Santa Clara Valley
Urban Runoff
Pollution Prevention Program

Watershed Monitoring and Assessment Program

Urban Creeks Monitoring Report

Part A: Creek Status and Pesticides & Toxicity Monitoring

Water Year 2021 (October 2020 – September 2021)

Submitted in compliance with Provision C.8.h.iii of NPDES Permit No. CAS612008, Order No. R2-2015-049

March 31, 2022

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ACCWP	Alameda Countywide Clean Water Program
AFDM	Ash Free Dry Mass
AFS	American Fisheries Society
ASCI	Algae Stream Condition Index
BASMAA	Bay Area Stormwater Management Agency Association
BMI	Benthic Macroinvertebrate
CCCWP	Contra Costa Clean Water Program
CDC	Center for Disease Control
CEDEN	California Environmental Data Exchange Network
COLD	Cold Freshwater Habitat
CSCI	California Stream Condition Index
DF	Detection Frequency
DO	Dissolved Oxygen
DPR	Department of Pesticide Regulation
FSURMP	Fairfield-Suisun Urban Runoff Management Program
GIS	Geographic Information System
GM	Geometric Mean
GRTS	Generalized Random Tessellation Stratified
GSI	Green Stormwater Infrastructure
IMR	Integrated Monitoring Report
IPI	Index of Physical Habitat Integrity
IPM	Integrated Pest Management
IWRMP	Integrated Water Resources Master Plan
LID	Low Impact Development
MDL	Method Detection Limit
MIGR	Fish Migration
MPC	Monitoring and Pollutants of Concern
MPN	Most Probable Number
MRP	Municipal Regional Permit
MS4	Municipal Separate Storm Sewer System
MUN	Municipal and Domestic Water Supply
MWAT	Maximum Weekly Average Temperature
NPDES	National Pollutant Discharge Elimination System
O/E	Observed to Expected Taxa
PAHs	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
PEC	Probable Effects Concentrations
PHAB	Physical Habitat Assessment
pMMI	Predictive Multimetric Index
PSA	Perennial Streams Assessment
QAPP	Quality Assurance Project Plan
QAPrP	Quality Assurance Program Plan
QA/QC	Quality Assurance/Quality Control
RARE	Preservation of Rare and Endangered Species
REC-1	Water Contact Recreation
RM	Reporting Module

RMC	Regional Monitoring Coalition
RWB	Reachwide Benthos
RWQC	Recreational Water Quality Criteria
SAFIT	Southwest Association of Freshwater Invertebrate Taxonomists
SCCWRP	Southern California Coastal Water Research Project
SCVURPPP	Santa Clara Valley Urban Runoff Pollution Prevention Program
SCVWD	Santa Clara Valley Water District or Valley Water
SFBRWQCB	San Francisco Bay Regional Water Quality Control Board
SMC	Southern California Stormwater Monitoring Coalition
SMCWPPP	San Mateo Countywide Water Pollution Prevention Program
SOP	Standard Operating Procedure
SPoT	Stream Pollution Trends
SPWN	Fish Spawning
SSID	Stressor/Source Identification
STV	Statistical Threshold Value
SURF	Surface Water Database
SWAMP	Surface Water Ambient Monitoring Program
SWPP	Surface Water Protection Program
TEC	Threshold Effects Concentrations
TMDL	Total Maximum Daily Load
TOC	Total Organic Carbon
TST	Test of Significant Toxicity
TU	Toxicity Unit
UCMR	Urban Creeks Monitoring Report
USEPA	Environmental Protection Agency
WARM	Warm Freshwater Habitat
WQO	Water Quality Objective
WY	Water Year

1.0 INTRODUCTION

This *Urban Creeks Monitoring Report (UCMR) Part A: Creek Status and Pesticides & Toxicity Monitoring*, *Water Year*[1] *(WY) 2021* was prepared by the Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP or Program), on behalf of its 15 member agencies (13 cities/towns, the County of Santa Clara, and the Santa Clara Valley Water District), which are subject to the National Pollutant Discharge Elimination System (NPDES) stormwater permit for Bay Area municipalities referred to as the Municipal Regional Permit (MRP). The MRP was first adopted by the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB or Regional Water Board) on October 14, 2009 as Order R2-2009-0074 (SFBRWQCB 2009; referred to as MRP 1.0). On November 19, 2015, the Regional Water Board updated and reissued the MRP as Order R2-2015-0049 (SFBRWQCB 2015; referred to as MRP 2.0). The next iteration of the MRP (i.e., MRP 3.0) is currently being drafted and is anticipated to become effective July 1, 2022.

This report fulfills the requirements of provision C.8.h.iii of the MRP for interpreting and reporting all Creek Status and Pesticides & Toxicity monitoring data collected during WY 2021 by SCVURPPP. Data presented in this report were collected pursuant to water quality monitoring requirements in provisions C.8.d (Creek Status Monitoring) and C.8.g (Pesticides & Toxicity Monitoring) of the MRP.[2] Data presented in this report were submitted electronically to the Regional Water Board by SCVURPPP and may be obtained via the California Environmental Data Exchange Network (CEDEN).

Sections of this report are organized according to the following topics:

- **Section 1.0** – Introduction including overview of the Program goals, background, monitoring approach, and statement of data quality
- **Section 2.0** – Biological condition assessment and stressor analysis at probabilistic sites
- **Section 3.0** – Continuous water quality monitoring (temperature, general water quality)
- **Section 4.0** – Pathogen indicators
- **Section 5.0** – Chlorine monitoring
- **Section 6.0** – Pesticides & Toxicity monitoring
- **Section 7.0** – Conclusions and recommendations

[1] Most hydrologic monitoring occurs for a period defined as a Water Year, which begins on October 1 and ends on September 30 of the named year. For example, Water Year 2021 (WY 2021) began on October 1, 2020 and concluded on September 30, 2021.

[2] Monitoring data collected pursuant to other C.8 provisions (e.g., Pollutants of Concern Monitoring, Stressor/Source Identification Monitoring Projects) are reported in other Parts of the SCVURPPP Urban Creeks Monitoring Report (UCMR) for WY 2021.

1.1 Monitoring Objectives

Provision C.8.d of the MRP requires Permittees to conduct creek status monitoring that is intended to answer the following management questions:

1. ***Are water quality objectives, both numeric and narrative, being met in local receiving waters, including creeks, rivers, and tributaries?***
2. ***Are conditions in local receiving water supportive of or likely supportive of beneficial uses?***

The first management question is addressed primarily through the evaluation of probabilistic and targeted monitoring data with respect to the triggers defined in the MRP. Sites where triggers are exceeded may indicate potential impacts to aquatic life or other beneficial uses and consideration for future Stressor/Source identification (SSID) projects.

The second management question is addressed by assessing indicators of beneficial uses. For example, the indices of biological integrity based on benthic macroinvertebrate (BMI) and algae data are direct measures of the condition of aquatic life beneficial uses. Continuous monitoring data (temperature, dissolved oxygen, pH, and specific conductance) are evaluated with respect to COLD and WARM beneficial uses. Pathogen indicator data are used to assess REC-1 (water contact recreation) beneficial uses.

Creek Status and Pesticides & Toxicity monitoring parameters, methods, occurrences, durations and minimum number of sampling sites are described in provisions C.8.d and C.8.g of the MRP, respectively.

The monitoring requirements in MRP 2.0 (SFBRWQCB 2015) are similar to MRP 1.0 (SFBRWQCB 2009) requirements (which began implementation on October 1, 2011) and build upon earlier monitoring conducted by SCVURPPP between 2002 and 2009. Creek Status and Pesticides & Toxicity monitoring is coordinated through the Bay Area Stormwater Management Agency Association (BASMAA) Regional Monitoring Coalition (RMC). Monitoring results are evaluated to determine whether triggers are met and further investigation should be considered as part of a potential SSID Project, as described in provision C.8.e of the MRP.

Results of Creek Status and Pesticides & Toxicity Monitoring conducted in WYs 2012 through 2020 were detailed in prior reports[3] (SCVURPPP 2021, SCVURPPP 2020, SCVURPPP 2019a, SCVURPPP 2018, SCVURPPP 2017, SCVURPPP 2016, SCVURPPP 2015, SCVURPPP 2014).

1.2 Regional Monitoring Coalition

Provision C.8.a (Compliance Options) of the MRP allows Permittees to address monitoring requirements through a regional collaborative effort, their Stormwater Program, and/or individually. The RMC was formed in early 2010 as a collaboration among several BASMAA members and MRP Permittees (Table 1.1) to develop and implement a regionally coordinated water quality monitoring program to improve stormwater management in the region and address

[3] Prior monitoring reports prepared by the Program are available at https://scvurppp.org/monitoring/

water quality monitoring required by the MRP.[4] Implementation of the RMC's Creek Status and Long-Term Trends Monitoring Plan (BASMAA 2012) allows Permittees and the Regional Water Board to improve their ability to collectively answer core management questions in a cost-effective and scientifically rigorous way. Participation in the RMC is facilitated through the BASMAA Monitoring and Pollutants of Concern (MPC) Committee.

Table 1.1. Regional Monitoring Coalition (RMC) participants.

Stormwater Programs	RMC Participants
Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP)	Cities of Campbell, Cupertino, Los Altos, Milpitas, Monte Sereno, Mountain View, Palo Alto, San José, Santa Clara, Saratoga, Sunnyvale, Los Altos Hills, and Los Gatos; Santa Clara Valley Water District; and, Santa Clara County
Alameda Countywide Clean Water Program (ACCWP)	Cities of Alameda, Albany, Berkeley, Dublin, Emeryville, Fremont, Hayward, Livermore, Newark, Oakland, Piedmont, Pleasanton, San Leandro, and Union City; Alameda County; Alameda County Flood Control and Water Conservation District; and, Zone 7
Contra Costa Clean Water Program (CCCWP)	Cities of Antioch, Brentwood, Clayton, Concord, El Cerrito, Hercules, Lafayette, Martinez, Oakley, Orinda, Pinole, Pittsburg, Pleasant Hill, Richmond, San Pablo, San Ramon, Walnut Creek, Danville, and Moraga; Contra Costa County; and, Contra Costa County Flood Control and Water Conservation District
San Mateo County Wide Water Pollution Prevention Program (SMCWPPP)	Cities of Belmont, Brisbane, Burlingame, Daly City, East Palo Alto, Foster City, Half Moon Bay, Menlo Park, Millbrae, Pacifica, Redwood City, San Bruno, San Carlos, San Mateo, South San Francisco, Atherton, Colma, Hillsborough, Portola Valley, and Woodside; San Mateo County Flood Control District; and, San Mateo County
Fairfield-Suisun Urban Runoff Management Program (FSURMP)	Cities of Fairfield and Suisun City
Vallejo Permittees	City of Vallejo and Vallejo Flood and Wastewater District

The goals of the RMC are to:

1. Assist Permittees in complying with requirements in provision C.8 (Water Quality Monitoring) of the MRP;
2. Develop and implement regionally consistent creek monitoring approaches and designs in the Bay Area, through the improved coordination among RMC participants and other agencies (e.g., Regional Water Board) that share common goals; and
3. Stabilize the costs of creek monitoring by reducing duplication of effort and streamlining reporting.

The RMC's monitoring strategy for complying with Creek Status Monitoring is described in the RMC Creek Status and Long-Term Trends Monitoring Plan (BASMAA 2012). The strategy includes regional ambient/probabilistic monitoring and local "targeted" monitoring. The combination of these two components allows each individual RMC participating program to assess the status of beneficial uses in local creeks within its jurisdictional area, while also contributing data to answer management questions at the regional scale (e.g., differences

[4] The Regional Water Board issued the first five-year MRP to 76 cities, counties, and flood control districts (i.e., Permittees) in the Bay Area on October 14, 2009 (MRP 1.0; SFBRWQCB 2009). On November 19, 2015, the Regional Water Board updated and reissued the MRP (MRP 2.0; SFBRWQCB 2015). The BASMAA programs supporting MRP Regional Projects include all MRP Permittees.

between aquatic life condition in urban and non-urban creeks). The current MRP, updated and reissued in 2015, specifically prescribes the probabilistic/targeted approach and most of the other details of the RMC Creek Status and Long-Term Trends Monitoring Plan. Table 1.2 provides a list of which monitoring parameters are included in the probabilistic and targeted programs. This report includes data collected in Santa Clara County under both monitoring components. Data are organized into report Sections that reflect the format of monitoring requirements in the MRP.

Table 1.2. Monitoring parameters of MRP provisions C.8.d (Creek Status Monitoring) and C.8.g (Pesticides & Toxicity Monitoring) and associated monitoring component.

Monitoring Elements	Monitoring Component		Report Section
	Regional Ambient (Probabilistic)	Local (Targeted)	
Creek Status Monitoring (C.8.d)			
Bioassessment & Physical Habitat Assessment	X	X[1]	2.0
Nutrients	X	X[1]	2.0
General Water Quality (Continuous)		X	3.0
Temperature (Continuous)		X	3.0
Pathogen Indicators		X	4.0
Chlorine	X	X[2]	5.0
Pesticides & Toxicity Monitoring (C.8.g)			
Water Toxicity		X	6.0
Sediment Toxicity		X	6.0
Sediment Chemistry		X	6.0

Notes:
[1] Provision C.8.d.i.(6) allows for up to 20% of sample locations to be selected on a targeted basis. Subsequent communications by Regional Board staff allow for all sample locations to be selected on a targeted basis if probabilistic stations have been exhausted.
[2] Provision C.8.d.ii.(2) provides options for probabilistic or targeted site selection. In WY 2012 - 2021, chlorine was measured at probabilistic and targeted bioassessment sites.

1.3 Monitoring and Data Assessment Methods

1.3.1 Monitoring Methods

Water quality data were collected and reviewed in accordance with California Surface Water Ambient Monitoring Program (SWAMP) comparable methods and procedures described in the BASMAA RMC Standard Operating Procedures (SOPs) (BASMAA 2016) and the associated Quality Assurance Project Plan (QAPP; BASMAA 2020). These documents are updated as needed to optimize applicability. Where applicable, monitoring data were collected using methods comparable to those specified by the SWAMP Quality Assurance Program Plan (QAPrP)[5], and were submitted in SWAMP-compatible format to the Regional Water Board. The

[5] The current SWAMP QAPrP is available at: https://www.waterboards.ca.gov/water_issues/programs/swamp/qapp/swamp_QAPrP_2017_Final.pdf

SOPs were developed using a standard format that describes health and safety cautions and considerations, relevant training, site selection, and sampling methods/procedures, including pre-fieldwork mobilization activities to prepare equipment, sample collection, and de-mobilization activities to preserve and transport samples.

During WY 2021, Program management and monitoring activities continued to be impacted by the COVID-19 public health emergency. To control the spread of COVID-19 during implementation of monitoring activities, the Program and its monitoring consultants developed (SOPs) based on Center for Disease Control (CDC) guidance. The SOPs consist of hygiene and social distancing practices, and are updated as needed when new information regarding COVID-19 becomes available. Implementation of the COVID-19 SOPs did not impact sampling results or data quality.

1.3.2 Laboratory Analysis Methods

RMC participants, including SCVURPPP, agreed to use the same laboratories for individual parameters (except pathogen indicators), developed standards for contracting with the labs, and coordinated quality assurance samples. All samples collected by RMC participants that were sent to laboratories for analysis were analyzed and reported per SWAMP-comparable methods as described in the BASMAA QAPP (BASMAA 2020). Analytical laboratory methods, reporting limits and holding times for chemical water quality parameters are also described in the BASMAA QAPP (2020). Analytical laboratory contractors in WY 2021 included:

- BioAssessment Services, Inc. – BMI identification
- EcoAnalysts, Inc. – Algae identification
- CalTest, Inc. – Sediment chemistry, nutrients, chlorophyll a, ash free dry mass
- Pacific EcoRisk, Inc. - Water and sediment toxicity
- Cel Analytical – Pathogen indicators

1.3.3 Data Analysis Methods

Monitoring data generated during WY 2021 were analyzed and evaluated to identify potential stressors that may be contributing to degraded or impacted biological conditions, including exceedances of water quality objectives (WQOs). Creek Status Monitoring and Pesticides & Toxicity Monitoring data are evaluated with respect to numeric thresholds (i.e., triggers) specified in the MRP (SFBRWQCB 2015). Sites with monitoring data that do not meet WQOs and/or MRP trigger thresholds require consideration for further evaluation as part of a SSID project. SSID projects are intended to be oriented toward taking action(s) to alleviate stressors and reduce sources of pollutants. A stepwise process for conducting SSID projects is described in Provision C.8.e.iii of the MRP.

In compliance with Provision C.8.e.i of the MRP, all monitoring results exceeding trigger thresholds are added to a list of candidate SSID projects that will be maintained throughout the permit term. Follow-up SSID projects are selected from this list.

1.4 Setting

1.4.1 Watersheds Monitored by SCVURPPP

There are 13 major watersheds within the SCVURPPP jurisdictional boundaries. These watersheds encompass most of the Santa Clara Basin. The watersheds are illustrated in Figure 1.1 and their major characteristics are listed in Table 1.3. The Santa Clara Basin, which drains to the Lower South San Francisco Bay, is 840 square miles and bounded by the Diablo Mountains on the east and the Santa Cruz Mountains on the south and west. Elevations range from sea level at the Bay to almost 4,000 feet in the Santa Cruz Mountains. There is a distinct transition in geography and land use at elevations of 600 to 800 feet. Areas above this elevation generally have steeper slopes and are largely forest, rangeland, or open space. Below this elevation threshold, urbanized landscape dominates. The headwaters of most watersheds begin in the undeveloped mountains and drain north through urbanized areas and into the Lower South Bay. Flows in the lower reaches of most watersheds are controlled by reservoirs managed by Valley Water (formerly Santa Clara Valley Water District) and other agencies. Many of the reservoirs are located at the transition between the foothills and the valley floor. Water is captured during the winter rainy season and released in the spring at managed rates to allow for percolation through the stream bed or off-channel ponds to groundwater aquifers and to protect fish habitat downstream of the reservoirs. To varying degrees, portions of all streams within the urban zone have been engineered or placed within underground culverts. The Sunnyvale East and West Channel watersheds contain no natural creek bed at all, as they were constructed in the 1960s strictly for flood control purposes.

Table 1.3. Characteristics of major watersheds within SCVURPPP boundary.

Watershed	Area (miles^2)	# of Tributary Creeks	Natural Creek Bed (Miles)	Engineered Channel (Miles)	Underground Culvert or Stormdrain (Miles)	Impervious Area	Land Use				
							Residential	Industrial/ Commercial	Forest	Rangeland	Other
Adobe	11.0	7	18.8	2.3	12.0	45%	47%	12%	36%	3%	3%
Barron	15.6	5	15.1	7.9	28.6	60%	61%	20%	7%	7%	5%
Calabazas	20.3	6	12.9	14.1	55.5	NA	55%	29%	9%	5%	2%
Coyote	321	53	670	36.4	146	11%	9%	4%	50%	30%	8%
Guadalupe	171	50	207	45.5	265	37%	30%	14%	35%	16%	7%
Lower Penitencia	28.6	13	29.2	20.8	61.6	43%	31%	19%	1%	39%	11%
Matadero	14.0	3	18	NA	NA	60%	57%	6%	9%	8%	20%
Permanente	17.3	7	NA	NA	NA	44%	46%	13%	35%	3%	3%
San Francisquito	42.8	25	90.6	4.8	15.3	21%	30%	5%	45%	15%	6%
San Tomas Aquino	44.8	15	50.5	15.5	79.3	60%	54%	19%	24%	1%	3%
Stevens	29.2	12	54.2	1.1	30.0	29%	25%	9%	49%	13%	5%
Sunnyvale East	7.1	0	0	6.2	26.6	82%	65%	32%	0%	0%	3%
Sunnyvale West	7.6	0	0	6.7	18.7	72%	21%	65%	0%	0%	14%
Totals	**730.3**	**196**	**1166.3**	**161.3**	**738.6**	**27%**	**25%**	**10%**	**38%**	**20%**	**7%**

Source SCBWMI 2003
NA – not available

1.4.2 WY 2021 Creek Status and Pesticides & Toxicity Monitoring Stations

The complete list of probabilistic and targeted monitoring sites sampled by SCVURPPP in WY 2021 in compliance with provisions C.8.d (Creek Status Monitoring) and C.8.g (Pesticides and Toxicity Monitoring) is presented in Table 1.4. Station ID's for probabilistic sites, generated from the RMC Sample Frame, station ID's for targeted sites, based on SWAMP station numbering methods (BASMAA 2016), and station ID's for Valley Water sites are provided. Monitoring locations from WY 2021 with monitoring parameter(s) are shown in Figure 1.2.

Monitoring Station Naming Conventions

- **Regional Monitoring Coalition (RMC) Sample Frame** – RMC Monitoring sites were probabilistically identified during the initial implementation of the MRP.
    - **Example**: 202R04736 (2 = Water Board Region, 02 = Hydrological Unit Code, 04736 = order in which the site was drawn from the sample frame)
- **Surface Water Ambient Monitoring Program (SWAMP)** – SWAMP is the State Water Board's monitoring program. Monitoring sites are "targeted or handpicked by SCVURPPP staff.
    - **Example**: 205COY121 (2 = Water Board Region, 05 = Hydrological Unit Code, COY = watershed abbreviation, 121 – location of sample site on creek with low numbers representing sites closer to the creek mouth)
- **Valley Water** – Valley Water is the Countywide agency that provides water supply, flood protection, and stream stewardship on behalf of local taxpayers. Valley Water uses stratified, randomly selected monitoring stations to collect data for the Fish and Aquatic Habitat Collaborative Effort (FAHCE).
    - **Example**: LG004 (LG = creek abbreviation, 004 = station identification number)

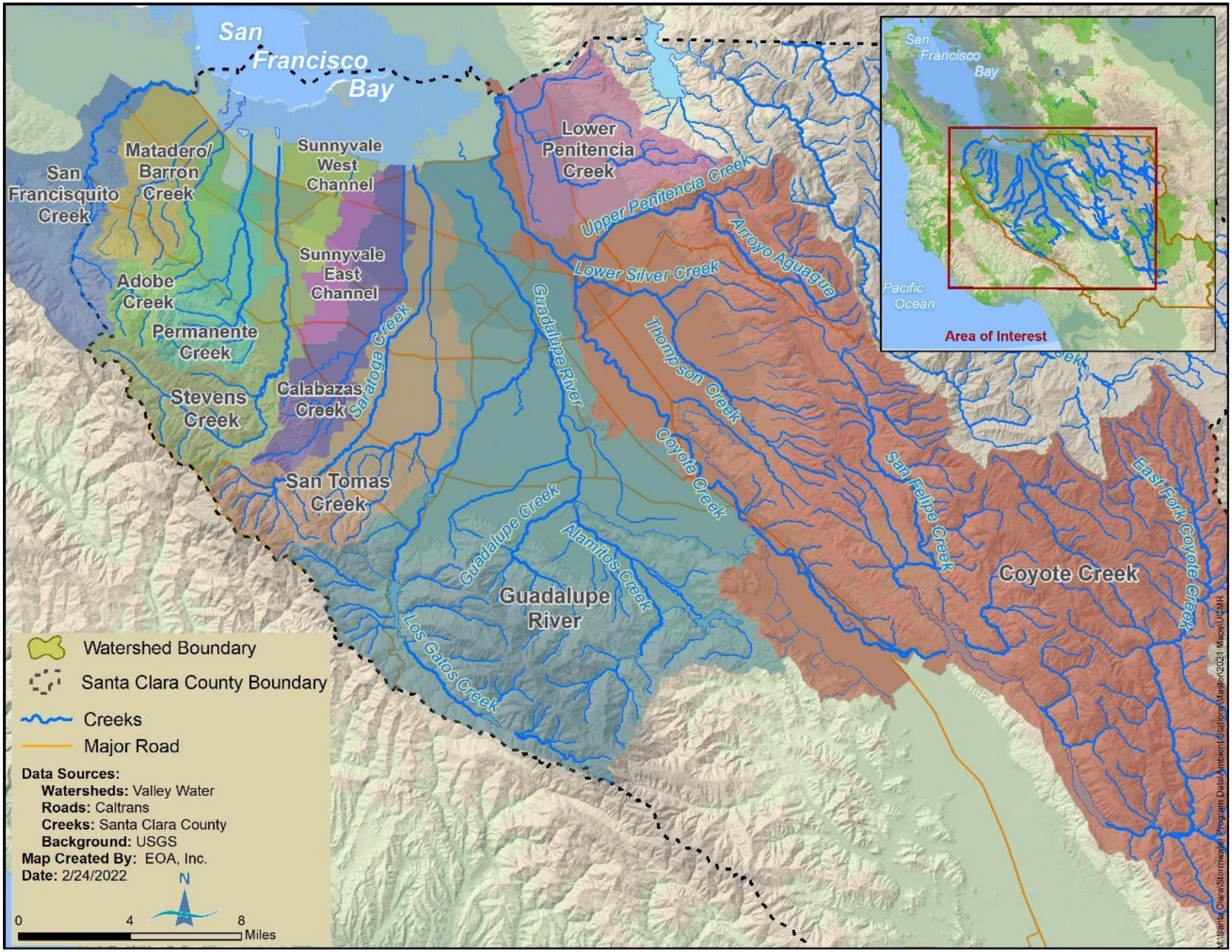

Figure 1.1. Watersheds within SCVURPPP jurisdictional boundaries.

Table 1.4. Sites and parameters monitored in WY 2021 in Santa Clara County.

