
>4°C but ≤10°C transport time < 1hr	14	SM 9060B 1.a	Yes

All 56 samples submitted for this monitoring program were accepted and processed as they were all < 10°C when they arrived at the lab. There were 14

samples in which the transport conditions did not meet the ≤ 4°C requirement of the QAPP. Program will need to determine if the deviation from the QAPP for those 14 samples is acceptable.

II. Transport times

Samples for regulatory monitoring should be submitted to the lab within 6 hours of collection.

The time the samples were received in the lab was noted on the chain of custody (COC) form for each sampling event. All documented transport times were within the allotted 6 hour transport time.

III. Method Blanks

A. Field/Equipment Blanks: 12 field blanks were collected for the SAR Bacterial Monitoring. One field blank was collected for each sampling event.
16 field blanks were tested for other monitoring programs on the same days that SAR Bacterial Monitoring samples were tested.

B. Laboratory Blanks: 95 internal blank samples were tested on the days that SAR samples were tested. The lab ran blank samples at a rate of 24% (97/397). QAPP requires method blanks to be run at a rate of 5% (1/20)

For *E. coli* and Enterococcus the 14 field blanks that were collected for SAR monitoring all showed no growth with results reported below the reporting limit of <10 MPN/100ml for SM 9223B and SM 9230D methods. The 16 field blanks collected for other monitoring programs also showed no growth for all bacterial indicators tested. Results for 91 of the 95 laboratory blanks showed no growth or <1 CFU/100ml which met the established acceptance criteria. 4 blank samples showed some growth of atypical colony types, but it was determined through investigation that the growth was incidental and did not affect the results for actual samples.

IV. Field Replicates/Lab Duplicates:

A. Field Replicates

Field replicates for the SAR sampling were collected at a frequency of 35% (9/26) for E. coli and 80% (4/5) for Enterococcus. The replicate samples were analyzed for the same parameters as its paired field sample.
44 field replicate analysis for other monitoring programs were submitted on the same days that SAR samples were tested. Results of the field replicate analyses can be used to assess field adherence to sample collection protocols. Also, laboratory precision can be assessed by examining the results from the field sample and its replicate pair. Precision of replicate analysis was determined using Standard Methods, 20th Ed. 9020 B section 8.

1. For field replicate samples submitted for *E. coli* by SM 9223B analysis (Colilert-18), a precision criteria of 0.4277 (3.27 x 0.1308) was established.

Of the 9 replicate samples submitted, all samples were within the established precision criteria.

2. For field replicate samples submitted for Enterococcus by SM 9230D analysis (Enterolert), a precision criteria of 0.4164 (3.27 x 0.1273) was established.

Of the 4 replicate samples submitted, all were within the established precision criteria.

3. For the 44 field replicates submitted for other monitoring programs, a precision criteria of 0.3825 (3.27 x 0.1170) was established. Two of the 44 samples were outside the established precision criteria.

The imprecision for the 2 field replicates submitted for other monitoring programs on the same days that SAR monitoring samples were submitted was determined to be acceptable due to low count samples.

B. Laboratory Duplicates

Laboratory duplicates were analyzed on 13% (51/397) of total samples received on the days SAR samples were tested. The results of duplicate analyses are used to assess laboratory precision during analysis. Precision of duplicate analysis was determined using Standard Methods, 20th Ed. 9020 B section 8.

1. For the 51 laboratory duplicates tested, a precision criteria of 0.4218 (3.27 x 0.1290) was established. Two samples had a difference in results outside the established precision criteria.

Although there were 2 laboratory duplicates outside the established precision criteria value, the imprecision is determined to be acceptable. The imprecision represented low count samples where there was only a 1 to 3 colony difference between the sample and the duplicate.

V. Laboratory Accuracy and Method Blanks for Analytical Methods:

A. *E. coli* with Colilert-18 media (SM 9223B)

One lot of Idexx Colilert-18 media was used during the SAR monitoring. There are four parameters tested for with each new lot prior to use:

1. *Escherichia coli* culture is used as a positive control with positive reactions for both yellow color production and apple green fluorescence.
2. *Klebsiella pneumoniae* culture is used as a positive control for yellow color production, but negative control for apple green fluorescence.
3. *Psuedomonas aeruginosa* culture used as a negative control, for both yellow color production and apple green fluorescence.
4. 1 packet per new lot of media is set up as a sterility control and to check for auto fluorescence.

One lot of sterile 90ml dilution blank water was used to test for E. coli by SM 9223B. There are three parameters tested for with each new lot prior to use:

1. the entire contents of the dilution blank is filtered and the membrane filter is transferred onto a blood agar plate and incubated to check for sterility.
2. the entire contents of the dilution blank is poured into a calibrated graduated cylinder to check that the 90ml aliquot is accurate.
3. pH is checked to make sure it is within specifications.

One lot of sterile Quanti-tray 2000 trays were used to test for E. coli by SM 9223B. Each new lot is checked for sterility before use.

B. Enterococcus with Enterolert media (SM 9230D)

One lot of Idexx Enterolert media was used during the SAR monitoring. There are four parameters tested for with each new lot prior to use:

1. *Enterococcus faecalis* culture is used as a positive control with positive reaction for blue fluorescence.
2. *Aerococcus viridans* culture is used as a negative control for blue fluorescence.
3. *Serratia marcescens* culture is used as a negative control for blue fluorescence.
4. 1 packet per new lot of media is set up as a sterility control and to check for auto fluorescence.

Two lots of sterile 90ml dilution blank water were used to test for Enterococcus by SM 9230D. There are three parameters tested for with each new lot prior to use:

1. the entire contents of the dilution blank is filtered and the membrane filter is transferred onto a blood agar plate and incubated to check for sterility.
2. the entire contents of the dilution blank is poured into a calibrated graduated cylinder to check that the 90ml aliquot is accurate.
3. pH is checked to make sure it is within specifications.

Two lots of sterile Quanti-tray 2000 trays were used to test for Enterococcus by SM 9230D. Each new lot is checked for sterility before use.

All lots of Colilert-18 media, Enterolert media, sterile 90ml dilution water, and Quanti-tray 2000 trays used for the SAR monitoring had acceptable quality control results for all parameters tested. QC records are available.

VI. Laboratory Equipment Maintenance and Calibration

Temperatures for the 35°C and 41°C incubators were recorded twice daily on temperature charts. Both incubators were calibrated by a contracted vendor every 6 months and documentation is available for review.
The Quanti-Tray sealer used to seal the Quanti-tray 2000 trays for E. coli and Enterococcus had routine monthly maintenance performed and documentation is

available for review. Each new lot of sterile 10ml pipets are checked for accuracy and results documented.

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