Station ID	Watershed	Creek Name	Latitude	Longitude	Bioassessment, Nutrients, General WQ	Chlorine	Pesticides & Toxicity	Temp [1]	Cont. WQ [2]	Pathogen Indicators
AC002	Guadalupe River	Alamitos Creek	37.22229	-121.85051	X	X				
AC004	Guadalupe River	Alamitos Creek	37.17409	-121.82406	X	X				
CC001	Guadalupe River	Arroyo Calero	37.21349	-121.83208	X	X				
CC003	Guadalupe River	Arroyo Calero	37.2034	-121.81686	X	X				
GC003	Guadalupe River	Guadalupe Creek	37.23006	-121.90285	X	X				
GC004	Guadalupe River	Guadalupe Creek	37.21836	-121.90883	X	X				
GC006	Guadalupe River	Guadalupe Creek	37.20488	-121.89643	X	X				
LG002	Guadalupe River	Los Gatos Creek	37.31601	-121.90302	X	X				
LG003	Guadalupe River	Los Gatos Creek	37.30155	-121.91856	X	X			X	
LG004	Guadalupe River	Los Gatos Creek	37.29109	-121.93488	X	X			X	
205R01930	Guadalupe River	Los Gatos Creek	37.26288	-121.95201	X	X			X	
205R03530	Guadalupe River	Los Gatos Creek	37.25120	-121.9650	X	X			X	
205R01706	San Tomas Aquino	Saratoga Creek	37.26554	-122.02575	X	X				
205R02474	San Tomas Aquino	Saratoga Creek	37.2578	-122.0348	X	X				
205R03562	San Tomas Aquino	Saratoga Creek	37.2524	-122.04504	X	X				
205R00170	San Tomas Aquino	Saratoga Creek	37.24844	-122.07084	X	X				
SC002	Stevens Creek	Stevens Creek	37.32458	-122.06157	X	X				
SC004	Stevens Creek	Stevens Creek	37.31429	-122.06454	X	X				
SC006	Stevens Creek	Stevens Creek	37.30298	-122.07466	X	X				
205STE095	Stevens Creek	Stevens Creek	37.27954	-122.07378	X	X				
205COY121	Coyote Creek	Upper Penitencia Cr	37.3953	-121.8280				X		
205COY132	Coyote Creek	Upper Penitencia Cr	37.3931	-121.8158				X		
205COY135	Coyote Creek	Upper Penitencia Cr	37.3965	-121.8045				X		
205COY140	Coyote Creek	Upper Penitencia Cr	37.4012	-121.7953				X		
205COY142	Coyote Creek	Upper Penitencia Cr	37.4036	-121.7925				X		
205COY145	Coyote Creek	Upper Penitencia Cr	37.4047	-121.7917				X		
205AAG010	Coyote Creek	Arroyo Aguague	37.4011	-121.7888				X		
205AAG015	Coyote Creek	Arroyo Aguague	37.4008	-121.7860				X		
205AAG025	Coyote Creek	Arroyo Aguague	37.3971	-121.7858				X		
205LGA420	Guadalupe River	Los Gatos Creek	37.2203	-121.9830						X
205LGA400	Guadalupe River	Los Gatos Creek	37.2388	-121.9708						X
205LGA060	Guadalupe River	Los Gatos Creek	37.2908	-121.9350						X
205STE065	Stevens Creek	Stevens Creek	37.3136	-122.0640						X
205STE064	Stevens Creek	Stevens Creek	37.3173	-122.0620						X
205STE021	Stevens Creek	Stevens Creek	37.4098	-122.0691			X			
205STQ010	San Tomas Aquino	San Tomas Aquino	37.3886	-121.9685			X			

[1] Temperature monitoring was conducted continuously (i.e., hourly) April through September.

[2] Continuous water quality monitoring (temperature, dissolved oxygen, pH, specific conductivity) was conducted during two 1 to 2-week periods (spring and summer).

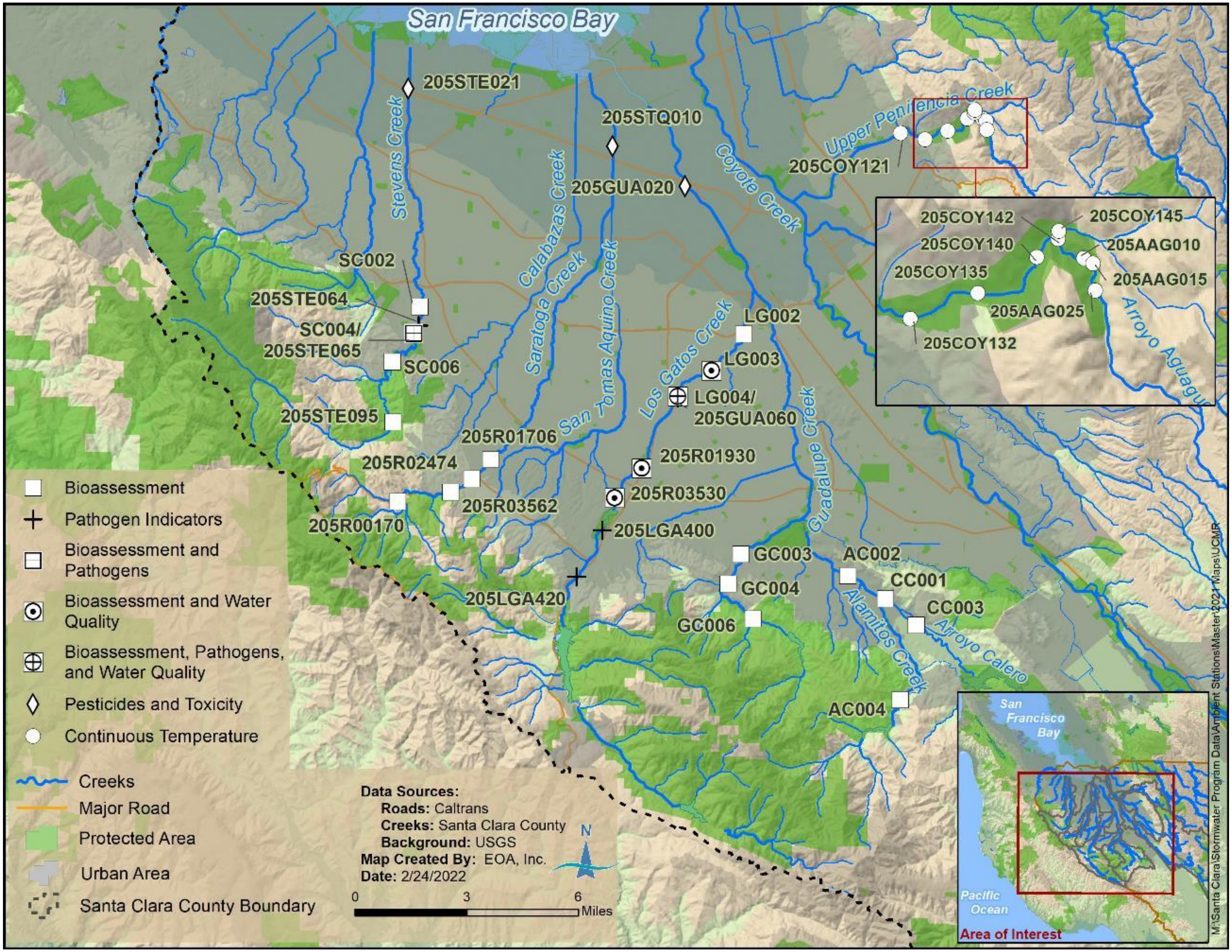

Figure 1.2. SCVURPPP Program Area, major creeks, and sites monitored in WY 2021.

1.4.3 Designated Beneficial Uses

Beneficial uses define the resources, services, and qualities of aquatic systems and are the ultimate goal for protection and achievement of high water quality. Beneficial uses in Santa Clara Valley creeks are designated by the Regional Water Board for specific water bodies and serve as the basis for establishing applicable WQOs designed to protect those uses (SFBRWQCB 2017). All creeks in the Santa Clara Basin are designated as having warm freshwater habitat (WARM) beneficial use. Except for Lower Silver Creek, Lower Penitencia Creek, and a few small tributaries, Santa Clara Basin creeks are designated as having cold freshwater habitat (COLD) beneficial use, meaning that they either historically or currently support trout, anadromous salmon, and/or steelhead fisheries. Dissolved oxygen (DO) WQOs are more stringent in creeks with COLD beneficial uses because these species are less tolerant of low dissolved oxygen conditions. Virtually all creeks in the region are designated as having water contact recreation (REC-1) beneficial use, such as swimming, where ingestion of water is considered reasonably possible; however, for most creeks this is a presumed use that has not been documented and may not actually exist. Fecal indicator bacteria WQOs are intended to protect the REC-1 beneficial use. Los Gatos Creek is designated as having the municipal and domestic water supply (MUN) beneficial use. The Basin Plan identifies WQOs for several constituents of concern that apply only to waters with the MUN beneficial use, i.e., chloride and nitrate. Beneficial uses for creeks monitored in WY 202u are listed in Table 1.5.

Table 1.5. Beneficial uses designated by the Regional Water Board for creeks monitored in WY 2021 in the Santa Clara Valley (SFBRWQCB 2017).

Waterbody	AGR	MUN	FRSH	GWR	IND	PROC	COMM	SHELL	COLD	EST	MAR	MIGR	RARE	SPWN	WARM	WILD	REC-1	REC-2	NAV
Alamitos Creek			E	E					E			E	E	E	E	E	E	E	
Arroyo Aguague									E			E	E	E	E	E	E	E	
Arroyo Calero			E						E			E	E	E	E	E	E	E	
Guadalupe Creek			E	E					E			E	E	E	E	E	E	E	
Los Gatos Creek		E	E	E					E			P	E	P	E	E	E	P	
San Tomas Aquino									E				E		E	E	E	E	
Saratoga Creek	E		E	E					E						E	E	E	E	
Stevens Creek			E	E					E			E	E	E	E	E	E	E	
Upper Penitencia Creek			E	E					E			E	E	E	E	E	E	E	

Notes:
E = Existing Use, P = Potential Use

1.4.4 Climate

The Santa Clara Valley experiences a Mediterranean-type climate with cool, wet winters and hot, dry summers. The area is characterized by microclimates created by topography, ocean currents, fog exposure, and onshore winds which can result in large differences in temperature and rainfall within short distances. The wet season typically extends from October through April with local long-term, mean annual precipitation ranging from 15 inches near the Bay to over 55 inches along the highest ridges in the Santa Cruz Mountains (PRISM Climate Group 30-year normals, 1981-2020[6]). Figure 1.3 illustrates the geographic variability of mean annual precipitation in the area based on statistical models; actual measured precipitation in a given year rarely equals the statistical average. Figure 1.4 illustrates the temporal variability in annual precipitation measured at the Mineta San José International Airport (station SJC) from WY 1946 to WY 2021. Creek Status Monitoring in compliance with the MRP began in WY 2012 which was the first year of a severe statewide drought that persisted through WY 2016. Rainfall at SJC was also below average in WYs 2018, 2020, and 2021, with WY 2021 one of the driest on record.

The overall Bay Area climate and the specific conditions within any given year are influenced by global climate change. The most recent Climate Change Assessment report for the Bay Area highlights several impacts of climate change that are already being felt: the Bay Area's average annual maximum temperature increased by nearly 1°C from 1950 – 2005, coastal fog may be less frequent, and sea level in the Bay Area has risen over eight inches (Ackerly et al. 2018). These changes are projected to increase significantly in the coming decades. As a consequence, heat extremes, high year-to-year variability in precipitation, droughts, intense storms, wildfire and other events are also predicted to increase.

Climate patterns (e.g., extended droughts) and individual weather events (e.g., extreme storms, hot summers) influence biological communities (i.e., vegetation, wildlife) and their surrounding physical habitat and water quality. They should therefore be considered when evaluating the type of data collected by the Creek Status Monitoring Program. For example, periods of drought (rather than individual dry years) can result in changes in riparian and upland vegetation communities. Long drought periods are associated with increased streambed sedimentation which can persist directly or indirectly for many years, depending on the occurrence and magnitude of flushing flow events. Furthermore, in response to prolonged drought, the relative proportion of pool habitat can increase at the expense of riffle habitat. In addition, during severe droughts, water management agencies (such as the Valley Water) may also decrease the magnitude and duration of reservoir releases.

[6] http://www.prism.oregonstate.edu/normals/

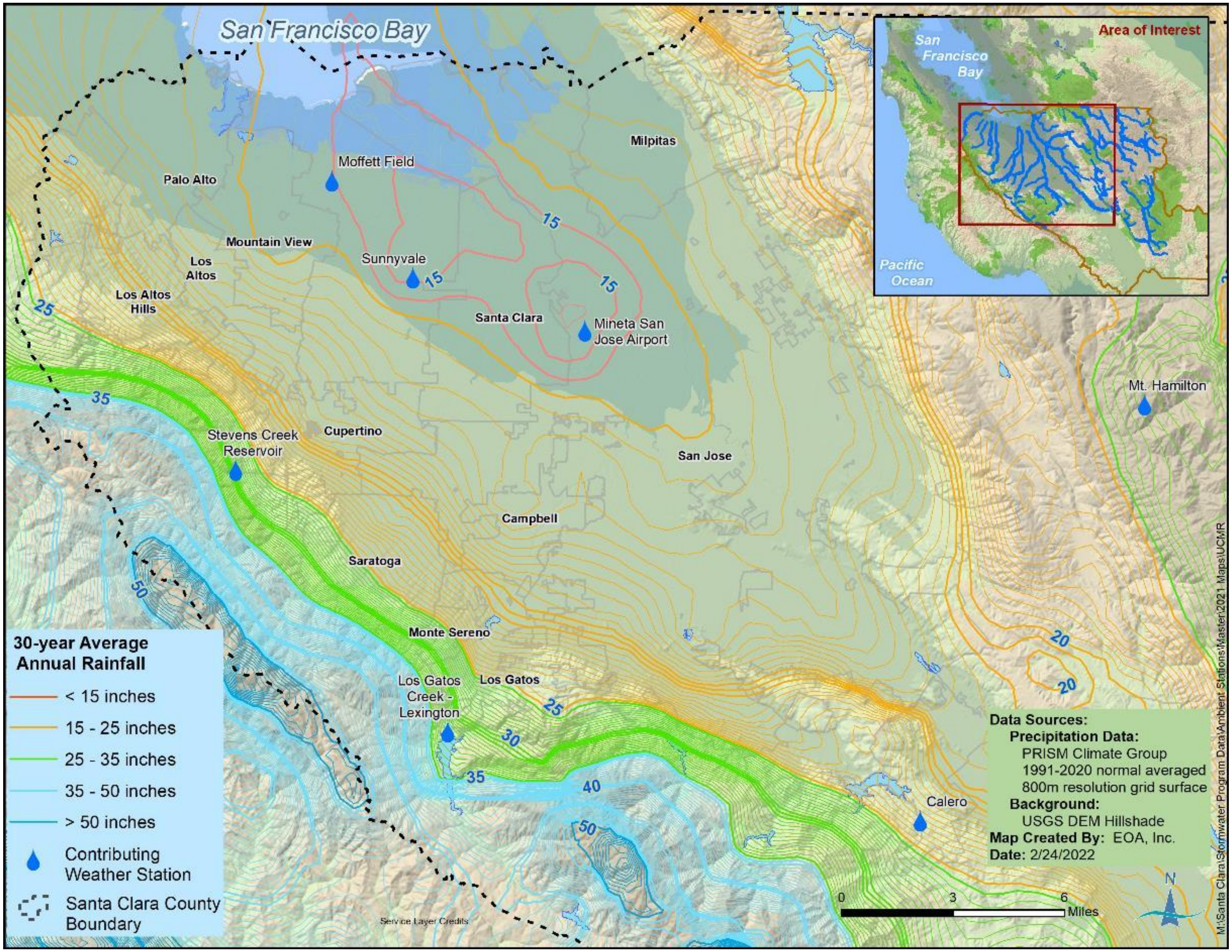

Figure 1.3. Average annual precipitation in Santa Clara Valley, as modeled by the PRISM Climate Group for the period of 1991-2020.

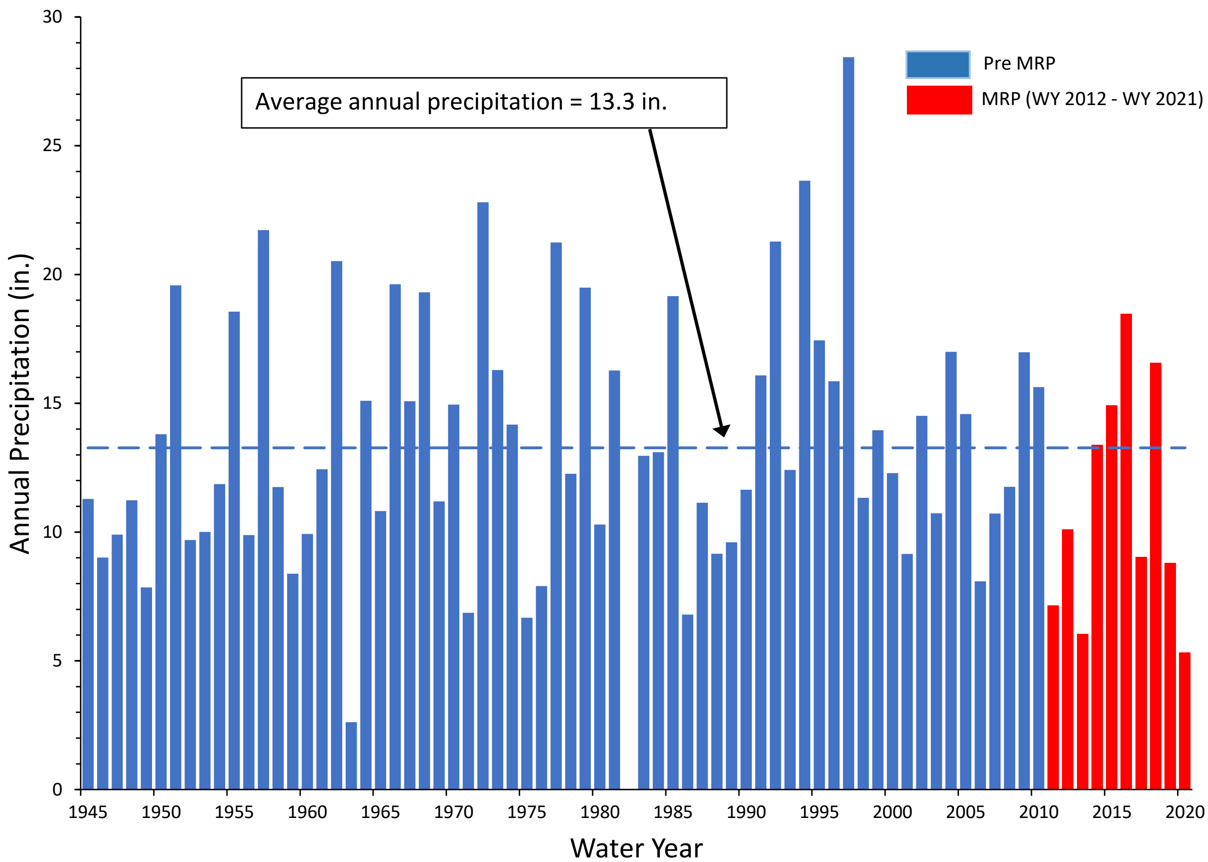

Figure 1.4. Annual rainfall recorded at the San José Airport (SJC), WY 1946 – WY 2021. WY 1983 data is missing from the record.

It is uncertain what effect these climatic factors have on biological index scores calculated using data collected by the Creek Status Monitoring Program, such as benthic macroinvertebrates or algae. A study evaluating 20 years of bioassessment data collected in northern California showed that, although BMI taxa with certain traits may be affected by dry (and wet) years and/or warm (and cool) years, indices based on these organisms appear to be resilient (Mazor et al. 2009, Lawrence et al. 2010). However, this study did not specifically examine the impact of *longer periods* of extended drought or heat on biological indices, which would require analysis of a dataset with a much longer period of record. The Herbst Lab at the Sierra Nevada Aquatic Research Laboratory, University of California Santa Barbara recently completed a study exploring how taxa metrics in Sierra Nevada streams vary in response to flooding and drought. While species diversity and density remained relatively constant during flooding, extreme dry weather conditions significantly impacted BMI population structure. These differences increased with continued exposure to drought (Herbst et al. 2019). Similar changes to the BMI community in Santa Clara County streams may have occurred during the Creek Status Monitoring period of record but have not been evaluated.

1.5 Statement of Data Quality

A comprehensive Quality Assurance/Quality Control (QA/QC) program was implemented by SCVURPPP covering all aspects of Creek Status and Pesticides & Toxicity monitoring. In general, QA/QC procedures were implemented as specified in the BASMAA RMC QAPP (BASMAA, 2020) and monitoring was performed according to protocols specified in the BASMAA RMC SOPs (BASMAA 2016). Both documents were adapted from the methods detailed in the SWAMP QAPrP.[7]

Overall, the results of the QA/QC review suggests that the Creek Status and Pesticides & Toxicity Monitoring data generated during WY 2021 were of sufficient quality in comparison to objectives outlined in the QAPP. However, some data were rejected or flagged in accordance with QA/QC protocols. A summary of the QA/QC analysis is provided below:

- Most of the dissolved oxygen data collected at station 205R03530 during both deployments were rejected due to sensor fouling.
- Some data were flagged for accuracy and precision but not rejected.
- Past ammonia concentrations were suspected of being biased high based on the theoretical relationship between ammonia and total Kjeldahl nitrogen (TKN) (i.e., ammonia concentration should be lower than TKN), but data were not flagged or rejected until this finding could be confirmed and the source identified. A small-scale investigation of ammonia analytical methods was conducted in WY 2021. The study concluded that the low-level undistilled ammonia methodology (which is specified in the BASMAA QAPP as it meets the target reporting limit) should be discontinued and the regular, distilled methodology (which exceeds the target reporting limit) be used for future ammonia analysis.

A detailed QA/QC report for WY 2021 data is included as Attachment 1.

[7] The current SWAMP QAPrP is available at: https://www.waterboards.ca.gov/water_issues/programs/swamp/qapp/swamp_QAPrP_2017_Final.pdf

2.0 BIOLOGICAL CONDITION ASSESSMENT

2.1 Introduction

The Program has conducted bioassessment monitoring since WY 2012 in Santa Clara Valley creeks in compliance with Creek Status Monitoring provisions C.8.c of MRP 1.0 and C.8.d.i of MRP 2.0. Nearly all bioassessment monitoring has been performed at randomly selected sites using a probabilistic monitoring design. The probabilistic monitoring design allows each individual RMC participating program to objectively assess overall creek ecosystem conditions within its program area (e.g., County boundary) while contributing data to answer regional management questions about water quality and Beneficial Use condition in San Francisco Bay Area creeks. The probabilistic design provides an unbiased framework for condition assessment of ambient aquatic life uses within known estimates of precision. The monitoring design was developed to address management questions for RMC participating counties and the overall RMC area:

1. *What is the condition of aquatic life in creeks in the RMC area; are water quality objectives met and are Beneficial Uses supported?*
    - i. *What is the condition of aquatic life in the urbanized portion of the RMC area; are water quality objectives met and are Beneficial Uses supported?*
    - ii. *What is the condition of aquatic life in RMC participant counties; are water quality objectives met and are Beneficial Uses supported?*
    - iii. *To what extent does the condition of aquatic life in urban and non-urban creeks differ in the RMC area?*
    - iv. *To what extent does the condition of aquatic life in urban and non-urban creeks differ in each of the RMC participating counties?*
2. *What are major stressors to aquatic life in the RMC area?*
    - i. *What are major stressors to aquatic life in the urbanized portion of the RMC area?*
3. *What are the long-term trends in water quality in creeks over time?*

The first question (i.e., *What is the condition of aquatic life in creeks in the RMC area?*) is addressed by assessing indicators of aquatic biological health at probabilistic sampling locations. Once sufficient samples have been collected, ambient biological condition can be estimated for streams at a regional (or countywide) scale. Over the past ten years (WY 2012 through WY 2021), SCVURPPP and the Regional Water Board have sampled 178 probabilistic and 34 targeted sites[8], for a total of 212 sites in the Santa Clara Valley. The number of sampled probabilistic samples is sufficient to estimate ambient biological condition for both urban and non-urban streams in the Valley.[9] However, there are still insufficient samples to accurately assess the biological condition for many individual watersheds and smaller areas (e.g., city boundaries).

[8] MRP 2.0 allows for up to 20% of bioassessment surveys at targeted sites to address other types of management questions. Subsequent communications from Regional Board staff have authorized additional monitoring at targeted sites due to exhaustion of available probabilistic sites.

[9] For each of the strata, it is necessary to obtain a sample size of at least 30 in order to evaluate the condition of aquatic life within known estimates of precision. This estimate is defined by a power curve from a binomial distribution (BASMAA 2012).

The second question (i.e., *What are major stressors to aquatic life in the RMC area?*) is addressed by evaluation of physical habitat and water chemistry data collected at the probabilistic sites, as potential stressors to biological health. The stressor levels can be compared to biological indicator data through correlation and random forest statistical models. Assessing the extent and relative importance of stressors in predicting biological condition can help prioritize stressors at a regional scale and inform local management decisions.

The third question (i.e., *What are the long-term trends in water quality in creeks over time?*) is addressed by assessing the change in biological condition over several years. Understanding changes in biological condition over time can help evaluate the effectiveness of management actions. Although, long-term trend analysis for the probabilistic survey will require more than ten years of data collection, preliminary trend analysis of biological condition may be possible for some stream reaches using a combination of historical targeted data with the probabilistic data.

All three management questions were comprehensively evaluated using eight years of bioassessment data (WY 2012 – WY 2019) and reported in the Program's WY 2019 Integrated Monitoring Report (IMR) (SCVURPPP 2020). Results presented in the IMR were similar to findings from an analysis of regional probabilistic data collected during WY 2012 – WY 2016 (BASMAA 2019).

This section of the report presents bioassessment results from WY 2021. In compliance with Provision C.8.d.i.(8) of the MRP, WY 2021 data are compared to triggers and water quality objectives identified in the MRP. Sites with results exceeding trigger thresholds were added to the list of trigger exceedances maintained by the Program.

2.2 Methods

2.2.1 Probabilistic Survey Design

Prior to WY 2020, the Program conducted bioassessments primarily at sites selected using the RMC probabilistic design. The RMC probabilistic design was created using the Generalized Random Tessellation Stratified (GRTS) approach developed by the United States Environmental Protection Agency (USEPA) and Oregon State University (Stevens and Olsen 2004). GRTS offers multiple benefits for coordinating among monitoring entities, including the ability to develop a spatially balanced design that produces statistically representative data with known confidence intervals. The GRTS approach has been implemented in California by several agencies including the statewide Perennial Streams Assessment (PSA) conducted by SWAMP (Ode et al. 2011) and the Southern California Stormwater Monitoring Coalition's (SMC) regional monitoring program conducted by municipal stormwater programs in Southern California (SCCWRP 2007).

Probabilistic monitoring sites were selected using the GRTS approach from a sample frame consisting of a creek network geographic information system (GIS) data set within the 3,407-square mile RMC area (BASMAA 2012). The sample frame includes non-tidally influenced perennial and non-perennial creeks within five management units representing areas managed by the stormwater programs associated with the RMC (see Table 1.1). There is approximately one site for every stream kilometer in the sample frame. The National Hydrography Plus Dataset (1:100,000) was selected as the creek network data layer to provide consistency with both the Statewide PSA and the SMC, and the opportunity for data coordination with these programs.

Once the master draw was performed, the list of sites was classified by county and land use (i.e., urban and non-urban) to allow for comparisons between these strata. Urban areas were delineated by combining urban area boundaries and city boundaries defined by the U.S. Census (2000). Non-urban areas were defined as the remainder of the RMC area. Some sites classified as urban fall near the non-urban edge of the city boundaries and have little upstream development. For the purposes of consistency, these urban sites were not re-classified. Therefore, data values within the urban classification represent a wide range of conditions.

The RMC participants decided to partition their sampling efforts so that approximately 80% are in urban areas and 20% in non-urban areas. In addition, between WY 2012 and WY 2015, the SFBRWQCB SWAMP conducted 34 bioassessments throughout the RMC region at non-urban sites selected from the sample frame, including 12 sites in Santa Clara County.

All probabilistic sites identified in the master draw are evaluated by each RMC participant in chronological order using the process described in RMC SOP FS-12 (BASMAA 2016) which is consistent with the procedure described by Southern California Coastal Water Research Project (SCCWRP 2012). Each site is evaluated to determine if it meets RMC sampling location criteria (e.g., not tidally influenced, sufficient flow, safe accessibility, landowner permission to access site). Site evaluation information is stored in a database and analyzed to determine the statistical significance of local and regional ambient conditions calculated from the multi-year dataset.

2.2.2 Targeted Sites

During the site evaluation process in WY 2020, the complete list of SCVURPPP *urban* probabilistic sites from the RMC Sample Frame was evaluated for sampling and only ten met the RMC criteria10. As a result, in WY 2020, 10 of the 20 required bioassessment surveys (i.e., 50%) were conducted at targeted sites. A majority of the WY 2020 targeted sites were probabilistic sites that were previously sampled prior to WY 2020.

In recognition of the exhaustion of probabilistic sites in Santa Clara County, Regional Water Board staff supported a monitoring approach that included more than 20% targeted sites.[11] Regional Water Board staff recommended targeted monitoring to fill spatial data gaps and/or to assess changes over time. Therefore, during WY 2021, all 20 bioassessment surveys were conducted at targeted sites. Thirteen of the WY 2021 targeted sites were located at sites in Stevens Creek, Los Gatos Creek, Alamitos Creek, Arroyo Calero and Guadalupe Creek that are regularly monitored by Valley Water to assess the condition of steelhead populations. Six bioassessments were conducted at sites that were previously sampled probabilistic sites, including four in Saratoga Creek and two in Los Gatos Creek. One new bioassessment site was selected on Stevens Creek upstream of the dam.

2.2.3 Field Sampling Methods

Bioassessment survey methods were consistent with the BASMAA RMC QAPP (BASMAA 2020) and SOPs (BASMAA 2016). In accordance with the RMC QAPP (BASMAA 2020) bioassessments were planned during the spring index period (approximately April 15 – July 15) with the goal to sample a minimum of 30 days after any significant storm (defined as at least

[10] A high proportion of probabilistic sites that were evaluated in WY 2020 could not be sampled due to an exceptionally dry winter wet season and a resulting lack of spring baseflow.

[11] January 26, 2021, letter from Derek Beauduy, Regional Water Board, to stormwater monitoring program managers.

0.5-inch of rainfall within a 24-hour period). The 30-day grace period allows diatom and soft algae communities to recover from peak flows that may scour benthic algae from the bottom of the stream channel.[12] In WY 2021, bioassessment sampling occurred between April 26 and May 25, 2021. Field work began after a long dry period, with the last significant storm of the season occurring on January 28, 2021.

Each bioassessment sampling site consisted of a 150-meter stream reach that was divided into 11 equidistant transects placed perpendicular to the direction of flow. Benthic macroinvertebrate and algae samples were collected at each of the 11 evenly spaced transects using the Reachwide Benthos (RWB) method described in the SWAMP SOP (Ode et al. 2016). The most recent SWAMP SOP (i.e., Ode et al. 2016) combines the BMI and algae methods that are referenced in the MRP (Ode 2007, Fetscher et al. 2009), provides additional guidance, and adds two new physical habitat analytes (assess scour and engineered channels). The full suite of physical habitat data was collected within the sample reach using methods described in Ode et al. (2016).

Immediately prior to biological and physical habitat data collection, water samples were collected for nutrients, conventional analytes, ash free dry mass (AFDM), and chlorophyll a analysis using the Standard Grab Sample Collection Method as described in SOP FS-2 (BASMAA 2016). Water samples were also collected and analyzed in the field for free chlorine and total chlorine residual using a Pocket Colorimeter™ II and DPD Powder Pillows according to SOP FS-3 (BASMAA 2016) (see Section 5.0 for chlorine monitoring results). In addition, general water quality parameters (dissolved oxygen, pH, specific conductance and temperature) were measured at or near the centroid of the stream flow using a pre-calibrated multi-parameter probe.

Biological and water samples were sent to laboratories for analysis. The laboratory analytical methods used for BMIs followed Woodard et al. (2012), using the Southwest Association of Freshwater Invertebrate Taxonomists (SAFIT) Level 1 Standard Taxonomic Level of Effort, with the additional effort of identifying chironomids (midges) to subfamily/tribe instead of family (Chironomidae). Soft algae and diatom samples were analyzed following SWAMP protocols (Stancheva et al. 2015). The taxonomic resolution for all data was compared SWAMP master taxonomic list. All BMI and algal taxa identified in samples collected over the eight-year monitoring period were consistent with the taxa listed on the SWAMP Master List, which was then included in the data submittal each year.

2.2.4 Data Analysis

Biological condition indicator and stressor data for all bioassessment sites surveyed in WY 2021 were compiled into a master spreadsheet for data analyses. The master spreadsheet is included with this report as Attachment 2. BMI and algae data were analyzed to assess the biological condition (i.e., aquatic life beneficial uses) of the sampled reaches using condition index scores. Physical habitat data were used to assess biological condition and were evaluated as potential stressors. Water chemistry data were evaluated as potential stressors to biological health using triggers and WQOs identified in the MRP (see Stressor Variable section below). Data analysis methods for biological indicators and stressors are described below.

[12] The BASMAA 30-day grace period is more conservative than the 21-day grace period described in the SWAMP SOP (Ode et al. 2016).

The BMI and algae data were compiled, formatted, and submitted to the Moss Landing Marine Laboratory – San Jose State University Research Foundation (MLML-SJSURF) for the calculation of biological condition index scores using the RStudio statistical package and the necessary program scripts, developed by Southern California Coastal Water Research Project (SCCWRP) (Boyle 2020). Drainage areas upstream of all bioassessment sampling locations were delineated in GIS and sent to MLML-SJSURF for the calculation of environmental predictor variables, which are necessary input for the calculation of biological index scores. In addition, physical habitat data were compiled, formatted, and submitted to MLML-SJSURF for the calculation of physical habitat metrics using the SWAMP Bioassessment Reporting Module (SWAMP RM), a custom Microsoft Access™ application developed by the State Water Board. A subset of these metrics was then used to calculate physical habitat index scores. Detailed descriptions for each of the indices used to evaluate bioassessment data are described below.

2.2.4.1 Biological Indicators

Benthic Macroinvertebrates

The benthic (i.e., bottom-dwelling) macroinvertebrates collected through this monitoring program are organisms that live on, under, and around the rocks and sediment in the stream bed. Examples include dragonfly and stonefly larvae, snails, worms, and beetles (Figure 2.1). Each BMI species has a unique response to water chemistry and physical habitat condition. Some are relatively sensitive to poor habitat and pollution; others are more tolerant. Therefore, the abundance and variety of BMIs in a stream is an indicator of the biological condition of the stream.

The California Stream Condition Index (CSCI) is an assessment tool that was developed by the State Water Board to support the development of California's statewide Biological Integrity Plan[13]. The CSCI translates BMI data into an overall measure of stream health. The CSCI was developed using a large reference data set that represents the full range of natural conditions in California and site-specific models for predicting biological communities. The CSCI combines two types of indices: 1) taxonomic completeness, as measured by the ratio of observed-to-expected taxa (O/E); and 2) ecological structure and function, measured as a predictive multimetric index (pMMI) that is based on reference conditions. The CSCI score is computed as the average of the sum of the O/E and pMMI.

CSCI scores for each station are calculated using a combination of biological and environmental data following methods described in Rehn et al. (2015). Biological data consist of the BMI data collected and analyzed using the protocols described in the previous section. Environmental predictor data are generated in GIS using drainage areas upstream of each BMI sampling location.

The State Water Board is continuing to evaluate the performance of CSCI in a regulatory context. In Provision C.8.d of MRP 2.0, the Regional Water Board defines a CSCI score of 0.795 as a trigger threshold for identifying sites with potentially degraded biological condition that may be considered as candidates for a SSID project.

[13] The Biological Integrity Assessment Implementation Plan has been combined with the Biostimulatory Substances Amendment project. The State Water Board is proposing to adopt a statewide WQO for biostimulatory substances (e.g., nitrate) along with a program of implementation. A draft policy document for public review is anticipated in late 2021.

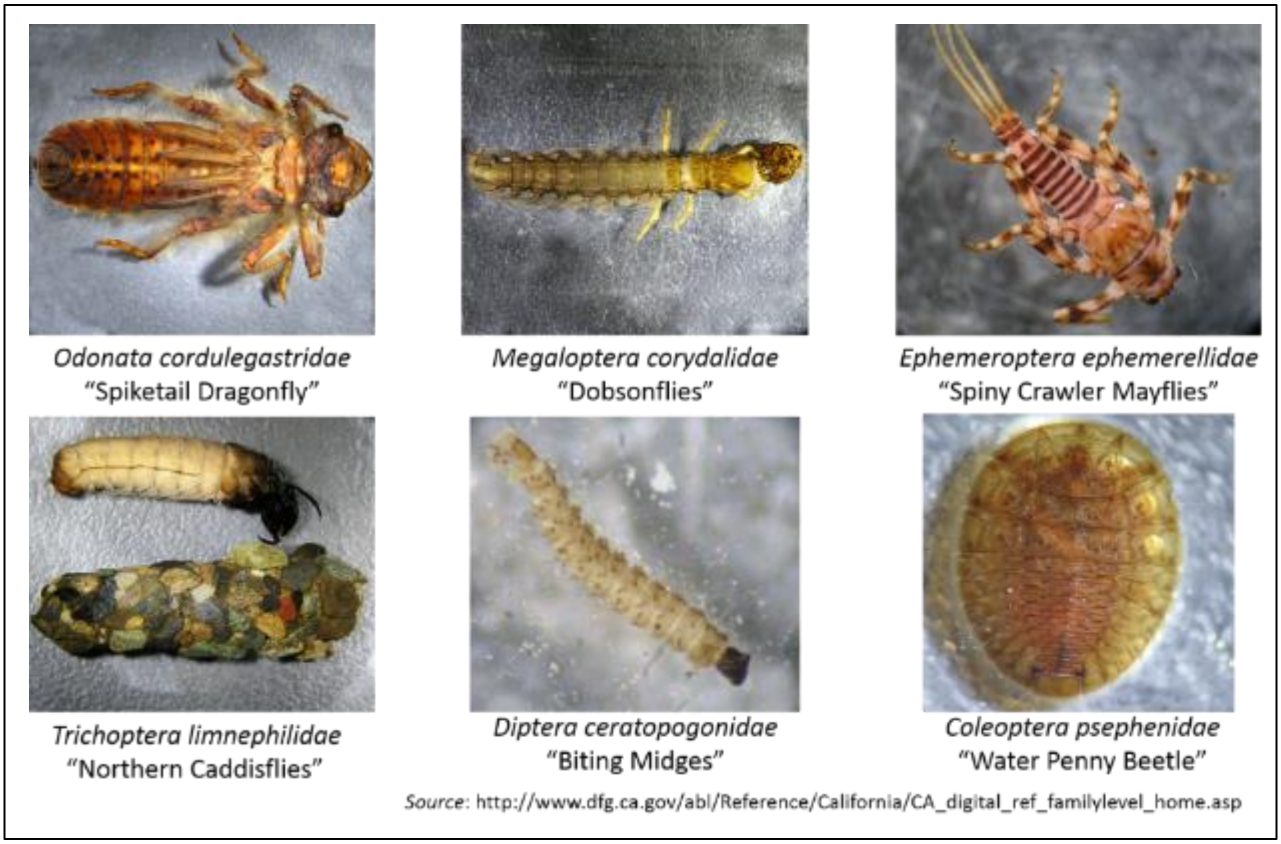

Figure 2.1. Examples of benthic macroinvertebrates.

Benthic Algae

Similar to BMI's, the abundance and type of benthic algae species living on a streambed are an indicator of stream health. When evaluated with the CSCI, biological indices based on benthic algae can provide a more complete picture of the streams biological condition because algae respond more directly to nutrients and water chemistry. In contrast, BMIs are more responsive to physical habitat. Figure 2.2 shows examples of benthic algae common in Bay Area streams.

The State Water Board and SCCWRP recently updated and finalized the Algae Stream Condition Index (ASCI)[14] which uses benthic algae data as a measure of biological condition for streams in California (Theroux et al. 2020*).* The ASCI uses predictive multimetric indices to evaluate ecological conditions. There are three versions of the ASCI pMMI: an index for diatoms, one for soft-bodied algae and a hybrid index using both assemblages. Using a statewide data set, all three indices were evaluated by Theroux et al. (2020) for precision, accuracy, responsiveness, and regional bias. The diatom and hybrid indices were found to be the most sensitive to anthropogenic stressor gradients.

There are no thresholds for ASCI scores in the MRP for identifying sites with potentially degraded biological condition. Condition categories based on reference conditions are presented in Theroux et al (2020) and used to evaluate data in this report. Hybrid ASCI scores were primarily used to evaluate the bioassessment data.

[14] Previously reported ASCI scores summarized in the SCVURPPP IMR (SCVURPPP 2020) have been superseded.

Additional research is needed to determine the best approach to apply the ASCI tools to evaluate bioassessment data. For example, it is not clear if the ASCI should be used as a second line of evidence to understand CSCI scoring results, or if it would be more effective as an independent indicator to evaluate different types of stressors (e.g., nutrients) to which BMIs are not very responsive. The ASCI is currently under review by the Biostimulatory-Biointegrity Policy Science Advisory Panel and the State Water Board.

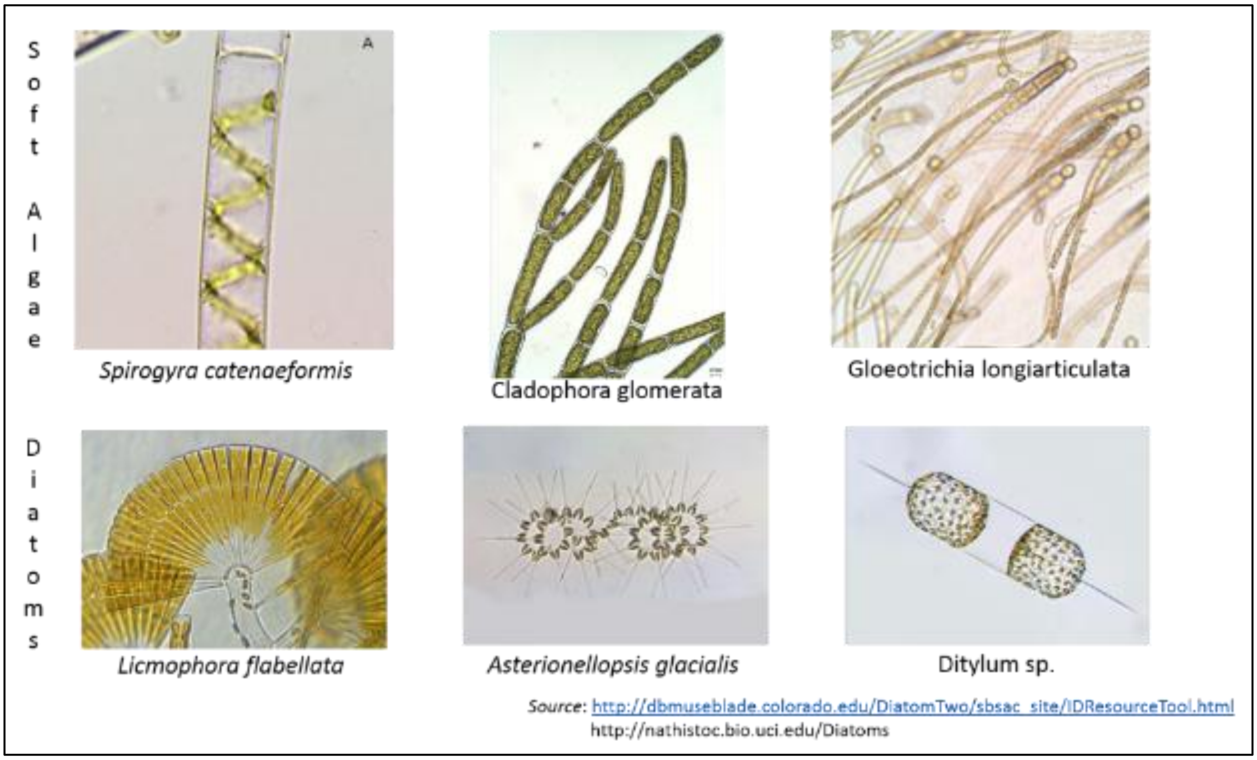

Figure 2.2. Examples of soft algae and diatoms.

2.2.4.2 Physical Habitat Indicators

The condition of the physical habitat within the riparian corridor is a major contributor to stream ecosystem health. Physical habitat components such as streambed substrate, channel morphology, microhabitat complexity, in-stream cover-type complexity, and riparian vegetation cover contribute to the overall physical and biological integrity of a stream. The physical characteristics of a stream reach are affected by both natural factors (e.g., climate, slope, geology) and human disturbance (e.g., channelization, development, stream crossings, hydromodification).

Physical habitat conditions are evaluated using two methods. Physical habitat metrics were calculated using reach-scale averages of transect-based measurements and observations. Approximately 170 different metrics were generated from the SWAMP RM using physical habitat measurements collected by SCVURPPP at bioassessment stations. The metrics are classified into five thematic groups representing different physical attributes: substrate, riparian vegetation (including structure and shading), flow habitat variability, in-channel cover, and channel morphology.

The State Water Board recently developed the Index of Physical Habitat Integrity (IPI) as an overall measure of physical habitat condition. Like the CSCI, the IPI is calculated using a combination of physical habitat data collected in the field and environmental data generated in GIS following the methods described in Rehn et al. (2018). The IPI is based on 12 of the metrics generated by the SWAMP RM (Table 2.1). The metrics were selected for their ability to discriminate between reference and stressed sites and provide unbiased representation of waterbodies across the different ecoregions of California. Scoring for these metrics were then calibrated using environmental variables that were associated with drainage areas for each sampling location.

Table 2.1. Physical habitat metrics calculated from bioassessment data collected in WY 2021. The 12 metrics used to calculate IPI scores are also shown.

Type/Class	Metric/Variable Name	Variables used for IPI Score
Channel Morphology	Mean Bankfull Width (SBKF_W)	x
	Mean Slope of Reach (XSLOPE)	x
	Percent Stable Banks (PBM_S)	
Flow Habitat	Evenness of Flow Habitat Types (Ev_FlowHab)	x
	Percent Pools in Reach (PCT_POOL)	x
	Shannon Diversity (H) of Aquatic Habitat Types (H_AqHab)	x
	Percent Fast Water (PCT_FAST)	
Instream Cover	Mean Filamentous Algae Cover (XFC_ALG)	x
	Natural Shelter cover – SWAMP (XFC_NAT_SWAM)	
	Mean Undercut Banks Cover (XFC_UCB)	
Riparian Cover	Mean Upper Canopy Trees and Saplings (XC)	x
	Riparian Cover Sum of Three Layers (SCMG)	x
Substrate	Percent Concrete/Asphalt (PCT_RC)	x
	Percent Sand (PCT_SA)	x
	Percent Gravel – coarse (PCT_GC)	
	Percent Substrate Smaller than Sand (<2 mm) (PCT_SAFN)	x
	Shannon Diversity (H) of Natural Substrate Types (H_SubNat)	x
	Median Particle Size (d50) (SB_PT_D50)	

Physical habitat is also assessed using the reachwide qualitative assessment (PHAB) that consists of three separate attributes: channel alteration, epifaunal substrate, and sediment deposition. Each attribute is individually scored on a scale of 0 to 20, with a score of 20 representing good condition. The total PHAB score is the sum of three individual attribute scores with a score of 60 representing the highest possible score.

2.2.4.3 Biological and Physical Habitat Condition Thresholds

Existing thresholds for CSCI scores (Mazor 2015) and ASCI Hybrid scores (Theroux et al. 2020) were used to evaluate the BMI and algae data collected in Santa Clara County and analyzed in this report (Table 2.2). Provisional thresholds for IPI scores (Rehn et al 2018) were used to evaluate physical habitat conditions. The thresholds for all three indices were based on the distribution of scores for data collected at reference calibration sites located throughout California. Four condition categories are defined by these thresholds: “likely intact” (greater than 30^{th} percentile of reference site scores); “possibly altered” (between the 10^{th} and the 30^{th}

percentiles); "likely altered" (between the 1st and 10th percentiles); and "very likely altered" (less than the 1st percentile).

A CSCI score below 0.795 is referenced in the MRP as a threshold indicating a potentially degraded biological community, and thus should be considered for a SSID Project. The MRP threshold is the division between the "possibly altered" and "likely altered" condition categories described in Mazor (2015). Further investigation is needed to evaluate the applicability of this threshold to sites in highly urban watersheds and/or modified channels that are common throughout the Bay Area.

Table 2.2. Condition categories used to evaluate CSCI, ASCI Hybrid and IPI scores.

Biological Indicator	Tool	Likely Intact	Possibly Altered	Likely Altered	Very Likely Altered
BMI	CSCI	≥ 0.92	≥ 0.79 to < 0.92	≥ 0.63 to < 0.79	< 0.63
Algae	ASCI Hybrid	≥ 0.94	≥ 0.86 to < 0.94	≥ 0.75 to < 0.86	< 0.75
Physical Habitat	IPI	≥ 0.94	≥ 0.84 to < 0.94	≥ 0.71 to < 0.83	< 0.70

2.2.4.4 Stressor Variables

Attachment A includes biological condition scores (CSCI, ASCI, IPI) and potential stressor data for bioassessment sites monitored in WY 2021. Stressors are conditions that affect the biological condition of a stream. They include, but are not limited to, the types of physical habitat, landscape characteristics, general water quality, and water chemistry data collected during bioassessment surveys.

Potential stressors included in Appendix A are:

- ***Physical habitat*** stressor variables include metrics developed by the SWAMP RM (described above) and physical habitat variables from the reachwide qualitative assessments that are conducted in compliance with the BASMAA (BASMAA 2016) and SWAMP (Ode et al. 2016) SOPs.

- ***Land Use*** variables are calculated in GIS by overlaying land use and transportation layers with the drainage area upstream of the sampling location. Appendix A includes percent urban area, percent impervious area, and road density.

- ***Water quality*** stressor variables include the general parameters measured in the field (i.e., DO, pH, temperature and specific conductivity, free chlorine and total chlorine residual) and water chemistry analyzed at laboratories (nutrients and anions). Additional water quality variables included chlorophyll a and AFDM, both measured from filtration of the benthic algae composite samples.

  Some of the water quality stressor variables were calculated or converted from other analytes or units of measurement:

- Unionized ammonia is calculated from measured concentrations of total ammonia, pH, temperature, and specific conductance using a formula provided by the American Fisheries Society (AFS; https://fisheries.org/wp-content/uploads/2016/03/Copy-of-pub_ammonia_fwc.xls).
- Total nitrogen concentration was calculated by summing nitrate, nitrite, and Total Kjeldahl Nitrogen concentrations.
- The volumetric concentrations (mass/volume) for AFDM and chlorophyll a (as measured by the laboratory) were converted to an area concentration (mass/area). Calculations required using both algae sampling grab size and composite volume.

The Integrated Monitoring Report evaluated the relationship between potential stressors and biological condition (i.e., CSCI and ASCI scores) for the WY 2012 through WY 2019 probabilistic dataset (SCVURPPP 2020) using statistical analyses such as correlation and random forest models. Those analyses were not updated to include data collected in WY 2020 and WY 2021.

2.2.4.5 Trigger Thresholds

In compliance with provision C.8.h.iii.(4) of the MRP, water chemistry data collected at the bioassessment sites during WY 2021 were compared to MRP trigger thresholds and applicable water quality standards (Table 2.3). Thresholds for pH, specific conductance, DO, and temperature (for waters with COLD Beneficial Use only) are listed in provision C.8.d.iv of the MRP. Except for temperature and specific conductance, these conform to WQOs in the Basin Plan (SFBRWQCB 2017). Of the eleven nutrients analyzed synoptically with bioassessments, WQOs only exist for three: ammonia (unionized form), chloride, and nitrate (for waters with MUN Beneficial Use only).

Table 2.3. MRP trigger thresholds for nutrient and general water quality variables.

	Units	Threshold	Direction	Source
Nutrients and Ions				
Nitrate as N [a]	mg/L	10	Increase	Basin Plan
Unionized Ammonia, annual median [b]	mg/L	0.025	Increase	Basin Plan
Unionized Ammonia, maximum	mg/L	0.4	Increase	Basin Plan
Chloride [a]	mg/L	250	Increase	Basin Plan
General Water Quality				
Oxygen, Dissolved [d]	mg/L	5.0 or 7.0	Decrease	Basin Plan
pH	--	6.5 to 8.5	Both	Basin Plan
Temperature, instantaneous maximum [c]	°C	24	Increase	MRP
Specific Conductance [c]	µS/cm	2000	Increase	MRP

[a] Nitrate and chloride WQOs only apply to waters with MUN designated Beneficial Use
[b] This threshold is an annual median value and is not typically applied to individual samples.
[c] The MRP thresholds (or triggers) for temperature and specific conductance apply when 20 percent of instantaneous results are in exceedance. Application to individual samples is provisional.
[d] The WQO for WARM and COLD Beneficial Use is 5.0 and 7.0, respectively.

Ammonia, specifically unionized ammonia, is toxic to aquatic life. Therefore, the Basin Plan states that discharge of wastes shall not cause receiving waters to contain annual median concentrations of un-ionized ammonia in excess of 0.025 mg/L or maximum concentrations above 0.4 mg/L in the Lower Bay, which includes creeks in the Santa Clara Basin (SFBRWQCB

2017). Conversion of measured total ammonia to the more toxic form of unionized ammonia was calculated to compare with the WQOs in the San Francisco Basin Water Quality Control Plan (Basin Plan) (SFBRWQCB 2017).

2.3 Results and Discussion

The results for bioassessment monitoring in WY 2021 are presented in the section below.

- **Section 2.3.1** presents a summary of biological assessment data collected at 20 targeted sites in Santa Clara County during WY 2021.
- **Section 2.3.2** presents a comparison between biological condition scores using bioassessment data and steelhead population data collected by Valley Water.
- **Section 2.3.3** presents a comparison of BMI and algae data between targeted sites sampled in WY 2021, the driest WY during implementation of the MRP, and probabilistic sites (pre-WY 2021) sampled across mix of dry and wet years.

Conclusions and recommendations for this section are presented in Section 7.0.

2.3.1 Bioassessment Results (WY 2021)

This section documents the biological condition and stressor data collected at 20 targeted sites in Santa Clara County during WY 2021. Sites monitored are listed in Table 2.4 and illustrated in Figure 2.3. Thirteen of the targeted sites monitored in WY 2021 are located at sites in Stevens Creek, Los Gatos Creek, Alamitos Creek, Arroyo Calero and Guadalupe Creek. These sites are regularly monitored by Valley Water to assess the condition of *Oncorhynchus mykiss* (steelhead trout) populations. Of the remaining seven sites, six (four in Saratoga Creek and tow in Los Gatos Creek) are located at sites sampled during a previous WY. The remaining site is located on Stevens Creek upstream of Stevens Creek Reservoir at the Valley Water stream gage. All sites except those in Saratoga Creek and the upper site in Stevens Creek are located below impoundments.

Table 2.4. Bioassessment sampling dates and locations in Santa Clara County in WY 2021.

Station Code	Creek	Sample Date	Elevation (m)	Latitude	Longitude	Targeted		
						Re-sampled (prior station code)	New Site	Valley Water Fish Survey Site
AC002	Alamitos Creek	5/4/2021	243	37.22229	-121.85051	X (205R02650)		X
AC004	Alamitos Creek	5/4/2021	458	37.17409	-121.82406			X
CC001	Arroyo Calero	5/5/2021	285	37.21349	-121.83208	X (205R01434)		X
CC003	Arroyo Calero	5/5/2021	337	37.20340	-121.81686			X
GC003	Guadalupe Creek	4/29/2021	270	37.23006	-121.90285	X (205R04638)		X
GC004	Guadalupe Creek	4/28/2021	322	37.21836	-121.90883			X
GC006	Guadalupe Creek	4/28/2021	425	37.20488	-121.89643			X
LG002	Los Gatos Creek	5/13/2021	93	37.31601	-121.90302	X (205R03331)		X
LG003	Los Gatos Creek	5/12/2021	136	37.30155	-121.91856			X
LG004	Los Gatos Creek	5/12/2021	156	37.29109	-121.93488	X (205GUA060)		X
205R01930	Los Gatos Creek	5/11/2021	223	37.26288	-121.95201	X		
205R03530	Los Gatos Creek	5/11/2021	276	37.25120	-121.96500	X		
205R01706	Saratoga Creek	5/3/2021	396	37.26554	-122.02575	X		
205R02474	Saratoga Creek	5/10/2021	463	37.25780	-122.03480	X		
205R03562	Saratoga Creek	5/10/2021	567	37.25240	-122.04504	X		
205R00170	Saratoga Creek	5/6/2021	900	37.24844	-122.07084	X		
SC002	Stevens Creek	4/27/2021	288	37.32458	-122.06157			X
SC004	Stevens Creek	4/26/2021	331	37.31429	-122.06454			X
SC006	Stevens Creek	5/25/2021	414	37.30298	-122.07466	X (205R01187)		X
205STE095	Stevens Creek	5/25/2021	573	37.27954	-122.07378		X	

2.3.1.1 Biological and Physical Habitat Conditions

Biological condition, as represented by CSCI and ASCI Hybrid score, for the 20 bioassessment sites sampled by SCVURPPP in WY 2021, is shown in Table 2.5. Physical habitat condition, as represented by IPI score, is also shown in Table 2.5. Scores in the two higher condition categories for each indicator (as defined in Table 2.2) are shown in shaded cells with bold text. Site characteristics related to percent impervious watershed area and total PHAB scores are also presented. Condition scores are illustrated in Figure 2.3.

CSCI Scores

The CSCI scores ranged from 0.48 to 1.07 across the 20 bioassessment sites sampled in WY 2021 (Table 2.5). 20% of the sites had CSCI scores in the two higher condition categories: “likely intact” and “possibly altered.” The relative level of impervious areas in the contributing watersheds of these four sites were relatively low (< 3%). Two of the four high scoring sites are in Guadalupe Creek, one (GC004) just downstream of the Valley Water stream gage and the other approximately one mile downstream of Guadalupe Reservoir in Almaden Quicksilver County Park. The remaining two sites with higher condition scores are in Saratoga Creek

(205R00170), just upstream of Saratoga Springs Event Center, and in Stevens Creek (205STE095) at the stream gage upstream of Stevens Creek Reservoir.

Seven sites (35%) were ranked as “likely altered” (CSCI score ≥0.63 to < 0.79). Six of these sites had moderately low impervious areas in their contributing watersheds, ranging from 2% to 5%. The remaining “likely altered” site is in Los Gatos Creek (LG002) and has the highest percent imperviousness (17% impervious) of all WY 2021 sites monitored (Figure 2.4).

Nine sites were ranked as “very likely altered” (CSCI score < 0.63), indicating highly degraded conditions. Watershed imperviousness was highly variable across the watershed for these sites, ranging from 1% to 13%. These “very likely altered” sites included all three sites in Stevens Creek below the Stevens Creek Reservoir, four of five sites in Los Gatos Creek, and the upper site in Alamitos Creek, located in Almaden Quicksilver County Park just downstream of Almaden Reservoir.

Table 2.5. Biological condition, presented as CSCI and H_ASCI scores, and physical habitat condition, presented as IPI score and Total PHAB score, for 20 sites sampled in Santa Clara County during WY 2021. Bold-shaded values indicate scores in the two highest condition categories for each indicator. Overall condition scores, i.e., the sum of the three individual index scores, are also shown. The six sites with highest overall condition score (> 2.75) are shown in bold. Site characteristics related to percent impervious watershed area and total PHAB are also presented.

Station Code	Creek	Impervious Watershed Area	Total PHAB	CSCI Score	ASCI Hybrid Score	IPI Score	Overall Score
AC002	Alamitos Creek	5%	41	0.72	0.61	**1.10**	2.43
AC004	Alamitos Creek	1%	43	0.55	0.48	**1.07**	2.10
CC001	Arroyo Calero	3%	40	0.70	0.74	**1.09**	2.53
CC003	Arroyo Calero	3%	29	0.71	0.78	**1.15**	2.64
GC003	Guadalupe Creek	3%	40	0.64	**0.93**	**1.10**	2.67
GC004	Guadalupe Creek	1%	46	**0.93**	**0.87**	**1.19**	**2.99**
GC006	Guadalupe Creek	1%	48	**0.80**	0.81	**1.16**	**2.77**
LG002	Los Gatos Creek	17%	32	0.65	0.71	**0.94**	2.29
LG003	Los Gatos Creek	13%	36	0.60	0.77	**1.15**	2.53
LG004	Los Gatos Creek	12%	44	0.63	0.69	**1.20**	2.52
205R01930	Los Gatos Creek	8%	37	0.58	0.58	**0.96**	2.12
205R03530	Los Gatos Creek	7%	39	0.58	0.81	**1.15**	2.53
205R01706	Saratoga Creek	5%	35	0.79	**0.95**	**1.04**	**2.78**
205R02474	Saratoga Creek	4%	39	0.60	**0.87**	**1.07**	2.55
205R03562	Saratoga Creek	2%	37	0.78	**0.86**	**1.22**	**2.86**
205R00170	Saratoga Creek	2%	49	**1.07**	**0.98**	**1.08**	**3.13**
SC002	Stevens Creek	3%	34	0.54	0.77	**1.03**	2.35
SC004	Stevens Creek	2%	41	0.48	0.81	**0.98**	2.26
SC006	Stevens Creek	2%	42	0.59	0.62	**1.18**	2.39
205STE095	Stevens Creek	2%	51	**0.98**	**0.98**	**1.09**	**3.05**

ASCI Hybrid Scores

The ASCI Hybrid scores ranged from 0.48 to 0.98 across the 20 bioassessments sites sampled in WY 2021 (Table 2.5). Seven of the sites had ASCI Hybrid scores in the two higher condition categories (scores > 0.86): “likely intact” and “possibly altered.” These sites included all four sites in Saratoga Creek, two lower elevation sites in Guadalupe Creek, and the highest elevation site in Stevens Creek. Three of these seven sites also received CSCI scores in the upper two condition categories.

Six sites had ASCI Hybrid scores in the “likely altered” (≥ 0.75 to < 0.86) condition category. Four these sites have a relatively low level of urban development in their contributing watershed area (impervious area <4%). The remaining two sites are located in Los Gatos Creek and have moderate to high levels of urban development in their contributing watershed area (impervious area 7% and 13%).

The remaining seven sites were ranked as “very likely altered” (ASCI Hybrid score < 0.75). These low scoring sites included three sites in Los Gatos Creek, two sites in Alamitos Creek, one in Calero Creek, and one in Stevens Creek below the Stevens Creek Reservoir.

IPI Scores

Physical habitat condition, as represented by IPI scores, ranged from 0.94 to 1.22 across the 20 bioassessment sites sampled in WY 2021 (Table 2.5). All sites had IPI scores in the highest condition category (≥ 0.94). Most of the sites are in natural channels with minimal modification and relatively wide riparian corridors.

Overall Biological/Physical Condition

The overall biological/physical condition of a site was calculated by summing the two biological condition index scores (CSCI and ASCI Hybrid) and the physical habitat condition score (IPI). Six of the 20 sites had overall scores greater than 2.75. Three of these six sites are in Saratoga Creek, two sites are in Guadalupe Creek, and the remaining site is the upper elevation site in Stevens Creek. The two sites in Guadalupe Creek were the only ones located below reservoirs to receive high scores for all three indices: CSCI, ASCI Hybrid and IPI score.

In general, land use factors (e.g., % imperviousness) and physical habitat appear to have minimal association with biological condition scores in the WY 2021 dataset. Factors associated with impoundments (e.g., regulated flows and reduced sediment transport) and low flow conditions due to the extremely dry water year may also have an important influence on biological condition for most sites sampled during WY 2021.

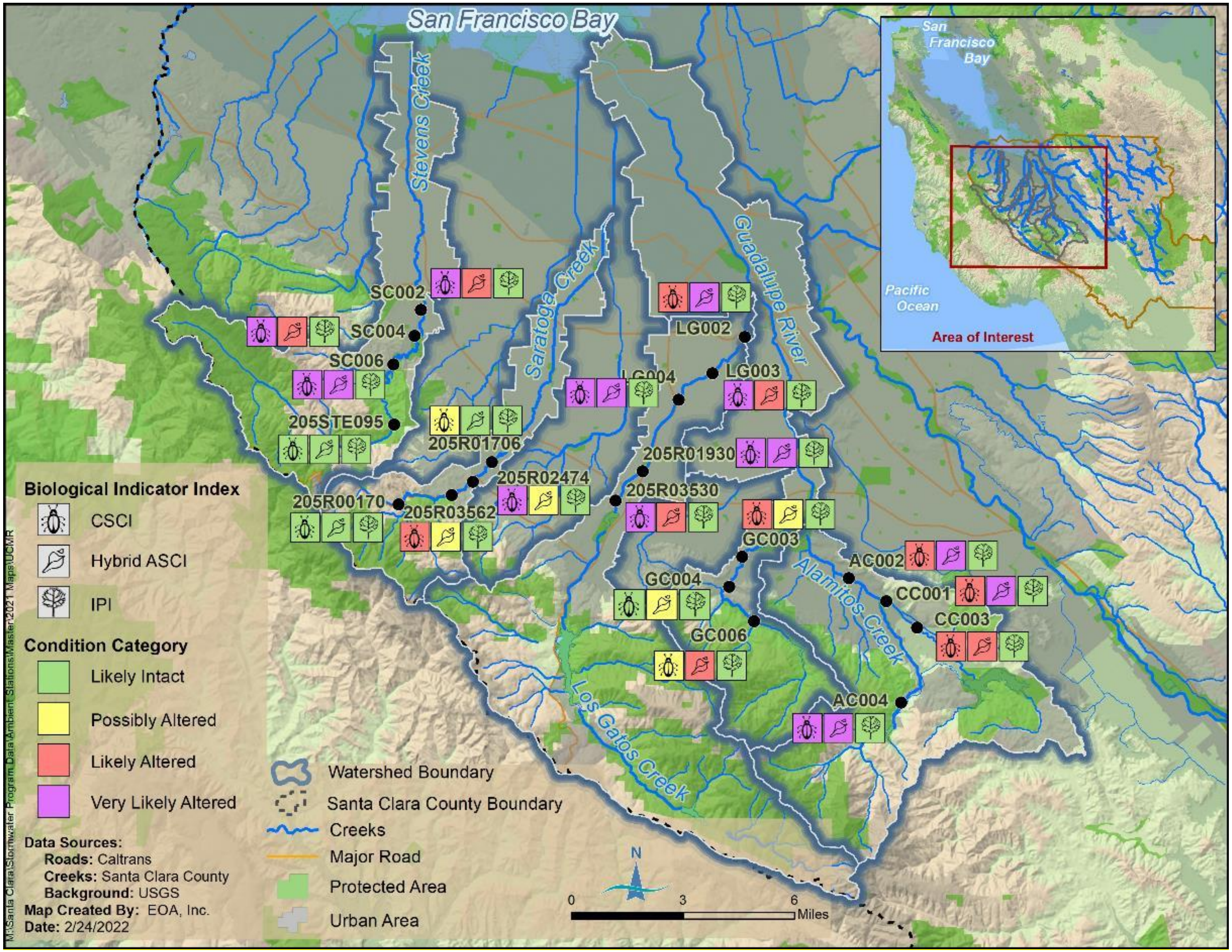

Figure 2.3. Condition category as represented by CSCI, ASCI Hybrid, and IPI scores for 20 sites sampled in Santa Clara County during WY 2021.

Figure 2.4. SCVURPPP field member collecting benthic macroinvertebrates in Los Gatos Creek (station LG002). The CSCI score at this site is 0.65.

2.3.1.2 Stressor Assessment (WY 2021)

This section presents results for stressor data collected at the 20 bioassessment sites monitored in WY 2021. The comparison of WY 2021 stressor data to associated MRP triggers and/or WQOs is documented for the purposes of maintaining the list of sites with trigger exceedances.

General Water Chemistry

Results of general water quality measurements collected at the bioassessment sites in WY 2021 are listed in Table 2.6. A single measurement taken at one of the sites (205STE095) exceeded the WQO for pH (> 8.5). No other WQOs or MRP triggers were exceeded.

Table 2.6. General water quality measurements at 20 bioassessment sites in Santa Clara County, WY 2021.

Station Code	Creek Name	Sample Date	DO (mg/L)	Temp (Deg C)	Specific Cond (uS/cm)	pH
AC002	Alamitos Creek	5/4/2021	9.5	17.7	580	7.8
AC004	Alamitos Creek	5/4/2021	8.4	14.7	375	7.3
CC001	Arroyo Calero	5/5/2021	9.0	17.2	582	8.0
CC003	Arroyo Calero	5/5/2021	8.5	13.5	537	7.6
GC003	Guadalupe Creek	4/29/2021	9.7	13.0	592	8.0
GC004	Guadalupe Creek	4/28/2021	10.8	12.4	535	8.0
GC006	Guadalupe Creek	4/28/2021	12.8	9.3	495	7.9
LG002	Los Gatos Creek	5/13/2021	8.8	18.7	517	8.0
LG003	Los Gatos Creek	5/12/2021	8.5	20.7	508	7.6
LG004	Los Gatos Creek	5/12/2021	7.7	19.5	509	7.5
205R01930	Los Gatos Creek	5/11/2021	6.5	20.3	49	7.6
205R03530	Los Gatos Creek	5/11/2021	7.2	20.1	459	7.9
205R01706	Saratoga Creek	5/3/2021	8.8	12.9	639	7.8
205R02474	Saratoga Creek	5/10/2021	10.2	15.8	617	7.5
205R03562	Saratoga Creek	5/10/2021	10.5	11.8	593	7.6
205R00170	Saratoga Creek	5/6/2021	10.0	11.0	505	8.2
SC002	Stevens Creek	4/27/2021	11.5	10.3	776	7.9
SC004	Stevens Creek	4/26/2021	10.1	10.7	704	7.5
SC006	Stevens Creek	5/25/2021	7.4	13.8	649	8.1
205STE095	Stevens Creek	5/25/2021	10.9	12.1	689	**8.7**

Water Chemistry (Nutrients)

Nutrient and conventional analyte concentrations measured in water samples collected at bioassessment sites during WY 2021 are listed in Table 2.7. No WQOs or MRP trigger thresholds were exceeded.

Total nitrogen concentrations ranged from 0.046 to 1.6 mg/L. The two highest total nitrogen concentrations were both measured in Stevens Creek (1.6 mg/L; site SC006) and (1.0 mg/L; site SC002). Total phosphorus concentrations ranged from <0.02 to 0.29 mg/L. The highest total phosphorus concentration was measured in Stevens Creek (0.29 mg/L; site SC006).

Chlorophyll a and ash free dry mass are two indicators of biomass. The highest concentration of chlorophyll a (150 mg/m^2) was measured in Stevens Creek (site SC004). The highest concentration of AFDM (575 g/ m^2) was measured in Stevens Creek (site SC006).

Table 2.7. Nutrient and conventional constituent concentrations in water samples collected at 20 sites in Santa Clara County during WY 2021.

Station Code	Creek Name	Ammonia (as N)	Unionized Ammonia (as N)	Chloride	Nitrate (as N)	Nitrite (as N)	Total Kjeldahl Nitrogen (as N)	Total Nitrogen	Ortho-phosphate (as P)	Phosphorus	Silica (as SiO2)	AFDM	Chlorophyll a
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	g/m2	mg/m2
	Water Quality Objective	***NA***	***0.025 [b]***	***250[a]***	***10[a]***	***NA***	***NA***	***NA***	***NA***	***NA***	***NA***	***NA***	***NA***
AC002	Alamitos Creek	0.09 J	0.002	49	0.28	0.003 J	0.04	0.32	0.03	0.05	20	216	61
AC004	Alamitos Creek	0.28	0.001	8	0.14	0.005	0.08 J	0.23	0.03	0.06	17	173	46
CC001	Arroyo Calero	0.28	0.007	66	0.28	0.004 J	0.22	0.50	0.05	0.07	21	141	15
CC003	Arroyo Calero	0.32	0.003	68	0.13	0.007	0.25	0.39	0.07	0.10	16	222	25
GC003	Guadalupe Creek	0.19	0.004	21	0.005	0.001 J	0.04	0.05	0.02	0.03	12	75	50
GC004	Guadalupe Creek	0.19	0.002	14	0.08 J	0.001 J	0.17	0.25	0.01	0.02	11	14	27
GC006	Guadalupe Creek	0.18	0.004	12	0.09 J	0.002 J	0.11	0.21	0.01	0.02	11	86	44
LG002	Los Gatos Creek	0.18	0.005	33	0.15	0.003 J	0.47	0.62	0.05	0.06	8.6	96	110
LG003	Los Gatos Creek	0.25	0.003	31	0.11	0.002 J	0.36	0.47	0.03	0.06	8.6	75	81
LG004	Los Gatos Creek	0.32	0.004	33	0.14	0.002 J	0.47	0.61	0.02	0.07	9.7	48	78
205R01930	Los Gatos Creek	0.29	0.004	26	0.15	0.008	0.25	0.41	0.004 J	0.04	10	103	88
205R03530	Los Gatos Creek	0.26	0.007	16	0.06 J	0.005	0.61	0.68	<0.02	0.03	9.9	60	43
205R01706	Saratoga Creek	0.12	0.001	40	0.06 J	0.003 J	0.28	0.34	0.03	0.03	17	34	120
205R02474	Saratoga Creek	0.19	0.002	38	0.11	0.002 J	0.04	0.15	0.05	0.06	18	41	95
205R03562	Saratoga Creek	0.19	0.001	35	0.12	0.0005	0.04	0.16	0.06	0.06	18	78	51
205R00170	Saratoga Creek	0.17	0.005	15	0.12	0.0005	0.04	0.16	0.09	0.09	20	98	12
SC002	Stevens Creek	0.25	0.003	45	0.37	0.003 J	0.66	1.03	0.03	0.08	16	224	71
SC004	Stevens Creek	0.04 J	0.0002	28	0.13	0.002 J	0.25	0.38	0.04	0.10	12	198	150
SC006	Stevens Creek	0.67	0.019	26	0.33	0.034	1.2	1.56	0.15	0.29	15	575	120
205STE095	Stevens Creek	0.15	0.013	41	0.11	0.001 J	0.22	0.33	0.05	0.05	15	133	59

AFDM = Ash Free Dry Mass, NA = Not Applicable, NR = Not Reported
J = The reported result is an estimate. The value is less than the reporting limit but greater than the detection limit.
[a] Chloride and nitrate WQOs only apply to waters with MUN designated beneficial uses, i.e., Los Gatos Creek.
[b] This threshold is an annual median value and is not typically applied to individual samples.

Physical Habitat

There are no WQOs or MRP triggers associated with the physical habitat measurements collected during bioassessment surveys. However, physical habitat is an important factor that may influence biological conditions. The qualitative habitat (PHAB) scores, including individual scores for channel alteration, epifaunal substrate and sedimentation attributes[15], and total PHAB (sum of the three attributes scores) are shown in Table 2.8, with CSCI and IPI scores for comparison. Total PHAB scores ranged from 29 to 51 (highest possible score is 60).

Table 2.8. Qualitative physical habitat scores for 20 bioassessment sites in Santa Clara County sampled in WY 2021. CSCI and IPI scores are provided for comparison.

Station Code	Creek Name	CSCI Score	Channel Alteration	Epifaunal Substrate	Sediment Deposition	Total PHAB	IPI Score
AC002	Alamitos Creek	0.72	16	14	11	41	1.10
AC004	Alamitos Creek	0.55	15	16	12	43	1.07
CC001	Arroyo Calero	0.70	15	15	10	40	1.09
CC003	Arroyo Calero	0.71	17	8	4	29	1.15
GC003	Guadalupe Creek	0.64	13	17	10	40	1.10
GC004	Guadalupe Creek	0.93	15	15	16	46	1.19
GC006	Guadalupe Creek	0.80	17	17	14	48	1.16
LG002	Los Gatos Creek	0.65	13	10	9	32	0.94
LG003	Los Gatos Creek	0.60	11	14	11	36	1.15
LG004	Los Gatos Creek	0.63	13	16	15	44	1.20
205R01930	Los Gatos Creek	0.58	11	12	14	37	0.96
205R03530	Los Gatos Creek	0.58	11	15	13	39	1.15
205R01706	Saratoga Creek	0.79	13	12	10	35	1.04
205R02474	Saratoga Creek	0.60	14	14	11	39	1.07
205R03562	Saratoga Creek	0.78	6	17	14	37	1.22
205R00170	Saratoga Creek	1.07	19	18	12	49	1.08
SC002	Stevens Creek	0.54	14	12	8	34	1.03
SC004	Stevens Creek	0.48	16	16	9	41	0.98
SC006	Stevens Creek	0.47	19	18	5	42	1.18
205STE095	Stevens Creek	0.98	16	18	17	51	1.09

[15] Channelization is measure of extent of reach that is armored/modified; Epifaunal substrate is measure of quantity and quality of physical habitat features (e.g., substrate, wood) that provide structure for colonization of biological communities; Sedimentation is a measure of the amount of sediment that has accumulated in the reach.

2.3.2 Comparison of Fish Survey Data to Bioassessment Data

The health of the fish community is an indicator often used to evaluate biological conditions in creeks. Fish condition is assessed using a range of metrics, including fish population size/density, age class, fish condition (i.e., length/weight), species diversity, and percent native vs non-native species. The presence of anadromous fishes (e.g., steelhead trout) is a particularly good indicator of good water quality and physical habitat conditions. The size and condition of Steelhead trout (*Oncorhynchus mykiss*) can also be measured to assess the health of the population and to determine if food resources, such as benthic macroinvertebrates, are sufficient for growth.

Valley Water actively conducts fish monitoring as part of the Fish and Aquatic Habitat Collaborative Effort (FAHCE), a collaborative process to identify actions to balance fish and aquatic habitat needs with Valley Water's water supply operations.[16] The objectives of the FAHCE program are to improve aquatic spawning and rearing habitat and fish passage for migration within the Coyote, Guadalupe, and Stevens Creek watersheds. To achieve these objectives, Valley Water implements management actions such as optimizing reservoir operations to provide instream flows beneficial to fish, restoring habitat, and removing migration barriers. Fish monitoring is conducted to evaluate the effectiveness of these measures and inform future management decisions.

During WY 2021, 13 of the 20 sites where SCVURPPP conducted bioassessments had data on fish communities collected as part as fish surveys conducted by Valley Water during October and November 2020. The bioassessment survey reach at each site (150 meters in length) was defined so that it overlapped with the reach of the fish survey (ranging between 25 meters and 40 meters) to allow for comparisons between fish survey and bioassessment data. Overlapping sites included those located in the following creeks: Guadalupe Creek (3), Los Gatos Creek (3), Alamitos Creek (2) and Arroyo Calero (2) and Stevens Creek (3).

Fish survey data compiled from Valley Water reports for the Guadalupe River watershed (SCVWD 2021a) and the Stevens Creek watershed (SCVWD 2021b) are summarized in Table 2.9. These data include the estimated number of several native fish species, the number and density of juvenile steelhead trout (total fish per meter), and the total number of native fish species.

To provide additional context to site conditions, the Southern California Index of Biological Integrity (SoCal IBI) (Ode et al. 2005) was calculated to further evaluate the BMI data. The SoCal IBI was previously used to assess BMI data collected at bioassessment sites in Southern and Central California Coastal Streams prior to the development of the CSCI tool. Metric scores representing species richness, composition, tolerance, and functional feeding groups for BMI data collected at the thirteen sites are shown in Table 2.10.

<u>Fish Community Metrics</u>

The following bullets summarize fish community survey results from SCVWD 2021a and 2021b.

- The juvenile steelhead trout densities ranged from 0 – 0.4 fish/meter across all sites. No steelhead were captured at the three sites in Los Gatos Creek. The highest juvenile steelhead densities were measured at two of the sites in Stevens Creek (SC002 and

[16] https://www.valleywater.org/project-updates/creek-river-projects/fahce-fish-and-aquatic-habitat-collaborative-effort

SC004), the upper site in Calero Creek (CC003), and a middle elevation site in Guadalupe Creek (GC004).

- Riffle sculpin *(Cottus gulosus*), which has similar habitat requirements as steelhead trout, were found in relatively high numbers at all three sites in Guadalupe Creek but were not observed in the other creeks.
- In general, sites from all monitored creeks support 3 to 4 native fish species, including steelhead trout, and were predominantly comprised of only native fish. The exception was Los Gatos Creek, which had no fish at one site (LG003) and only one native fish species captured at the other two sites.

Potential Relationships between Fish Community Metrics and Biological Conditions

Potential relationships between fish community metrics and biological conditions (based on CSCI and ASCI Hybrid scores) were observed at the 13 sites. These observed relationships are qualitative and were not tested using statistical models.

- There is no apparent association between biological condition, based on CSCI and ASCI Hybrid scores (summarized in Section 2.2.4), and any of the fish population metrics listed in Table 2.9. In general, both CSCI and ASCI Hybrid scores were relatively low across all 13 fish survey locations, except for the three sites in Guadalupe Creek, which scored in the upper two condition categories for either CSCI or ASCI Hybrid scores.
- Site CG004 in Guadalupe Creek appeared to have the best overall conditions for both fish (i.e., relatively high numbers of juvenile steelhead and riffle sculpin) and biological condition, based on CSCI and ASCI Hybrid scores.
- Several sites that received low CSCI scores had relatively large numbers of juvenile steelhead trout. All three sites in Stevens Creek and the upper site in Alamitos Creek had juvenile steelhead trout densities greater than 0.1 fish/meter, but had CSCI scores in the lowest condition category, ranging between 0.48 and 0.59.

More refined information about the BMI community (i.e., the food source for most fish) (Table 2.10) may help explain fish community metrics (Table 2.9).

- The lack of a relationship between CSCI scores and steelhead population may be explained by differences in the life stages and residence times for fish and BMI assemblages. The juvenile steelhead trout life stage in a creek typically spans between one and two years. During this period, steelhead can be highly mobile, spawning and rearing in different creek segments, and potentially migrating to other areas in search of food or to avoid stressors (e.g., high temperatures, low DO). In contrast, BMIs are much shorter-lived, less mobile, and thus, more sensitive to episodic and/or seasonal changes in water quality and physical habitat conditions.
- Sensitive EPT Taxa (%) and Intolerant Organisms (%) are metrics used to measure the relative abundance of taxa/organisms that require good water quality and physical habitat conditions. The highest scores for both these metrics occurred at site GC004 and GC006 (Table 2.10). Similar patterns were observed with the species richness metrics, with highest scores for Taxonomic Richness and EPT Taxa occurring at the two upper sites on Guadalupe Creek. In contrast, scores for both sensitive/intolerance and richness metrics were very low for all sites in Stevens Creek.

Table 2.9. Valley Water fish population data collected at 13 sites in WY 2020 (SCVWD 2021a and 2021b). Sites with higher steelhead trout densities (i.e., greater than 0.1 fish/m) and sites with riffle sculpin are shown in bold. Biological conditions (CSCI and ASCI Hybrid) measured by SCVURPPP at overlapping sites in WY 2021 are shown for comparison. CSCI and ASCI Hybrid scores in the higher two condition categories are shown in bold.

Site ID	Creek	Number of Fish Observed								Algae	BMI
		Steelhead Trout		Riffle Sculpin	California Roach	Sac. Sucker	Three-Spine Stickleback	Prickly Sculpin	Total # Native Species	ASCI Hybrid Score	CSCI Score
		#	Density (fish/m)								
AC002	Alamitos Creek	4	**0.12**	0	6	8	0	4	4	0.61	0.72
AC004	Alamitos Creek	6	**0.12**	0	8	0	0	3	3	0.48	0.55
CC001	Arroyo Calero	2	0.05	0	11	4	0	1	4	0.74	0.70
CC003	Arroyo Calero	15	**0.37**	0	11	1	0	0	3	0.78	0.71
GC003	Guadalupe Creek	1	0.03	**51**	134	0	0	0	3	**0.93**	0.64
GC004	Guadalupe Creek	6	**0.15**	**102**	27	0	0	0	3	**0.87**	**0.93**
GC006	Guadalupe Creek	1	0.03	**11**	0	3	0	0	3	0.81	**0.80**
LG002[1]	Los Gatos Creek	0	0	0	35	0	0	0	1	0.71	0.65
LG003	Los Gatos Creek	0	0	0	0	0	0	0	0	0.77	0.60
LG004	Los Gatos Creek	0	0	0	0	15	0	0	1	0.69	0.63
SC002	Stevens Creek	31	**0.4**	0	40	17	15	0	4	0.77	0.54
SC004	Stevens Creek	7	**0.18**	0	16	15	8	0	4	0.81	0.48
SC006	Stevens Creek	6	**0.1**	0	4	6	0	0	3	0.62	0.59

Steelhead Trout (*Oncorhynchus mykiss*), Riffle Sculpin (*Cottus gulosus*), California Roach (*Hesperoleucus* symmetricus), Sacramento Sucker (*Catostomus occidentalis*)
Threespine Stickleback (*Gasterosteus aculeatus*), Prickly Sculpin (*Cottus asper*)

[1] Fish survey was not conducted at site LG002 in 2020. As a result, fish data collected at site LG001 (approximately one mile downstream of site LG002) were used to compare with bioassessment data collected at site LG002.

Table 2.10. SoCal IBI and individual metric scores generated from BMI data collected at 13 bioassessment sites sampled by SCVURPPP in WY 2021.

	Bioassessment Site												
	AC002	**AC004**	**CC001**	**CC003**	**GC003**	**GC004**	**GC006**	**LG002**	**LG003**	**LG004**	**SC002**	**SC004**	**SC006**
SoCal IBI Score	**29**	**29**	**30**	**31**	**41**	**56**	**49**	**20**	**20**	**21**	**31**	**19**	**29**
BMI Metric Values (metrics in bold used for SoCal IBI)													
Richness													
Taxonomic	36	29	29	24	23	38	40	19	23	28	24	21	20
EPT	10	9	10	7	6	16	13	5	6	7	5	1	4
Ephemeroptera	3	2	4	3	3	7	5	2	1	1	3	1	1
Plecoptera	0	2	0	0	0	2	1	0	0	0	0	0	1
Trichoptera	7	5	6	4	3	7	7	3	5	6	2	0	2
Coleoptera	2	0	1	1	1	2	2	0	0	0	1	1	1
Predator	8	9	5	6	9	10	15	4	5	7	8	8	6
Diptera	6	10	8	6	11	12	11	5	5	5	7	7	9
Composition													
EPT Index (%)	19	15	28	25	1.6	10	11	23	34	32	7.1	0.3	4.9
Sensitive EPT Index (%)	1.8	3.1	0.8	0.7	0.2	5.2	3.6	1.5	0.3	3.9	1.7	0.0	0.5
Shannon Diversity	2.63	1.96	2.03	2.03	1.78	2.22	2.30	2.29	2.12	2.53	2.03	1.91	1.70
Dominant Taxon (%)	25	50	44	36	36	40	28	32	28	26	37	37	45
Non-insect Taxa (%)	47	31	31	42	13	18	28	47	43	50	42	52	25
Tolerance													
Tolerance Value	5.5	5.7	5.5	5.4	5.8	5.4	5.6	5.3	5.2	5.0	5.7	6.3	5.6
Intolerant Organisms (%)	1.8	1.3	1.0	0.7	0.3	5.4	3.4	0.3	0.0	0.0	1.7	0.0	0.5
Intolerant Taxa (%)	11	10	14	8.3	8.7	21	13	5.3	0.0	0.0	8.3	0.0	5.0
Tolerant Organisms (%)	18	5.7	5.9	23	13	3.6	6.4	19	5.4	11	14	31	1.3
Tolerant Taxa (%)	39	31	17	25	17	13	23	21	22	36	29	43	20
Functional Feeding Groups													
Collector-Gatherers (%)	65	82	31	30	89	78	84	38	43	28	73	68	91
Collector-Filterers (%)	12	6.1	62	45	1.6	8.8	3.1	41	42	45	2.2	3.9	6.3
Collectors (%)	77	89	93	75	90	87	87	79	85	73	75	72	97
Scrapers (%)	13	3.1	4.3	19	1.9	5.4	1.5	9.0	2.5	1.8	20	25	0.0
Predators (%)	6.9	5.4	1.6	2.0	7.7	6.4	8.7	6.6	4.8	9.6	2.6	3.1	2.0
Shredders (%)	0.2	0.2	0.0	0.2	0.0	1.0	2.1	0.0	0.0	0.0	0.9	0.0	0.5
Other (%)	2.9	2.8	1.2	3.0	0.2	0.3	0.3	4.9	7.4	15	1.4	0.0	0.5

Fish growth and food availability

Juvenile steelhead trout condition data, calculated as mean relative weight (W_r), were reported by Valley Water for each creek where these fish were observed (i.e., weights measured for steelhead captured across all sites within each creek). Methods for calculating W_r are described by SCVWD (2021a). The total number of fish, mean relative weight, standard deviation, and the range of relative weights for fish captured in each creek during 2020 are presented in Table 2.11. Higher relative condition represents larger, heathier fish.

Table 2.11. Relative condition for juvenile steelhead trout captured in four creeks in WY 2020 (SCVWD 2021a).

Creek	Total Number of Juvenile Steelhead	Mean Relative Weight (W_r) (%) ± Standard Deviation	W_r Range (%)
Alamitos Creek	21	107.7 ± 17.8	83.5 – 150.3
Calero Creek	34	107.2 ± 11.8	84.1 – 153.3
Guadalupe Creek	13	100 ± 11.1	82.2 – 120.1
Stevens Creek	47	110.8 ± 10.2	91.6 – 133.4

Juvenile steelhead trout condition results suggest that food resources are not limiting growth. Fish condition in terms of body size were relatively consistent across all four creeks, with mean relative weights ranging between 100 and 110%. The mean relative weights for all creeks were within the range considered optimal for juvenile steelhead trout (SCVWD 2021a).

Drift sampling and analysis of stomach contents are typically the methods used to evaluate what fish are eating. Juvenile steelhead trout can feed on a wide range of organisms but have preference for aquatic insects in the Ephemeroptera (mayflies) and Plecoptera (stonefly) families (E+P) (Pert 1993). Juvenile steelhead trout may also switch preferences depending on flow conditions, feeding on oligochaetes (worms) during high flows and miscellaneous terrestrials during low flow conditions. Pert (1993) also found that steelhead tended to avoid Trichoptera larvae (caddisfly).

The overall abundance of BMI individuals in a sample and the relative abundance, depicted as an overall percentage of organisms within each sample, for selected taxa that may be potential food for juvenile steelhead are shown in Table 2.12 for the 10 bioassessment sites (Note: Los Gatos Creek sites were excluded since there were no steelhead trout at those sites). Additional taxa that were relatively abundant in samples and predict poor conditions are also presented in Table 2.12. Chironomids, which are short-lived taxa that can rapidly colonize disturbed habitat, and New Zealand Mud Snail (*Potamopyrgus antipodarum*), a highly invasive exotic species, are included.

Table 2.12. Overall abundance of BMI samples and percent organisms for selected aquatic and terrestrial insects that that may be preferred food items for juvenile steelhead. Additional taxa that may not be preferred food items, but may indicate potential conditions non-favorable to steelhead trout are also shown.

Creek	Site	Estimated Abundance (BMIs/m2)	Priority Taxa for Feeding (% total individuals)			Other Taxa (% total individuals)	
			Ephemeroptera + Plecoptera (Mayflies/Stoneflies)	Oligochaeta (Worms)	Americorophium (Amphipod)	Chironomidae (non-biting midges)	New Zealand Mud Snail
Alamitos	AC002	10,176	4	25	1	28	3
Alamitos	AC004	3,820	10	1	0	70	--
Arroyo Calero	CC001	2,851	16	4	7	8	3
Arroyo Calero	CC003	9,440	16	2	36	6	19
Guadalupe	GC003	17,150	1	5	0	76	--
Guadalupe	GC004	19,194	5	6	0	66	--
Guadalupe	GC006	19,162	9	6	0	69	--
Stevens	SC002	15,123	5	18	0	49	11
Stevens	SC004	12,817	0	10	0	49	24
Stevens	SC006	7,503	4	10	0	74	--

The highest overall BMI abundance was observed in samples collected at sites in Guadalupe Creek (Table 2.12). Precent individuals of Ephemeroptera and Plecoptera taxa (EP Taxa), highly preferred by juvenile steelhead (Pert 1993), were highest (16%) at sites in Arroyo Calero Creek. Worms were most abundant at the lower elevation site in Alamitos Creek and all three sites in Stevens Creek. Amphipods, another potential food species for steelhead, were only observed at sites in Arroyo Calero. In contrast, chironomids were by far the most abundant taxa across all sites, except for sites in Arroyo Calero. New Zealand Mud Snails were relatively abundant in the two lower elevation sites in Stevens and the upper site in Arroyo Calero.

Zooplankton drift (too small to capture in nets used for BMI sampling) originating from upstream reservoirs may also be an important food source for steelhead in these creeks.

Additional studies are needed to determine what BMI taxa juvenile steelhead are eating across the sites. However, the data suggest that steelhead are likely feeding on what is available, which is variable across sites and dependent on flow conditions.

2.3.3 Temporal Variability in Biological Condition

Resampling of sites can show changes in biological condition over time as a result of land use or riparian habitat changes. Resampling could also show how BMI and benthic algae communities respond to extreme climate conditions, such as those that occurred in WY 2021. Annual precipitation was at a record low during WY 2021, the driest year in 30 years at some long-term precipitation gauges. Precipitation in WY 2020 was also well below average, resulting in two consecutive dry years (see Section 1.5.4 and Figure 1.4). As a result, reservoir levels and releases, ground water levels, and surface water flows were extremely low during the bioassessment index period of WY 2021.

Table 2.13 lists the 13 bioassessment sites monitored in WY 2021 that had previously been monitored by SCVURPPP. These 13 sites were used to evaluate temporal variability in biological condition (CSCI scores).

Table 2.13. Comparison of CSCI scores for bioassessment data collected for two different sampling events at 13 targeted bioassessment sites. Sites with an increase of > 0.15 are shown in bold.

Fish Survey Code	RMC Station Code	Creek	Year Sampled	CSCI Score		Score Difference
				Pre-2021	2021	
AC002	205R02650	Alamitos Creek	2016	0.73	0.72	-0.01
CC001	205R01434	Arroyo Calero	2014	0.75	0.7	-0.05
GC003	205R04638	Guadalupe Creek	2019	**0.97**	0.64	**-0.33**
LG002	205R01539	Los Gatos Creek	2014	0.58	0.65	0.07
	205R01930	Los Gatos Creek	2015	0.34	**0.58**	**0.24**
LG003	205R03331	Los Gatos Creek	2017	0.59	0.6	0.01
	205R03530	Los Gatos Creek	2017	0.56	0.58	0.02
LG004	205GUA060	Los Gatos Creek	2019	0.57	0.63	0.06
	205R00170	Saratoga Creek	2013	1.03	1.07	0.04
	205R01706	Saratoga Creek	2015	0.72	0.79	0.07
	205R02474	Saratoga Creek	2016	**0.82**	0.6	**-0.22**
	205R03562	Saratoga Creek	2018	**1.08**	0.78	**-0.30**
SC006	205R01187	Stevens Creek	2014	0.43	**0.59**	**0.16**
			2019	0.44		**0.15**

In general, CSCI scores were relatively consistent across sampling events (Table 2.13). At eight of the 13 sites, minimal scoring differences (≤ 0.07 points) were observed. Larger differences in CSCI scores (> 0.15 points) were observed at the remaining five sites. CSCI scores dropped 0.2 – 0.3 points for the WY 2021 sample event at one site in Guadalupe Creek and two sites in Saratoga Creek. In contrast, CSCI scores increased 0.15 to 0.24 points for the WY 2021 sampling event at one site in Los Gatos Creek and one site in Stevens Creek. It is not clear if the larger differences in CSCI scores at these five sites is attributable to flow and climate conditions or impacts from other stressors.

Evaluating trends using bioassessment data may be challenging with small data sets over relatively short time periods (i.e., less than 10 years). Biological conditions can be influenced by many factors that change from year-to-year, including timing and magnitude of storm events during the sampling index period, variable antecedent conditions (e.g., precipitation, temperature), and changes in management actions (e.g., operations related to water releases from reservoirs or diversions). It is not clear, especially with such a small sample size, what factors, if any, might be associated with changes in biological conditions at these watersheds/sites.

3.0 CONTINUOUS WATER QUALITY MONITORING

3.1 Introduction

During WY 2021 water temperature and general water quality were monitored in compliance with Creek Status Monitoring Provisions C.8.d.iii – iv of the MRP. Monitoring was conducted at selected sites using a targeted design based on the directed principle[17] to address the following management questions:

1. *What is the spatial and temporal variability in water quality conditions during the spring and summer season?*
2. *Do general water quality measurements indicate potential impacts to aquatic life?*

The first management question is addressed primarily through evaluation of water quality results in the context of existing aquatic life uses. Temperature and general water quality data were evaluated for potential impacts to different life stages and overall population of fish community present within monitored reaches.

The second management question is addressed primarily through the evaluation of targeted data with respect to WQOs and thresholds from published literature. Sites where exceedances occur may indicate potential impacts to aquatic life or other beneficial uses and are added to the table of trigger exceedances that is maintained by the Program.

The sections below summarize methods and results from continuous temperature and water quality monitoring conducted in WY 2021. Conclusions and recommendations for continuous monitoring are presented in Section 7.0.

3.2 Methods

Continuous water quality and temperature data were collected in accordance with SWAMP-comparable methods and procedures described in the BASMAA RMC SOPs (BASMAA 2016) and associated QAPP (BASMAA 2020). Data were evaluated with respect to the MRP provision C.8.d “Follow-up” triggers for each parameter.

3.2.1 Continuous Temperature

Digital temperature loggers (Onset HOBO Water Temp Pro V2) were programmed to record data at 60-minute intervals. The loggers were deployed at targeted sites from April 5 through September 1, 2021. Procedures used for calibrating, deploying, programming, and downloading data are described in RMC SOP FS-5 (BASMAA 2016). SCVURPPP typically deploys temperature loggers at more than minimum number of sites in anticipation of field equipment being stolen or washed downstream.

3.2.2 Continuous General Water Quality

Water quality monitoring equipment recording DO, temperature, conductivity, and pH (Eureka Manta+35 water probes and/or YSI 6600 data sondes) were programmed to record data at 15-minute intervals. The sondes were deployed at targeted sites for two 1 to 2-week events: spring

[17] Directed Monitoring Design Principle: A deterministic approach in which points are selected deliberately based on knowledge of their attributes of interest as related to the environmental site being monitored. This principle is also known as "judgmental," "authoritative," "targeted," or "knowledge-based."

season (Event 1) and summer season (Event 2). Procedures for calibrating, deploying, programming, and downloading probes and sondes are described in RMC SOP FS-4 (BASMAA 2016).

3.2.3 Data Evaluation

Continuous temperature and water quality data generated during WY 2021 were analyzed and evaluated to identify potential stressors that may be contributing to degraded or impacted biological conditions, including exceedances of WQOs. Provision C.8.d of the MRP identifies trigger criteria as the principal means of evaluating the creek status monitoring data to identify sites where water quality impacts may have occurred. The relevant trigger criteria for continuous temperature and water quality data are listed in Table 3.1.

Table 3.1. Water Quality Objectives and thresholds used for trigger evaluation.

Monitoring Parameter	Objective/Trigger Threshold	Units	Source
Temperature	Two or more weekly average temperatures exceed the Maximum Weekly Average Temperature (MWAT) threshold of 17.0°C for a Steelhead stream, or when 20% of the results at one sampling station exceed the instantaneous maximum of 24°C.	°C	MRP provision C.8.d.iii. Sullivan et al. 2000
General Water Quality Parameters[1]	20% of results at each monitoring site exceed one or more established standard or threshold - applies individually to each parameter		
Conductivity	2000	µS/cm	MRP provision C.8.d.iii.
Dissolved Oxygen	WARM < 5.0, COLD < 7.0	mg/L	SF Bay Basin Plan Ch. 3, p. 3-4
pH	< 6.5, >8.5 [2]	pH	SF Bay Basin Plan Ch. 3, p. 3-4
Temperature	Same as Temperature (See Above)		

[1] Triggers are associated with continuous general water quality data.

[2] Special consideration will be used at sites where imported water is naturally causing higher pH in receiving waters.

3.3 Study Area

In compliance with the MRP, continuous temperature monitoring was conducted at a minimum of eight sites, and continuous general water quality monitoring at a minimum of three sites. In WY 2021, sites selected based on the presence of significant fish and wildlife resources as well as historical and/or recent indications of water quality concerns.

3.3.1 Temperature

Continuous (hourly) water temperature measurements were collected from April through September 2021, at the same nine locations[18] in the Upper Penitencia Creek watershed that were targeted in WY 2020. Six stations were located along Upper Penitencia Creek and three on Arroyo Aguague, an upper watershed tributary within Alum Rock Park (Figure 3.1). Monitoring sites within Alum Rock Park are perennial and support both rearing and spawning habitat for steelhead, as well as other native fishes (Stillwater Sciences 2006). Downstream of Alum Rock Park, the lower watershed is characterized by urban/residential development and unconfined geology conducive to infiltration. Flows in the lower reaches are seasonal and supplemented by releases of imported water from the Robert Gross Percolation Ponds which are operated by Valley Water and located about 0.5 mile downstream of the lowermost station (COY121).

[18] SCVURPPP typically monitors water temperature at more stations than the MRP required minimum of eight to mitigate for potential equipment loss.

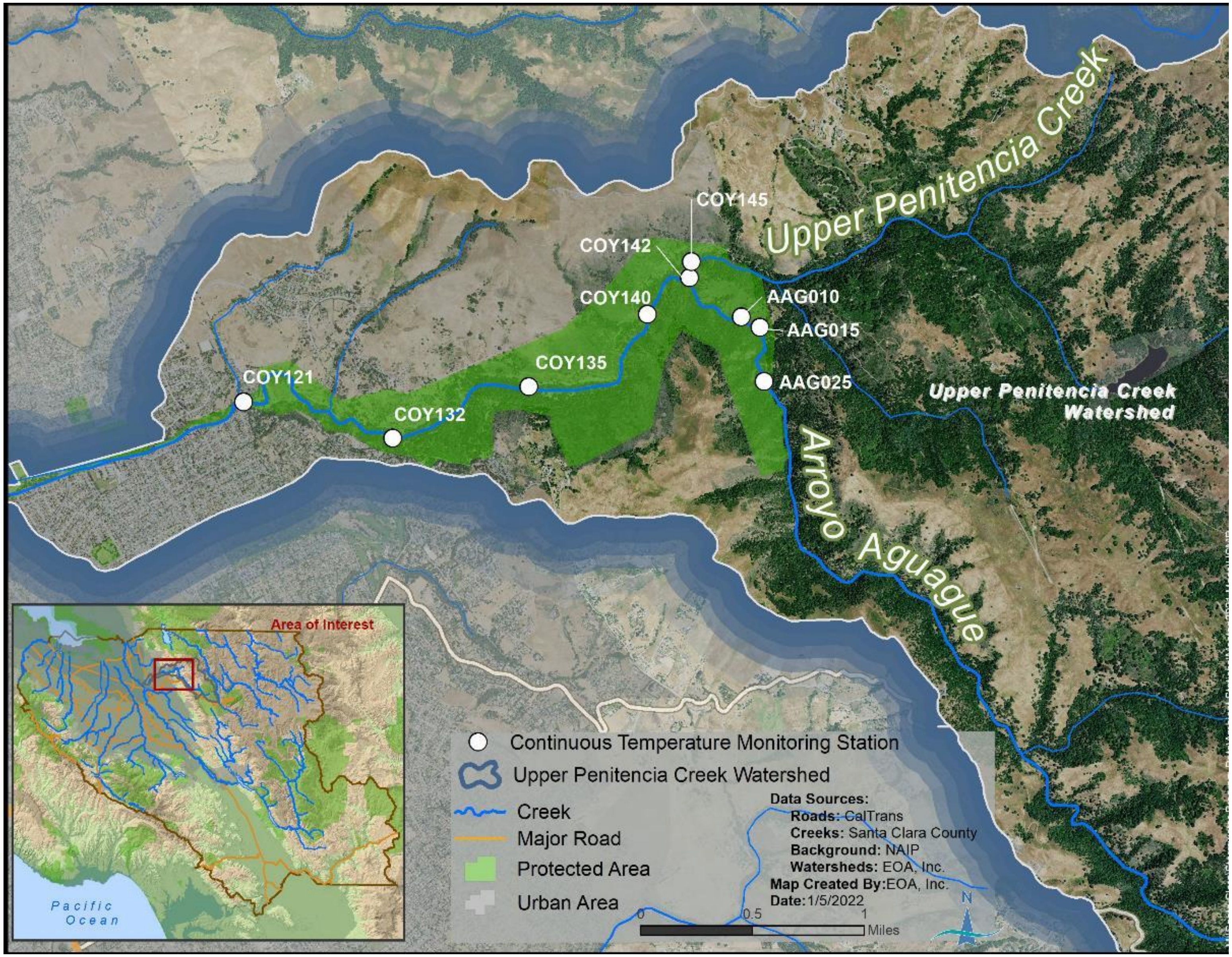

Figure 3.1. Continuous temperature stations in the Upper Penitencia Creek watershed, WY 2021.

3.3.2 General Water Quality

Continuous (15-minute) general water quality measurements (DO, specific conductance, pH, and temperature) were recorded at four locations on Los Gatos Creek (Figure 3.2). Los Gatos Creek was targeted for continuous water quality monitoring for three reasons: 1) it supports a cold-water fish community (i.e., chinook salmon and steelhead); 2) the Program has not conducted targeted monitoring (for continuous water quality) in Los Gatos Creek during the prior nine years of MRP compliance; and 3) Los Gatos Creek was recently added to the Clean Water Act (CWA) Section 303d list as impaired by elevated water temperature.

Los Gatos Creek is the largest tributary in the Guadalupe River watershed, draining an area of approximately 55 square miles. The creek originates from the Santa Cruz mountains and flows approximately 24 miles through Santa Clara Valley to the South San Francisco Bay. Although the valley floor is heavily urbanized, there is a narrow riparian corridor along the creek with a public trail that provides access for pedestrians and bikes. Stream flows are heavily managed, with two dams in the upper watershed (Lake Elsman, Lexington Reservoir) and one along the valley floor (e.g., Vasona Reservoir). In addition, there are several small check dams and diversions to off-channel percolation ponds, which are managed by Valley Water to recharge the groundwater aquifer.

In the SF Bay Basin Plan, Los Gatos Creek is identified as supporting the COLD beneficial use. Adult chinook salmon (*Oncorhynchus tshawytscha*) have been observed during winter months in recent years migrating upstream as far as Camden Ave, which is an impassible barrier for migratory fish. However, over the past three years no salmon or steelhead trout have been observed during fall fish surveys at the four sites in the lower reaches of Los Gatos Creek (SCVWD 2021a). The last reported occurrence of steelhead trout in Los Gatos Creek was in January and February 2014. Thus, it appears that there is no juvenile steelhead trout population in Los Gatos Creek in recent years. Although most of the fish observed in the lower reaches are non-native warm water species, it is likely that some sections of Los Gatos Creek (i.e., between Vasona Reservoir and the Camden Ave barrier) may support a cold-water fish community (e.g., non-migratory trout, sculpins) (Clayton Leal, Valley Water, personnel communication, Jan. 13, 2022).

There were two continuous general water quality monitoring events in WY 2021: late May (Event 1) and early July (Event 2). Monitoring was conducted at four sites during two sampling events. Site LG003 went dry prior to Event 2 and as a result the site was replaced with a new site (205R01930). The station numbers, date ranges, and locations for Events 1 and 2 are shown in Table 3.2.

Table 3.2. Date range for continuous general water quality during Events 1 and 2.

	LG003	LG004	205R01930	205R03530
Event 1	5/24/2021 to 6/7/2021	5/24/2021 to 6/7/2021	--	5/24/2021 to 6/7/2021
Event 2	--	7/8/2021 to 7/21/2021	7/8/2021 to 7/21/2021	7/8/2021 to 7/21/2021

All four continuous monitoring sites were also bioassessment sites in WY 2021. Bioassessment monitoring results are described in Section 2.0.

Figure 3.2. Continuous water quality stations in Los Gatos Creek, WY 2021.

3.4 Results and Discussion

This section describes the results from continuous temperature and water quality monitoring conducted during WY 2021. Conclusions and recommendations associated with the data presented in this section are presented in Section 7.0.

3.4.1 Continuous Temperature

Temperature loggers were deployed at nine sites in the Upper Penitencia Creek watershed on April 5, 2021 and removed on September 1, 2021 (22 weeks). A mid-deployment check on the loggers was conducted on June 21. During the mid-season check, the temperature logger at site COY142 was above the water surface due to dry channel conditions. That logger was moved 10 meters upstream where water was still present. The temperature logger at station COY140 was missing at the end of the season, resulting in only 12 weeks of data for that station collected during the mid-season check. The temperature logger at station AAG010 only recorded 16 weeks of data from April 5 through July 19 due to the creek drying up in that section about a month after the mid-season check.

Summary statistics for continuous water temperature data collected at the nine sites are listed in Table 3.3. The number and percent of measurements from each site that exceed the instantaneous maximum temperature trigger of 24°C are shown in that table. Instantaneous temperatures greater than 24°C periodically occurred at three of the nine sites (COY135, COY142 and AAG010); however, none of these sites exceeded the threshold for more than 20% of the data. As a result, the MRP trigger for instantaneous temperature was not exceeded at any of the stations monitored in WY 2021.

Weekly average temperature values were calculated for each of the nine monitoring sites (Table 3.4). Consistent with MRP requirements, the weekly average temperatures were calculated for non-overlapping, seven-day periods. The values were generally below the MRP Maximum Weekly Average Temperature (MWAT) trigger (17.0 °C) between April and middle of June across all the sites. Between June 14 and August 23, however, the MWAT trigger (i.e., 2 or more weeks above 17.0 °C) was exceeded at most sites, except for the upper elevation sites in both creeks (205COY145 and 205AAG025) and the site with the lost logger (205COY140). All sites exceeded the MWAT trigger for the week of August 9 (Table 3.4 and Figure 3.3). Weekly average temperature values decreased across all sites during the last two weeks of August. The MWAT trigger was exceeded at seven of the nine sampling locations; thus, those seven sites were added to the list of trigger exceedances that is maintained by the Program.

Water temperature data, calculated as a daily average, for monitoring sites in the Upper Penitencia watershed in WY 2021 are shown in Figure 3.4. Maximum daily air temperature data recorded at San Jose Airport are shown in Figure 3.5. Water temperatures gradually increased throughout the months of April through mid-August, followed by a small decline at the end of August before the temperature monitoring equipment was removed due to limited flow in the creek. Spikes in the daily average water temperatures observed in early-June and early-July correspond to spikes in maximum daily air temperature observed during the same time frame. Water temperatures were generally lower at the upstream sites (205COY145, 205AAG025) compared to the downstream locations for both mainstem Upper Penitencia Creek and the tributary Arroyo Aguague.

The same sites targeted for continuous temperature monitoring in WY 2021 were also targeted in WY 2020. Although the dates that the loggers were deployed were not exactly the same (April

30 to September 17 for WY 2020 vs. April 5 to September 1 for WY 2021), this approach allows for a comparison of summer season water temperatures between two different years. Across all sites in WY 2020, minimum temperatures ranged from 9.5 to 15.5°C, maximum temperatures ranged from 18.5 to 25.7°C, and average temperatures ranged from 16 to 19.6°C (SCVURPPP 2021). Comparatively, in WY 2021, minimum temperatures ranged from 7.6 to 10.4°C, maximum temperatures ranged from 17.7 to 25.3°C, and average temperatures ranged from 13.4 to 17.6°C (Table 3.3). Water temperatures had cooler minimums, maximums, and averages in WY 2021. Average water temperatures in WY 2021 were roughly 2°C cooler than in WY 2020.

Table 3.3. Descriptive statistics for continuous water temperature measured between April 5 and September 1, 2021 at nine sites in the Upper Penitencia Creek watershed, Santa Clara County.

		Upper Penitencia Creek (Downstream --------------------------- Upstream)						Arroyo Aguague (Downstream -------------------------Upstream)		
	Site ID	205COY121	205COY132	205COY135	205COY140	205COY142	205COY145	205AAG010	205AAG015	205AAG025
	Start Date	4/5/2021	4/5/2021	4/5/2021	4/5/2021	4/5/2021	4/5/2021	4/5/2021	4/5/2021	4/5/2021
	End Date	9/1/2021	9/1/2021	9/1/2021	6/21/2021	9/1/2021	9/1/2021	7/19/2021	9/1/2021	9/1/2021
Temperature (ºC)	Minimum	9.8	9.5	10.4	9.8	8.7	9.2	7.7	7.6	7.8
	Median	16.2	17.8	17.9	13.1	15.3	14.8	14.9	15.2	15.0
	Mean	15.9	17.2	17.6	13.4	15.0	14.2	15.6	14.7	14.3
	Maximum	22.7	23.7	25.0	19.3	25.3	18.3	24.9	23.1	17.7
	N (# individual measurements)	3575	3576	3576	1846	3517	3576	2532	3576	3575
# Measurements > 24°C		0	0	16	0	4	0	3	0	0
% Measurements > 24°C		0%	0%	0.4%	0%	0.1%	0%	0.1%	0%	0%

Table 3.4. Weekly average temperature values for water temperature data collected at nine stations in Upper Penitencia Creek watershed, WY 2021. Values that exceed the MWAT threshold (17°C) are indicated in bold.

	Upper Penitencia Creek (Downstream -- Upstream)						Arroyo Aguage (Downstream ---------------- Upstream)		
Station	**205COY121**	**205COY132**	**205COY135**	**205COY140[1]**	**205COY142**	**205COY145**	**205AAG010[2]**	**205AAG015**	**205AAG025**
Date	**Weekly Average Temperature (°C)**								
4/5/2021	12.7	12.7	12.8	11.6	10.5	10.3	10.2	10.1	9.9
4/12/2021	12.3	13.0	13.1	11.7	10.6	10.5	10.4	10.0	9.8
4/19/2021	13.0	13.8	14.0	12.2	11.1	10.9	11.6	11.1	10.8
4/26/2021	13.1	14.4	14.4	12.4	11.6	11.3	12.0	11.4	11.0
5/3/2021	14.0	16.0	16.1	13.4	12.8	12.2	13.5	13.0	12.4
5/10/2021	14.5	16.6	16.7	13.8	13.4	12.7	14.1	13.6	13.2
5/17/2021	13.2	14.9	15.1	12.9	12.2	12.5	12.9	11.7	12.5
5/24/2021	14.1	16.1	16.4	13.8	13.2	13.2	14.1	12.7	12.4
5/31/2021	15.9	**18.2**	**18.6**	15.3	15.3	14.1	**17.3**	15.1	14.1
6/7/2021	14.5	16.4	16.9	14.2	13.9	13.5	15.8	13.1	14.1
6/14/2021	**17.4**	**19.4**	**20.3**	16.4	16.6	14.9	**18.7**	16.0	14.6
6/21/2021	**18.0**	**19.4**	**20.0**	15.4	16.5	15.2	**20.6**	16.9	15.9
6/28/2021	**17.9**	**19.0**	**20.2**	--	**17.5**	15.6	**20.7**	**17.1**	16.4
7/5/2021	**17.7**	**19.0**	**20.4**	--	**17.4**	15.9	**20.7**	17.0	16.4
7/12/2021	**17.1**	**18.4**	**19.5**	--	**17.1**	15.9	**20.7**	16.6	16.4
7/19/2021	**18.0**	**19.1**	**19.6**	--	**18.2**	16.4	**21.6**	**17.2**	16.5
7/26/2021	**19.0**	**19.7**	**20.3**	--	**18.9**	17.0	--	**18.5**	**17.2**
8/2/2021	**18.5**	**18.8**	**19.0**	--	**17.3**	16.3	--	**17.1**	16.5
8/9/2021	**18.8**	**19.7**	**20.1**	--	**18.6**	**17.2**	--	**18.3**	**17.1**
8/16/2021	**17.8**	**18.7**	**19.1**	--	**17.3**	16.7	--	**17.2**	17.0
8/23/2021	16.8	**18.3**	**18.6**	--	17.0	16.3	--	16.1	16.3
8/30/2021	16.8	**18.2**	**18.1**	--	16.6	16.2	--	16.0	16.3
Total Weeks	22	22	22	12	22	22	16	22	22
Number Weeks >17°C	10	13	13	0	9	1	7	7	2
> MRP Trigger	**Y**	**Y**	**Y**	N	**Y**	N	**Y**	**Y**	**Y**

1. The temperature logger for 205COY140 went missing in the latter half of the monitoring season, so only twelve weeks of data were collected, from April 5 to June 21, 2021 (up to the mid-season check).
2. The creek location where the temperature logger for 205AAG010 was placed dried up about a month after the mid-season check; thus, only 16 weeks of data were collected at the site, from April 5 to July 19, 2021.

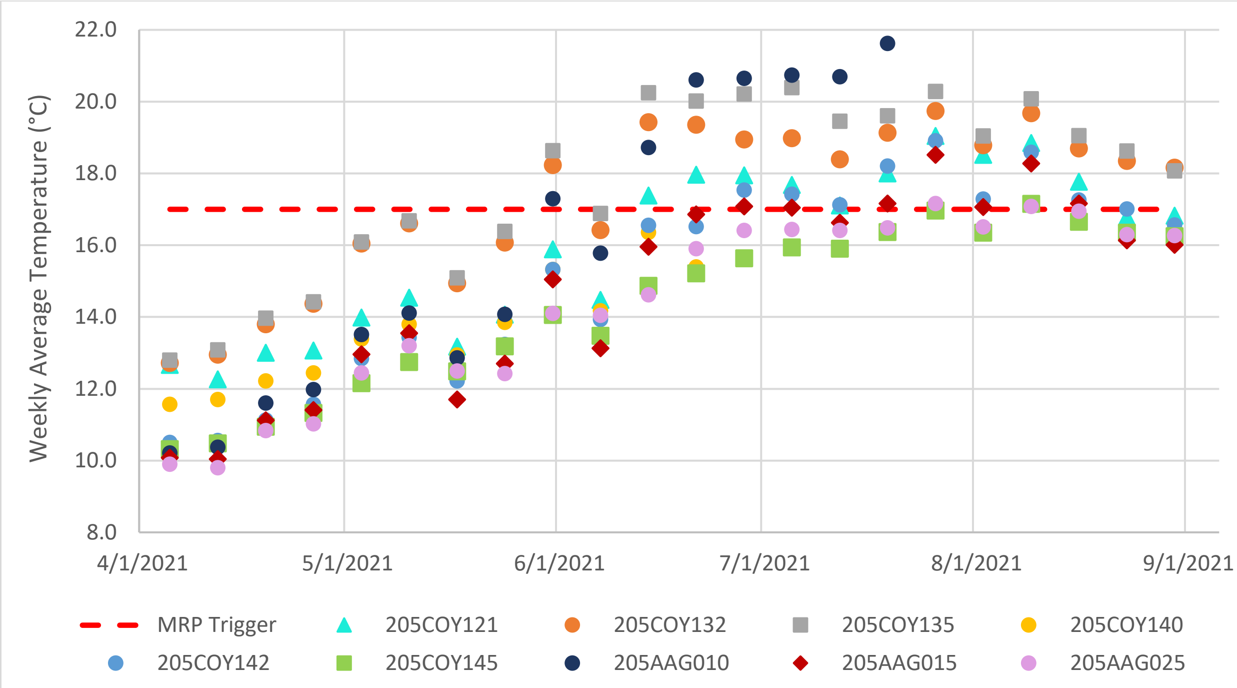

Figure 3.3. Weekly average temperature values calculated for water temperature collected at nine sites in the Upper Penitencia Creek watershed over 22 weeks of monitoring in WY 2021. The MWAT trigger threshold (17°C) is shown for comparison.

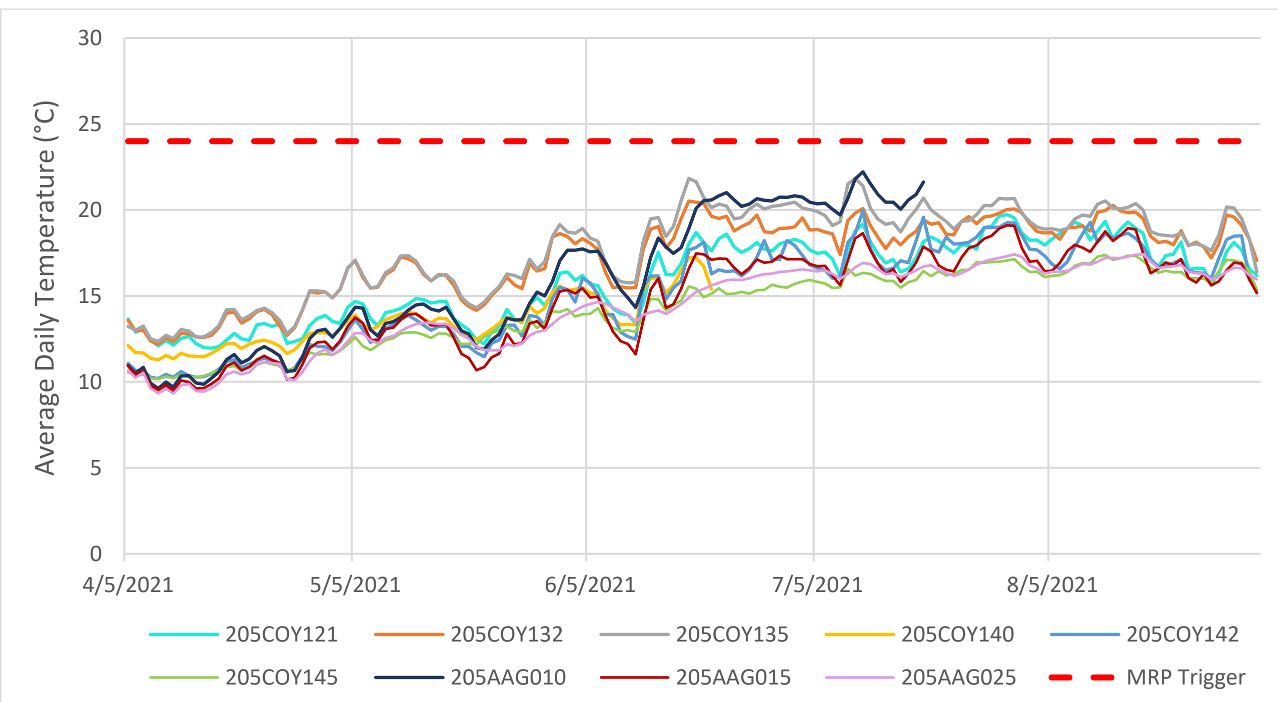

Figure 3.4. Water temperature, shown as daily average, collected between April and September at nine sites in the Upper Penitencia Creek watershed during WY 2021. The MRP trigger threshold (24°C) is shown for comparison.

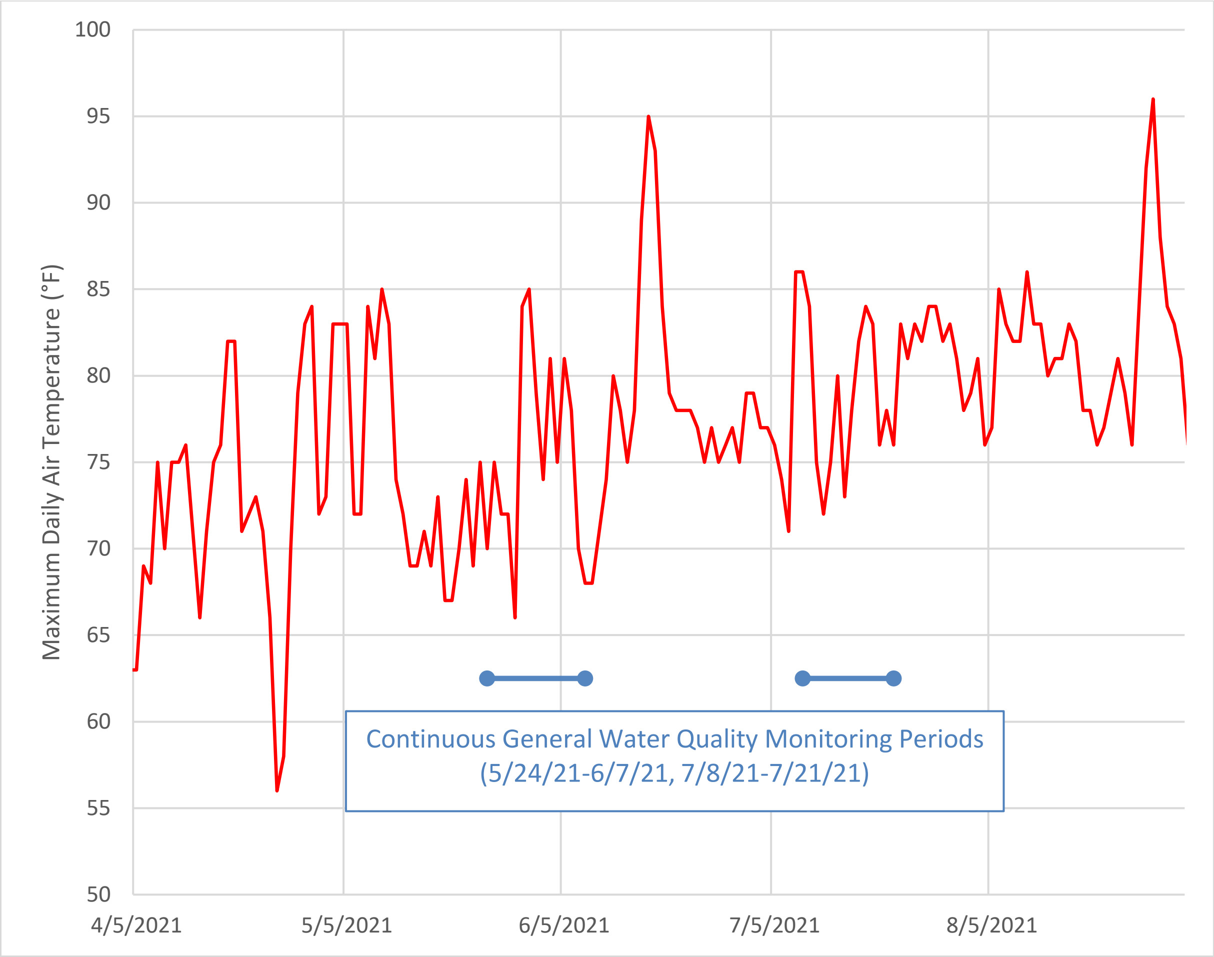

Figure 3.5. Maximum daily air temperatures at San José International Airport, April – September 2021 (NOAA station USW00023293).

3.4.2 General Water Quality

Summary statistics for continuous (15-minute) general water quality measurements (DO, pH, specific conductance, temperature) collected at the four sites in Los Gatos Creek during WY 2021 are listed in Table 3.5. Monitoring was conducted at three stations (LG003, LG004, 205R03530) between May 24 and June 7, 2021 (Event 1) and at three stations (LG004, 205R01930, 205R0350) between July 8 and July 21, 2021 (Event 2). Plots for all water quality parameters measured during both events are shown in Figures 3.6 and 3.7.

General water quality sampling locations are illustrated in Figure 3.2. Station 205R03530 is located on the south side of Lark Avenue in Los Gatos Creek just downstream of the dam for Vasona Reservoir. Station 205R01930 is located approximately one mile downstream of 205R03530, in the creek next to the ponds that are upstream of Los Gatos Creek County Park. Station LG004 is located by the Pruneyard Shopping Center just north of the Highway 17 overpass, approximately 2.5 miles downstream of 205R01930. Station LG003 is located in the section of Los Gatos Creek that runs between Stokes and Willow Street and is about 1.5 miles downstream of LG004. Photos of the four stations are included in Figure 3.8.

Table 3.5. Descriptive statistics for continuous water temperature, dissolved oxygen, pH, and specific conductance measured at four Los Gatos Creek sites in Santa Clara County during WY 2021. Data were collected every 15 minutes over two 2-week time periods during May/June (Event 1) and July (Event 2). Bold font indicates MRP trigger exceedance.

Parameter	Data Type	(Downstream -- Upstream)							
		LG003		LG004		205R01930		205R03530	
		Event 1	Event 2	Event 1	Event 2	Event 1	Event 2	Event 1	Event 2
	Assessment Date Range:	5/24-6/7	7/8-7/21	5/24-6/7	7/8-7/21	5/24-6/7	7/8-7/21	5/24-6/7	7/8-7/21
Temperature (°C)	Minimum	16.9	--	19.0	20.6	--	21.0	19.8	22.7
	Median	20.5	--	21.6	23.1	--	24.4	22.5	24.4
	Mean	20.7	--	21.7	23.4	--	24.3	22.4	24.6
	Maximum	24.6	--	25.2	27.5	--	27.3	25.6	27.4
	% > 24	1.9%	--	7.5%	**34.1%**	--	**59.1%**	16.1%	**64.3%**
Specific Conductivity (uS/cm)	Minimum	554	--	510	482	--	499	467	479
	Median	567	--	548	506	--	511	494	489
	Mean	566	--	550	512	--	512	495	491
	Maximum	578	--	566	545	--	535	502	516
	% > 2000	0%	--	0%	0%	--	0%	0%	0%
pH	Minimum	7.64	--	7.78	7.66	--	7.75	7.84	7.48
	Median	8.09	--	7.93	7.88	--	8.00	8.02	7.70
	Mean	8.10	--	7.95	7.94	--	8.00	8.03	7.70
	Maximum	8.39	--	8.21	8.40	--	8.38	8.30	7.92
	% < 6.5 or > 8.5	0%	--	0%	0%	--	0%	0%	0%
Dissolved Oxygen (mg/L)	Minimum	2.4	--	5.9	5.2	--	6.7	6.1	3.7
	Median	7.6	--	7.0	7.1	--	7.6	6.9	4.9
	Mean	7.6	--	7.3	7.5	--	7.8	7.1	5.1
	Maximum	9.8	--	9.6	10.5	--	9.6	8.4	6.5
	% < 7	**22.0%**	--	**50.8%**	**48.8%**	--	7.2%	**53.1%**	**100%**

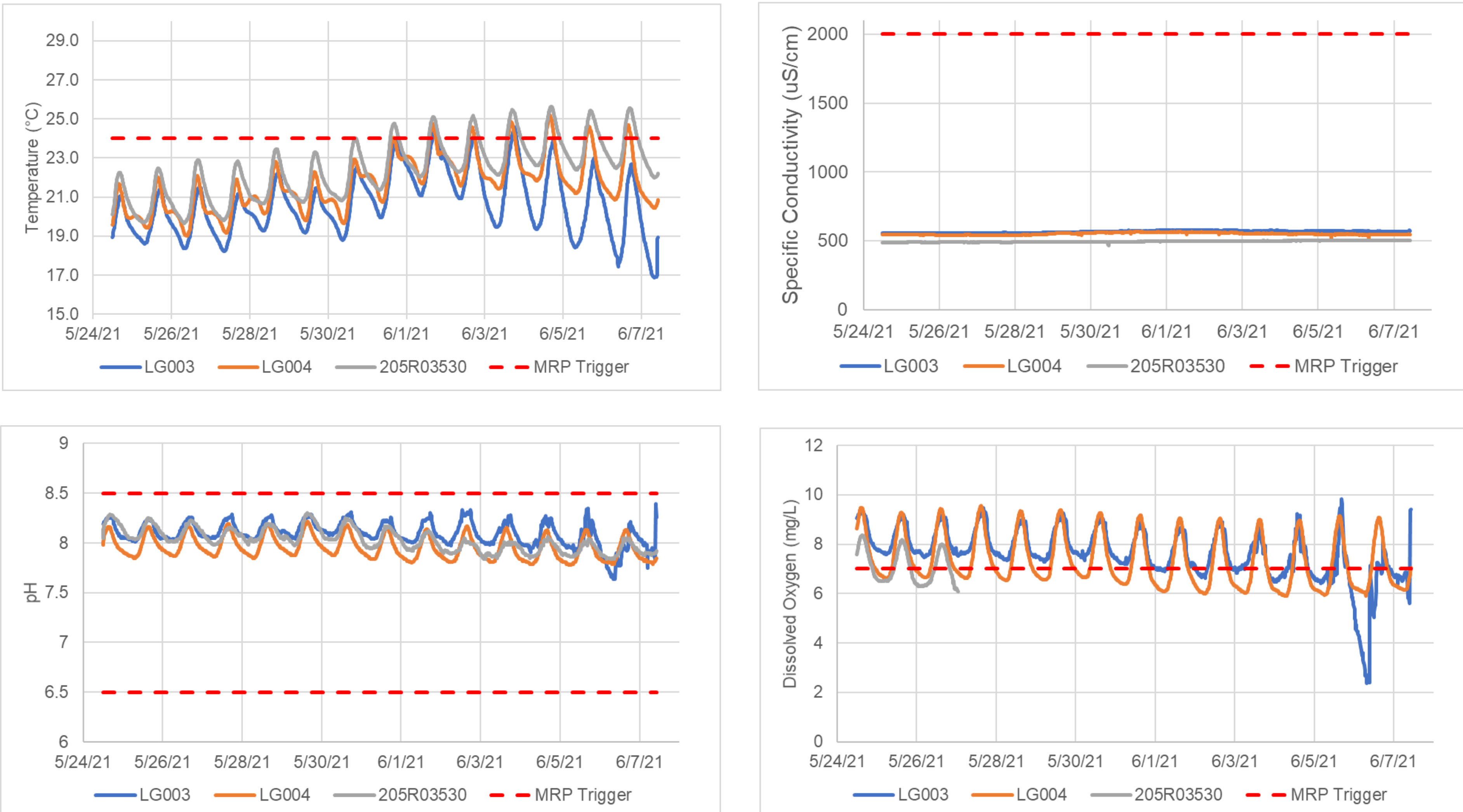

Figure 3.6. Continuous water quality data (temperature, specific conductance, pH, and dissolved oxygen) collected at three sites in Los Gatos Creek during Event 1 in late-May/early-June 2021.

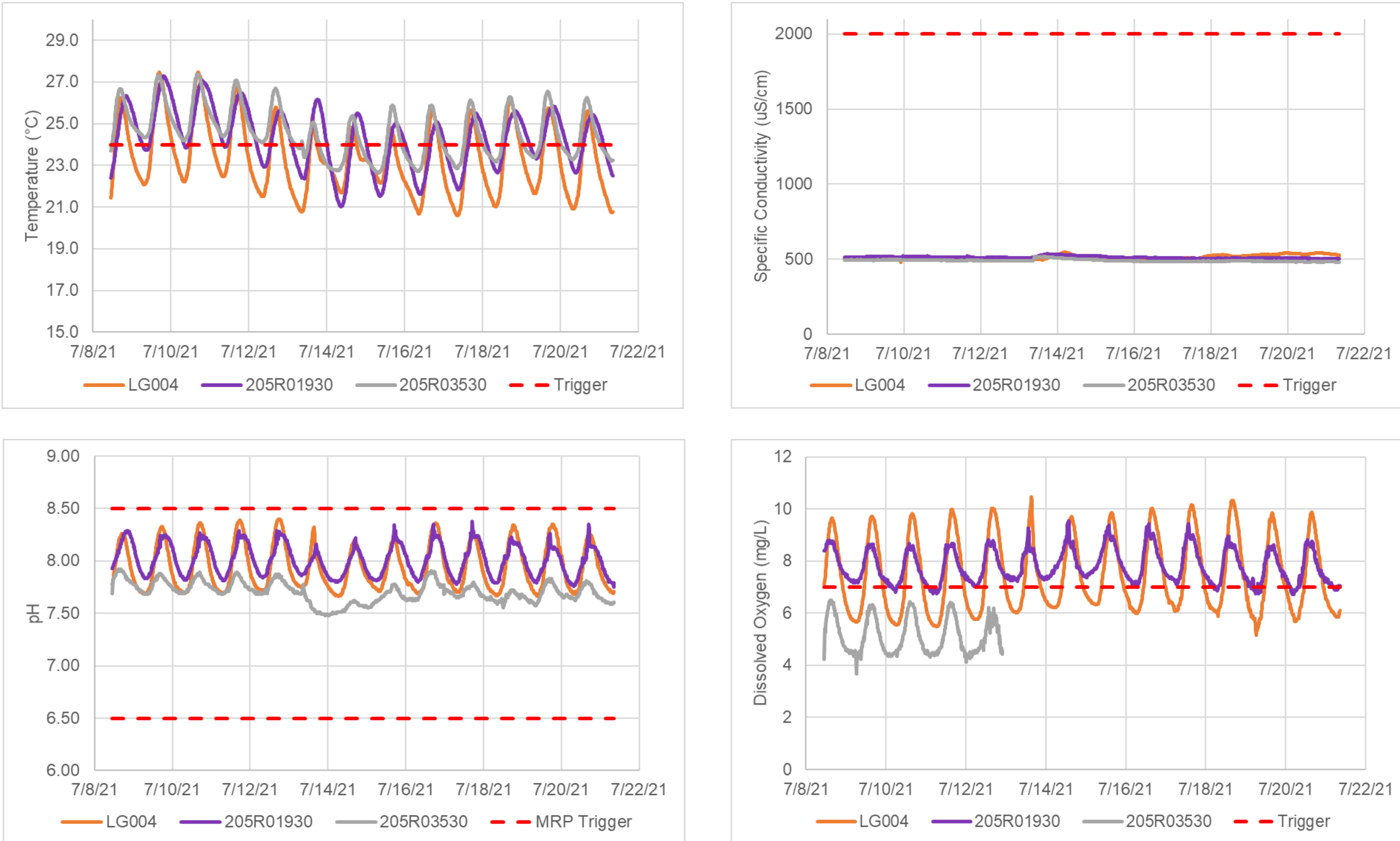

Figure 3.7. Continuous water quality data (temperature, specific conductance, pH, and dissolved oxygen) collected at three sites in Los Gatos Creek during Event Two in July 2021.

Figure 3.8. Los Gatos Creek at stations 205R03530, 205R01930, LG004, and LG003. Photos captured summer 2021.

Temperature

The water temperature data follow a similar pattern at all four sites during the two sample events (Figures 3.6 and 3.7). Cooler temperatures are recorded at night and warmer temperatures in the afternoon. Maximum water temperatures for both events appear to be associated with an increase in air temperatures, based on records from the San Jose International Airport station (Figure 3.5).

Water temperatures exceeded 24°C at all three sites during Event 1, but the exceedances did not comprise more than 20% of the results, which is the criteria for MPR trigger exceedance (Table 3.5). During Event 2, the 24°C instantaneous maximum was exceeded at all three sites. The MWAT threshold (17 °C) was exceeded at all four stations during all weeks of the two events. Even the minimum temperatures for all sites were above 17°C, with the exception of 16.9°C being the minimum for station LG003 during Event 1.

Specific Conductance

Specific conductance ranged between 467 to 578 µS/cm at all four sites during all sampling events, and thus, never exceeded the MRP trigger threshold (20% of data points above 2000 µS/cm). There was very little seasonality to the record with roughly the same levels measured during May/June compared to July. No distinct patterns were observed for any of the four stations during either event.

pH

Measured pH values ranged from a low of 7.48 at station 205R03530 during Event 2 to a high of 8.4, measured at station LG004 during Event 2 (Table 3.5). Overall, pH values were similar across all three stations during the three events; however, lower pH values and less diurnal variance were recorded at station 205R03530 during Event 2. The WQO for pH was not exceeded for either the upper limit of 8.5 or lower limit of 6.5 for any of the stations during either event.

Dissolved Oxygen

The DO concentrations ranged from a low of 2.4 mg/L at LG003 during Event 1 to a high of 10.5 mg/L at LG004 during Event 2. DO concentrations generally followed a diurnal pattern at all stations during both sample events with higher concentrations measured in the afternoon due to photosynthesis throughout the day and lower concentrations measured at night due to aquatic plant and animal respiration (Figure 3.6 and 3.7).

The lowest DO concentration occurred at site LG003 during Event 1, in which a sharp dip occurred near the end of the deployment. It is not clear if the dip was result of a sudden change in water quality or sensor malfunction. The second lowest DO measurement occurred at site 205R03530 during Event 2. The DO was consistently low at this station for the first five days of deployment, ranging between 3.4 to 6.5 mg. On July 13, the DO sensor malfunctioned, possibly due to fouling, and the data was rejected and not used in the analysis.

The lowest median concentration across all sites and sample events occurred at site 205R03530 (6.7 mg/L). This site is directly downstream of Lake Vasona, which is relatively shallow and warm, likely causing a drop in DO immediately downstream. Sites LG004 and

205R01930, had the highest median DO concentrations, ranging between 7.3 and 7.8 mg/L. These sites were moderately shaded, with mix of habitat types and deep pools (Figure 3.8).

The MRP trigger of at least 20% of results below the 7 mg/L WQO was exceeded at all stations during Event 1, and at LG004 and 205R03530 during Event 2 (Table 3.5).

<u>Continuous Water Quality Trigger Summary</u>

All stations exceeded the MRP triggers for MWAT and DO. All stations during Event 2 also exceeded the MRP Trigger for instantaneous temperature – over 20% of the results are over 24°C. These sites were added to the list of MRP trigger exceedances.

4.0 PATHOGEN INDICATORS

4.1 Introduction

This section describes the results of pathogen indicator monitoring that was conducted during WY 2021 in compliance with Creek Status Monitoring Provision C.8.d.v of the MRP. Monitoring sites were selected to address the following management question:

1. *What are the pathogen indicator concentrations at creek sites where there is potential for water contact recreation to occur?*

This management question is addressed primarily through the evaluation of data with respect to trigger thresholds identified in the MRP and statewide WQOs for freshwater that became effective on March 22, 2019. Sites where exceedances occur may indicate potential impacts to water contact recreation (REC-1) or other beneficial uses and are added to the list of sites with MRP trigger exceedances that is maintained by the Program.

The sections below summarize methods and results from pathogen indicator monitoring conducted in WY 2021. Conclusions and recommendations for this section are presented in Section 7.0.

4.2 Methods

4.2.1 Sample Collection

Pathogen indicator samples were collected during the dry season in accordance with SWAMP-comparable methods and procedures described in the BASMAA RMC SOPs (BASMAA 2016) and QAPP (BASMAA 2020). Sampling techniques for pathogen indicators (*E. coli* & enterococci) include direct filling of sterile containers and transfer of samples to the analytical laboratory within specified holding time requirements. Procedures for sampling and transporting samples are described in RMC SOP FS-2 (BASMAA 2020).

4.2.2 Data Evaluation

Pathogen indicator data were evaluated with respect to trigger thresholds identified in the MRP and statewide WQOs adopted by the State Water Board on August 7, 2018 and approved by the USEPA on March 22, 2019 (SWRCB 2019). Pathogen indicator trigger thresholds and WQOs are listed in Table 4.1.

The MRP triggers and the statewide WQOs are both based on the 2012 USEPA recommended recreational water quality criteria (RWQC). The 2012 RWQC offers two sets of numeric thresholds for *E. coli* and enterococci intended to protect water contact recreation where immersion and ingestion are likely. The two sets of criteria are based on estimated rates of gastrointestinal illness. The MRP specifies the illness rate of 36 per 1,000 recreators as a trigger threshold; whereas the State Water Board adopted the more conservative set of criteria based on the illness rate of 32 per 1,000 recreators.

The WQOs adopted by the State Water Board recognize *E. coli* as the sole indicator organism for freshwaters (i.e., salinity is equal to or less than 1 part per thousand (ppth) 95 percent or more of the time) and enterococci as the sole indicator for marine and brackish waters (i.e., salinity is greater than 1 ppth more than 5 percent of the time). The WQOs consist of both a geometric mean (GM) and a Statistical Threshold Value (STV). The GM criteria is applied when there are at least five samples distributed over a six-week period. The STV criteria should not be exceeded by more than 10 percent of the samples taken in a month, and therefore the STV approximates a single sample maximum. Because pathogen indicator samples collected in compliance with the MRP are not repeated, results are compared to the STV criteria. Also, in this evaluation, the Most Probable Number (MPN) of bacteria colonies given by the analytical method is compared directly with the Colony Forming Units (CFU) of the USEPA recommendations.

Table 4.1. Bacteriological trigger thresholds and water quality objectives for water contact recreation.

Pathogen Indicator	State Water Board WQO (Estimated Illness Rate 32/1,000) *		MRP Trigger Threshold (Estimated Illness Rate 36/1,000)	
	GM	STV	GM	STV
E. coli (cfu/100 mL)	100	320	125	410
Enterococci (cfu/100 mL)	30	110	35	130

* The State Water Board WQOs use *E. coli* as the indicator for freshwater and enterococci as the indicator for marine and brackish water.

4.3 Study Area

In compliance with Provision C.8.d.v of the MRP, five pathogen indicator samples were collected in WY 2021. Samples were collected during one sampling event (July 1, 2021) at five sites located in municipal parks with public access to creeks and thus potential for recreational water contact (Figure 4.1). Three sites were located on Los Gatos Creek, at Novitiate Park (205LGA420), Vasona Park (205LGA400) and at Creekside Way (205LGA060). Two sites were located on Stevens Creek, at Blackberry Farm (205STE064) and McClellan Road (205STE065). Four of these stations have been monitored by the Program for pathogen indicators during previous years (WYs 2013-2020). Historical data are included with WY 2021 data in Table 4.2 for comparison. Repeat sampling can provide information (albeit limited) on the variability at each site.

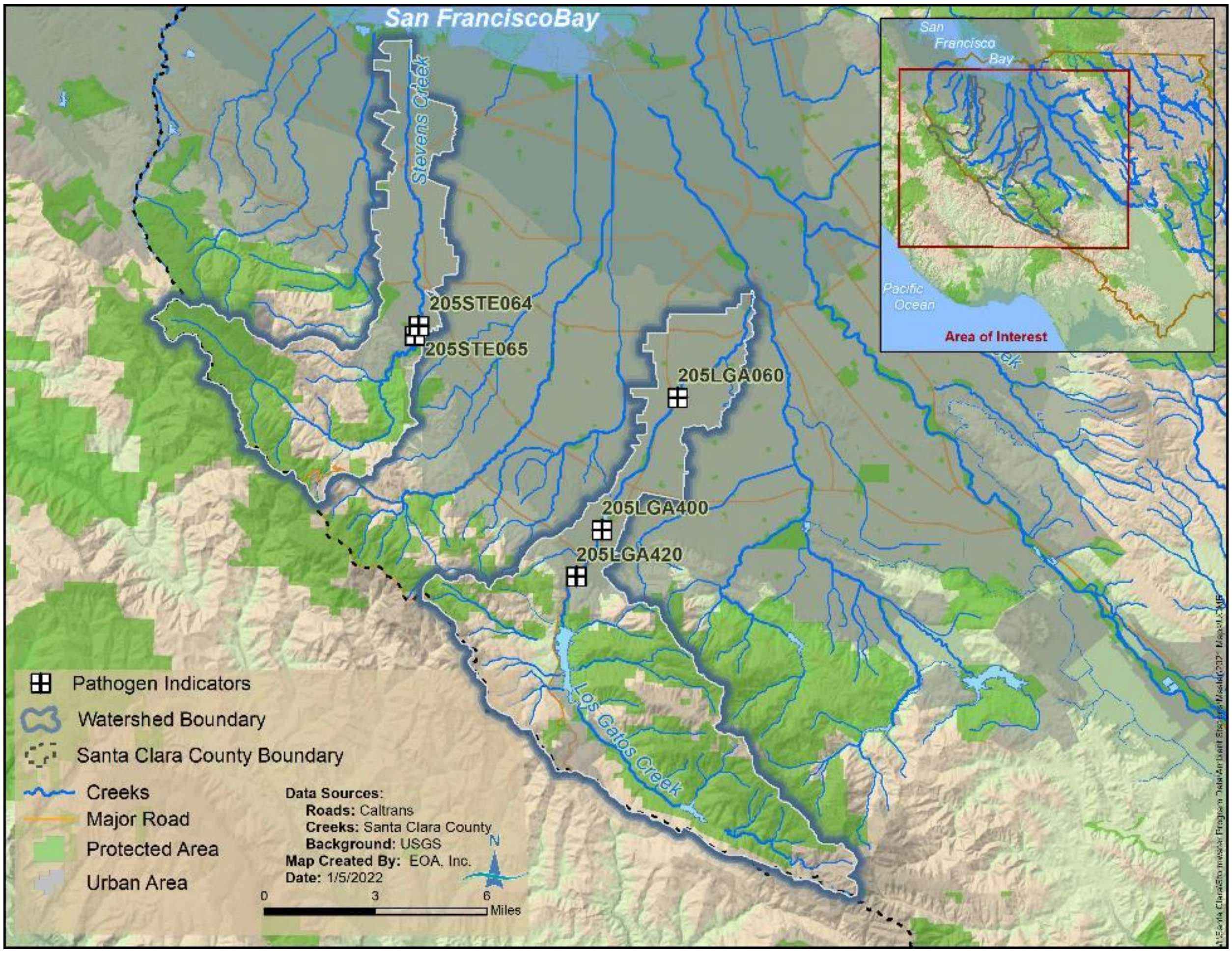

Figure 4.1. Pathogen indicator monitoring sites sampled in Santa Clara County in WY 2021.

4.4 Results and Discussion

Pathogen indicator (*E. coli* and enterococci) densities measured in grab samples collected on July 1, 2021 are listed in Table 4.2, along with historical data for those stations. Station locations are illustrated in Figure 4.1. No measurements exceeded the MRP trigger or the more conservative statewide WQO for *E. coli* in WY 2021. However, two samples were above the MRP trigger for enterococci (Stevens Creek at Blackberry Farm - 205STE064 and Los Gatos Creek at Vasona Park - 205LGA400).

Although the multi-year dataset in Table 4.2 is insufficient to identify trends, it does highlight the variability in microbial data in Santa Clara Valley creeks. For example, although enterococci densities at station 205LGA400 exceeded the MRP trigger in WY 2021 they were roughly half those concentrations in WY 2020.

Table 4.2. Enterococci and *E. coli* levels measured in Santa Clara County during WY 2021. Results exceeding the MRP trigger are highlighted. Results exceeding the more conservative WQO are bolded.

Site ID	Creek Name	Site Name	Enterococci (cfu/100ml) (MPN/100ml)[1]	*E. Coli* (cfu/100ml) (MPN/100ml)[1]	Sample Date
MRP Trigger Threshold (USEPA 2012; 36 per 1000 recreators)			130	410	
Statewide WQO (based on 32 per 1000 recreators)			110[2]	320	
205LGA420	Los Gatos Creek	Los Gatos Creek at Novitiate Park	62	33.2	07/01/2021
			5.2	22.6	07/17/2020
			7.4	27.2	08/01/2019
205LGA400	Los Gatos Creek	Los Gatos Creek at Vasona Park	249	130	07/01/2021
			120	60.5	07/17/2020
			17.1	**326**	08/01/2019
			88.6	138	07/27/2018
			28.5	54.6	07/27/2017
			NR	240	07/22/2013
205LGA060	Los Gatos Creek	Los Gatos Creek at Creekside Way	100	52.9	07/01/2021
205STE065	Stevens Creek	Stevens Creek at McClellan Road	71.2	132	07/01/2021
			NR	80	06/30/2015
				230	07/08/2014
205STE064	Stevens Creek	Stevens Creek at Blackberry Farm	517	261	07/01/2021
			411	276	07/27/2018
			345	69.7	07/27/2017
			NR	170	06/30/2015
				1100	07/22/2013

NR = not reported

[1] USEPA 2012 water quality criteria are given in cfu/100 mL; whereas, the analytical method used by the Program gives results in MPN/100 mL. These units are used interchangeably in this analysis.

[2] Statewide WQOs for enterococci do not apply to freshwaters.

It is important to recognize that "most strains of *E. coli* and enterococci do not cause human illness (that is, they are not human pathogens); rather, they indicate the presence of fecal contamination" because they often co-occur with pathogens (USEPA 2012). Thus, pathogen indicators do not directly represent actual pathogen concentrations, nor do they distinguish among sources of bacteria. Testing water samples for specific pathogens is generally not practical for several reasons (e.g., concentrations of pathogens from fecal contamination may be small and difficult to detect but still of concern, laboratory analysis is often difficult and expensive, the number of possible pathogens to potentially test for is large). Therefore, the presence of pathogens is inferred by testing for "pathogen indicator" organisms. The USEPA recommends using *E. coli* and enterococci as indicators of fecal contamination based on historical and recent epidemiological studies (USEPA 2012). However, the USEPA pathogen indicator thresholds were derived based on human recreation at beaches receiving bacteriological contamination from human wastewater and may not be applicable to conditions in urban creeks which do not receive wastewater treatment plant discharges. Furthermore, although animal fecal waste contributes to the pathogen indicator load, it is much less likely to contain pathogens of concern to human health than human sources. In most cases, it is the human sources that are associated with REC-1 health risks rather than wildlife or domestic animal sources (USEPA 2012). As a result, the comparison of pathogen indicator results to pathogen indicator thresholds may not be appropriate and should be interpreted cautiously.

5.0 CHLORINE MONITORING

5.1 Introduction

Chlorine is added to potable water supplies and wastewater to kill microorganisms that cause waterborne diseases in humans. However, chlorine can be toxic to aquatic species if left unmanaged. Chlorinated water may be inadvertently discharged to municipal separate storm sewer systems (MS4s) and/or urban creeks from residential activities such as pool dewatering and over-watering landscaping, or from municipal activities such as hydrant flushing and water main breaks.

In compliance with Provision C.8.d.ii of the MRP and to assess whether chlorine in receiving waters is present at concentrations potentially toxic to aquatic life, SCVURPPP field staff measured the concentration of free chlorine and total chlorine residual in creeks where bioassessments were conducted. Total chlorine residual is comprised of "combined" chlorine and free chlorine. Combined chlorine is the chlorine that has reacted with ammonia or organic nitrogen to form chloramines, while free chlorine is the chlorine that remains unbound. Both can be toxic to aquatic life, but chlorine dissipates into the atmosphere more quickly than chloramine.

5.2 Methods

In accordance with the BASMAA RMC Creek Status and Long-Term Trends Monitoring Plan (BASMAA 2012), WY2021 field testing for free chlorine and total chlorine residual was conducted at all twenty bioassessment sites concurrent with spring bioassessment sampling (April and May). Bioassessment site selection is described in Section 2.0.

Field testing for free chlorine and total chlorine residual conformed to methods and procedures described in the BASMAA RMC SOPs (BASMAA 2016). Per SOP FS-3 (BASMAA 2016), water samples were collected and analyzed for free chlorine and total chlorine residual using a Hach Pocket ColorimeterTM II and DPD Powder Pillows, which has a manufacturer reported method detection limit (MDL) of 0.02 mg/L. If concentrations exceeded the MRP trigger criteria of 0.1 mg/L, the site was immediately resampled. If the second sample also exceeded the trigger, the site is added to the list of sites with trigger exceedances that is maintained by the Program. Provision C.8.d.ii(4) of the MRP also specifies that, for sites with trigger exceedances, "Permittees report the observation to the appropriate Permittee central contact point for illicit discharges so that the illicit discharge staff can investigate and abate the associated discharge in accordance with its Provision C.5.e – Spill and Dumping Complaint Response Program."

5.3 Results and Discussion

In WY 2021, SCVURPPP monitored the twenty bioassessment sties in the spring for free chlorine and total chlorine residual. These measurements were compared to the MRP trigger threshold of 0.1 mg/L. Results are listed in Table 5.1 and mapped in Figure 5.1.

The trigger thresholds for free chlorine and total chlorine residual were exceeded at one station in unincorporated Santa Clara County (i.e., AC004 on Alamitos Creek). County of Santa Clara (County) staff were notified immediately about the results. County staff conducted a site visit that afternoon to look for signs of illicit discharges along Alamitos Creek; however, none were observed. County staff followed up by sending letters to seven addresses upstream of the sampling location. The letters reminded residents of the potential harm that chlorine poses to fish and aquatic life and possible sources of chlorine in receiving waters. Two informational brochures were included with the letters, “Draining Swimming Pools and Spas” and “You are the Solution to Pollution.” One resident responded to the letter, notifying the County about recent a fire hydrant leak (subsequently repaired) that may have been the cause of the high chlorine measurement.

For unknown reasons, the free chlorine result was greater than the total residual chlorine result at six stations (Table 5.1). Inverted results such as these have been occasionally noted through the WY 2012 – WY 2021 monitoring program (SCVURPPP 2021). Potential causes for these inverted results include matrix interferences, colorimeter user error, and concentrations near the detection limit. According to Hach, the colorimeter and reagent supplier, the free chlorine could have false positive results due to a pH exceedance of 7.6 and/or an alkalinity exceedance of 250 mg/L. The pH was measured concurrently with the chlorine sample and was above 7.6 at most sites including many without inverted results (Table 5.1), but alkalinity was not measured and may have played a role in the inverted results. The field crew is well-trained and aware of potential problems with this testing method, such as wait times between adding reagents and taking the readings and keeping the free chlorine and total residual chlorine samples separate. In addition, it should be noted that colorimetric field instruments are generally not considered capable of providing accurate measurements of free chlorine and total chlorine residual below 0.13 mg/L, regardless of the MDL provided by the manufacturer. For this reason, the Statewide General Permit for drinking Water Discharges (Order WQ 2014-0194-DWQ) uses 0.1mg/L as a reporting limit for field measurements of total chlorine residual.

Table 5.1. Chlorine testing results compared to MRP trigger of 0.1 mg/L, WY 2021. Results exceeding the MRP trigger are bold.

Site ID	Creek	Date	Free Chlorine (mg/L) [1,2,3]	Total Chlorine Residual (mg/L) [1,2,3]	pH
205R00170	Saratoga Creek	5/6/2021	0.03	0.04	8.2
205R01706	Saratoga Creek	5/3/2021	0.03	0.04	7.8
205R01930	Los Gatos Creek	5/11/2021	0.08	0.07	7.6
205R02474	Saratoga Creek	5/10/2021	0.03	0.08	7.5
205R03530	Los Gatos Creek	5/11/2021	0.09	0.09	7.9
205R03562	Saratoga Creek	5/10/2021	0.06	0.04	7.6
205STE095	Stevens Creek	5/25/2021	< 0.02	< 0.02	8.7
AC002	Alamitos Creek	5/4/2021	0.02	< 0.02	7.8
AC004	Alamitos Creek	5/4/2021	**0.24 / 0.18**	**0.20 / 0.18**	7.7 / 7.3
CC001	Arroyo Calero	5/5/2021	0.04	0.02	8.0
CC003	Arroyo Calero	5/5/2021	< 0.02	0.04	7.6
GC003	Guadalupe Creek	4/29/2021	< 0.02	0.02	8.0
GC004	Guadalupe Creek	4/28/2021	< 0.02	< 0.02	8.0
GC006	Guadalupe Creek	4/28/2021	0.05	0.05	7.9
LG002	Los Gatos Creek	5/13/2021	< 0.02	< 0.02	8.0
LG003	Los Gatos Creek	5/12/2021	0.03	<0.02	7.6
LG004	Los Gatos Creek	5/12/2021	0.05	0.02	7.5
SC002	Stevens Creek	4/27/2021	0.02	0.05	7.9
SC004	Stevens Creek	4/26/2021	< 0.02	< 0.02	7.5
SC006	Stevens Creek	5/25/2021	0.04	0.04	8.1

[1] The method detection limit is 0.02 mg/L; however, the Statewide General Permit for Drinking Water Discharges (Order WQ 2014-0194-DWQ) uses 0.1 mg/L as a reporting limit (minimum level) for field measurements of total chlorine residual.

[2] The MRP trigger threshold of 0.1 mg/L applies to both free chlorine and total chlorine residual measurements.

[3] The trigger threshold was exceeded at station AC004. The table shows the initial measurement and the immediate resample.

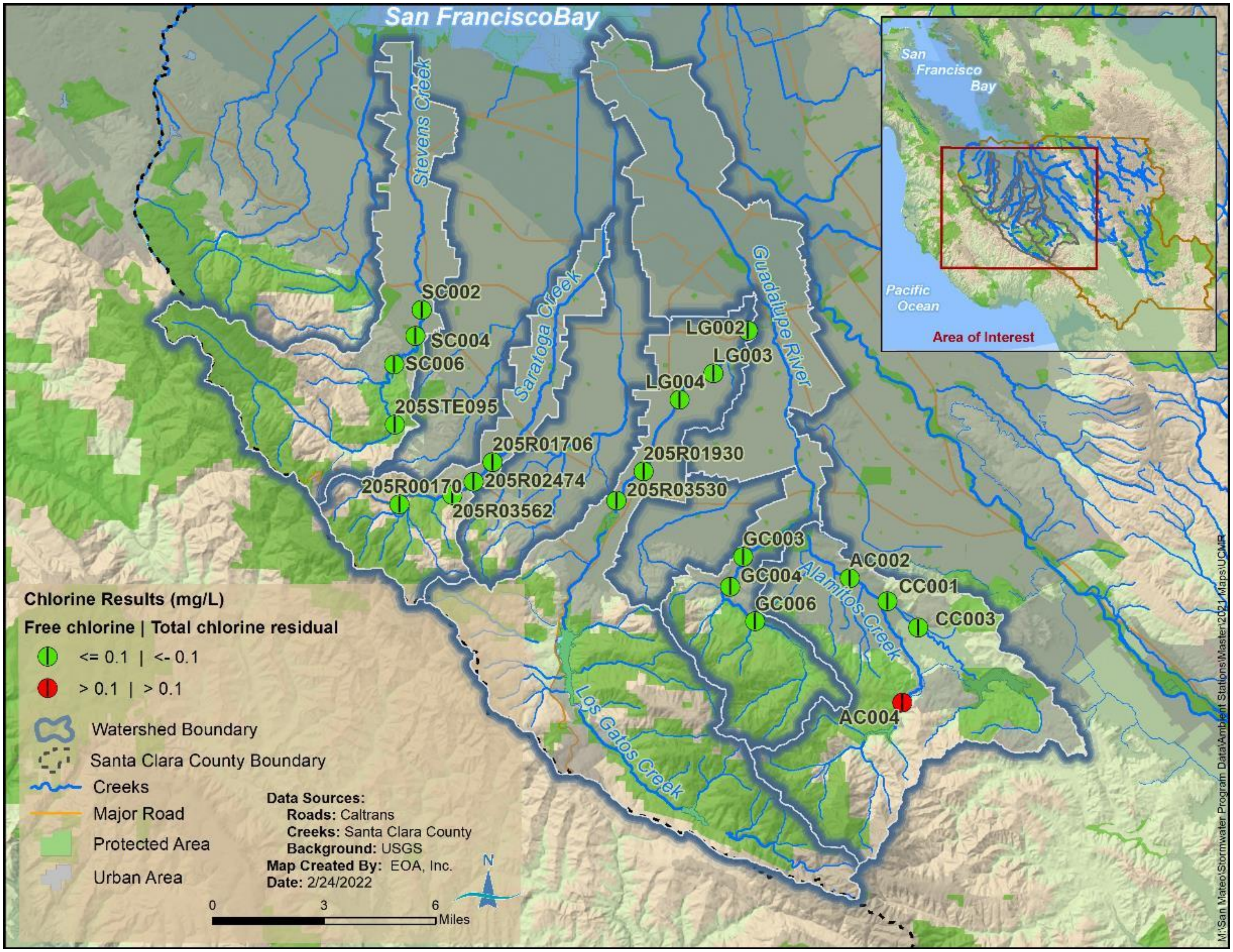

Figure 5.1 Chlorine sample stations and results in Santa Clara County, WY 2021.

6.0 TOXICITY AND SEDIMENT CHEMISTRY MONITORING

6.1 Introduction

This section describes the results of toxicity testing and sediment chemistry monitoring (collectively referred to as pesticides and toxicity monitoring) conducted during WY 2021 in compliance with Provision C.8.g of the MRP. The following discussion includes historical data from the WY 2021 stations as well as local pesticides and toxicity monitoring results from projects external to SCVURPPP to inform management efforts for Santa Clara Basin urban creeks with respect to achievement of WQOs and support of beneficial uses.

Toxicity testing provides a tool for assessing the toxic effects (acute and chronic) of all chemicals in samples of receiving waters or sediments on aquatic organisms and allows the cumulative effect of these chemicals to be evaluated. Because different test organisms are sensitive to different classes of chemicals and pollutants, several different organisms are monitored. Sediment and water chemistry monitoring for a variety of potential pollutants is conducted synoptically with toxicity monitoring to provide preliminary insight into the possible causes of toxicity, should it be observed.

Provision C.8.g of the MRP requires both wet and dry weather monitoring of pesticides and toxicity in urban creeks.

Dry Weather

Provision C.8.g of the MRP 2.0 requires the Program to sample two stream sites each year during the dry season for pesticides and toxicity. The MRP provides examples of possible monitoring location types, including sites with suspected or past toxicity results, existing bioassessment sites, or creek restoration sites. Dry weather pesticides and toxicity monitoring required by the MRP include:

- Toxicity testing in water using five species: *Ceriodaphnia* dubia (chronic survival and reproduction), *Pimephales promelas* (larval survival and growth), *Selenastrum capricornutum* (growth), *Hyalella azteca* (survival) and *Chironomus dilutus* (survival).
- Toxicity testing of bedded sediment using two species: *Hyalella azteca* (survival) and *Chironomus dilutus* (survival).
- Sediment chemistry analysis for pyrethroids, fipronil, carbaryl, polycyclic aromatic hydrocarbons (PAHs), metals, total organic carbon (TOC), and sediment grain size.

Wet Weather

Provision C.8.g.iii.(3) of the MRP requires a collective total of ten wet weather toxicity and water chemistry samples if the wet weather monitoring is conducted by the RMC on behalf of all Permittees. The MRP states that the monitoring locations should be representative of urban watersheds (i.e., at the bottom of watersheds). At the RMC Monitoring Workgroup meeting on January 25, 2016, RMC members agreed to collaborate on implementation of the wet weather monitoring requirements. Wet weather monitoring requirements include collection of water column samples during storm events for toxicity testing using the same five organisms required for dry weather testing and analysis of pyrethroids, fipronil, imidacloprid, and indoxacarb.[19] All ten wet weather samples were collected in WY 2018 during a single storm event on January 8, 2018. SCVURPPP and ACCWP each collected three samples, and SMCWPPP and CCCWP each collected two samples.

6.2 Methods

6.2.1 Site Selection

Throughout the term of the MRP, the Program has collected dry weather samples each year from the same two sites on Stevens Creek and San Tomas Aquino Creek (see Figure 6.1). Sites were selected to represent urban watersheds that were not already being monitored for toxicity or pesticides by other programs, such as the SWAMP Stream Pollution Trends (SPoT) program or the California Department of Pesticide Regulation (DPR) Surface Water Protection Program Monitoring (SWPP) (see Figure 6.1 for SPoT and DPR monitoring stations). SCVURPPP stations within the Stevens Creek and San Tomas Aquino Creek watersheds were identified based on the likelihood that they would contain fine depositional sediments during dry season sampling and would be safe to access during wet weather sampling. It is anticipated that SCVURPPP will continue to sample these same two stations during the remainder of MRP 2.0, with the goal of building a long-term dataset that complements data being gathered through SWAMP SPoT and DPR SWPP.

In WY 2018, in compliance with Provision C.8.g.iii of the MRP, water toxicity and pesticides samples were collected from three sites during wet weather: Stevens Creek, San Tomas Aquino Creek, and Calabazas Creek (see Figure 6.1). The sites on Stevens Creek and San Tomas Aquino Creek were selected because they were the focus of dry weather monitoring. The station on Calabazas Creek was selected because it is located at the bottom of a large urban watershed that may be representative of other urban watersheds in the Santa Clara Basin.

6.2.2 Sample Collection

Water and sediment samples for pesticides and toxicity monitoring were collected in accordance with SWAMP-comparable methods and procedures described in the BASMAA RMC SOPs (BASMAA 2016) and the associated QAPP (BASMAA 2020). Before sampling, field personnel conduct a qualitative assessment of the proposed sampling site to identify appropriate sampling locations. This is particularly necessary for sediment sampling, which requires the presence of fine-sediment depositional areas that can support at least five sub-sites within a 100-meter reach.

Water samples were collected using standard grab sampling methods. The required number of labeled amber glass bottles were filled and placed on ice to cool to < 6C. The laboratory was notified of the impending sampling delivery to meet sample hold times. Procedures used for sampling and transporting water samples are described in SOP FS-2 (BASMAA 2016).

Sediment samples were collected after any water samples were collected. Sediment samples were collected from the top 2 cm at each sub-site beginning at the downstream-most location and continuing upstream. Field staff walk in an upstream direction, carefully avoiding disturbance of sediment at collection sub-sites. Sediment samples were placed in a compositing container, thoroughly homogenized, and then aliquoted into separate jars for

[19] Standard analytical methods for indoxacarb were not available in 2018; thus the samples were not analyzed for indoxacarb.

chemical or toxicological analysis using standard clean sampling techniques (see SOP FS-6, BASMAA 2016).

Samples were submitted to respective laboratories under RMC SOP FS-9 Chain of Custody procedures and field data sheets were reviewed per SOP FS-13 (BASMAA 2016).

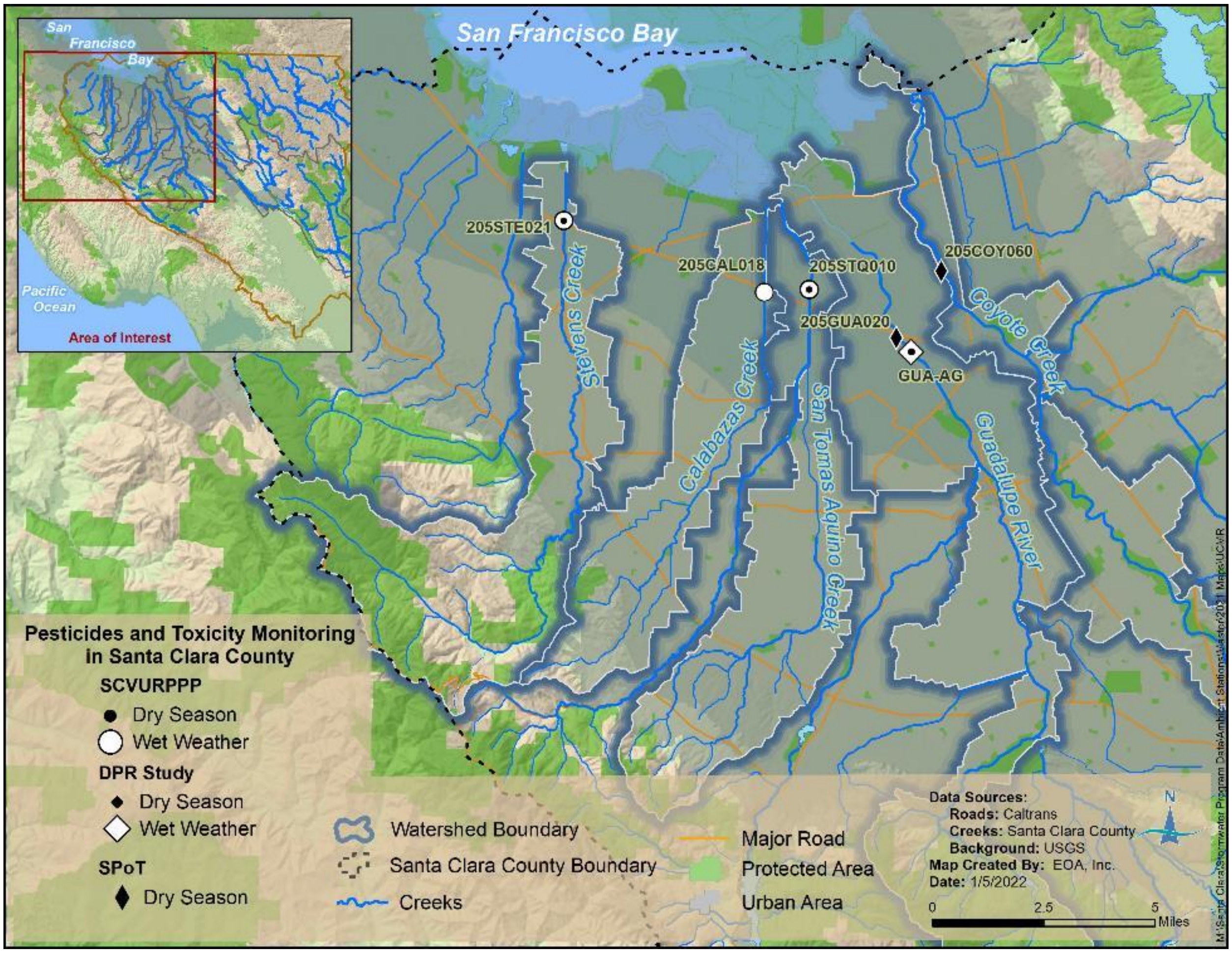

Figure 6.1. Pesticides and toxicity sampling stations in the Santa Clara Basin during WY 2021.

6.2.3 Data Evaluation

Water and Sediment Toxicity

Toxicity data evaluation required by the MRP involves first assessing whether the samples are toxic to the test organisms relative to the laboratory control treatment using the Test of Significant Toxicity (TST) statistical approach. For samples with toxicity (i.e., those that "fail" the TST), the Percent Effect is evaluated. The Percent Effect compares sample endpoints (survival, reproduction, growth) to the laboratory control endpoints. Follow-up sampling is required if any test organism is reported as "fail" via the TST approach *and* the Percent Effect is ≥ 50%. Both the TST result and the Percent Effect are determined by the laboratory. If both the initial and follow-up sample are reported as "fail" with ≥ 50% Percent Effect, the site is added to the list of trigger exceedances maintained by the Program.

Sediment Chemistry

In compliance with MRP Provision C.8.g.iv, sediment sample results are compared to Probable Effects Concentrations (PECs) and Threshold Effects Concentrations (TECs) as defined by MacDonald et al. (2000). PEC and TEC quotients are calculated as the ratio of the measured concentration to the respective PEC and TEC values from MacDonald et al. (2000). All results where a PEC or TEC quotient is equal to or greater than 1.0 are identified and added to the list of sites with trigger exceedances.

PECs and TECs are listed in MacDonald et al. (2000) for total PAHs, rather than the individual PAHs that are reported by the laboratory. Total PAH concentrations were calculated by summing the concentrations of the 24 individual PAHs that were measured by the Program. Concentrations equal to one-half of the respective laboratory MDLs were substituted for non-detect data so that calculations and statistics could be computed. Therefore, some of the TEC and PEC quotients may be artificially elevated (and contribute to trigger exceedances) due to the method used to account for filling in non-detect data.

The TECs for bedded sediments are very conservative values that do not consider site specific background conditions and are therefore not very useful in identifying real water quality concerns in receiving waters in the Santa Clara Valley. All sites in Santa Clara County are likely to have at least one TEC quotient equal to or greater than 1.0. This is due to high levels of naturally occurring chromium and nickel in geologic formations (i.e., serpentinite) and soils that contribute to TEC and PEC quotients. These conditions will be considered when making decisions about follow-up investigation.

The current MRP does not require consideration of pyrethroid, fipronil, or carbaryl sediment chemistry data for follow-up SSID projects, perhaps because pyrethroids are ubiquitous in the urban environment and little is known about fipronil and carbaryl distribution. However, SCVURPPP computed toxicity unit (TU) equivalents for individual pyrethroid results based on available literature values for pyrethroids in sediment LC50 values.[20,21] Because organic carbon mitigates the toxicity of pyrethroid pesticides in sediments, the LC50 values were derived on the basis of TOC-normalized concentrations. Therefore, the pesticide concentrations as reported by the lab were divided by the measured TOC concentration at each site, and the TOC-normalized concentrations were then used to compute TU equivalents for each constituent. Concentrations equal to one-half of the respective laboratory MDLs were substituted for non-detect data so that these statistics could be computed, potentially resulting in artificially elevated results.

Water Chemistry

Provision C.8.g.iv of MRP 2.0 requires that chemical pollutant data from water and sediment monitoring be compared to the corresponding WQOs in the Basin Plan for each analyte sampled. If concentrations in the samples exceed their WQOs, then the site at which the exceedances were observed will be added to the list of trigger exceedances. However, the Basin Plan does not contain numeric WQOs for the chemical analytes encompassed within the wet weather pesticide monitoring.

[20] The LC50 is the concentration of a given chemical that is lethal on average to 50% of test organisms.

[21] No LC50 is published for carbaryl in sediment.

6.3 Results and Discussion

From WY 2016 through WY 2021, dry weather water and sediment toxicity and sediment chemistry monitoring was conducted by SCVURPPP at two sites in Stevens Creek and San Tomas Aquino Creek. In WY 2018, wet weather toxicity and water chemistry monitoring was conducted at three sites to satisfy Provision C.8.g.iii of the MRP. Two of the wet weather sites were the sites in Stevens Creek and San Tomas Aquino Creek where the dry weather monitoring took place, while the third site was in Calabazas Creek.

Toxicity and pesticides monitoring results are described in the sections below. Conclusions and recommendations are provided in Section 7.0.

6.3.1 Toxicity

Table 6.1 provides a summary of toxicity testing results for water and sediment samples collected during dry weather on June 23, 2021.

- **San Tomas Aquino Creek (205STQ010).** The water sample collected at this site was significantly toxic to one of the five test organisms (*C. dubia* reproduction); however, the Percent Effect did not exceed the 50% threshold for follow up testing. The sediment sample was significantly toxic to one of the two test organisms (*C. dilutus*) and the Percent Effect exceeded the 50% threshold; however, the follow up sediment sample analysis was not successfully carried out due to an error in communication between SCVURPPP and the field monitoring subcontractor. Instead of retesting a sediment sample for *C. dilutus* (survival) a secondary water test for *C. dubia* was collected on August 18, 2021. The results from the secondary water test resulted in a less than significant effect for *C. dubia* (survival and reproduction).

- **Stevens Creek (205STE021).** The sediment samples collected at this site was not found to be significantly toxic to either *C. dilutus* or *H. azteca*. The water sample was significantly toxic to one of the five test organisms (*C. dubia* reproduction) with a Percent Effect greater than 50%. The follow-up water sample did not occur due to the error in communication with contract field staff. Instead of a follow-up water retest, a sediment retest for *C. dilutus* survival was collected and analyzed, which found no evidence of toxicity. The cause of the water toxicity in the June 23, 20121 sample collected from Stevens Creek is unknown. Chronic (reproduction) toxicity to *C. dubia*, however, has been observed in some prior samples collected by SCVURPPP (Table 6.2). Regional Water Board staff have also observed toxicity in Stevens Creek during previous years. A preliminary study of Stevens Creek toxicity conducted by the Regional Water Board was inconclusive and additional investigation is currently considered a low priority (Jan O'Hara, *personal communication*, Dec. 9, 2019). See below for further discussion of *C. dubia* toxicity.

San Tomas Aquino Creek and Stevens Creek will be monitored for the full suite of toxicity endpoints in WY 2022 in compliance with the MRP and as follow-up to the miscommunication.

Table 6.1. Summary of SCVURPPP dry weather toxicity results for WY 2021.

Site	Sample Type/Date	Organism	Test Type	Unit	Results: Lab Control	Results: Organism Test	% Effect	TST Value	Follow up needed (TST "Fail" and ≥50%)
205STQ010 San Tomas Aquino Creek	Original Sample June 23, 2021	**Water**							
		Ceriodaphnia dubia	Survival	%	100	100	0%	NA[1] (Pass)	No
			Reproduction	Num/Rep	44.3	24.6	44.5%	Fail	No
		Pimephales promelas	Survival	%	95	90	5.3%	Pass	No
			Growth	mg/ind	0.5	0.9	-69.7%	Pass	No
		Chironomus dilutus	Survival	%	100	97.7	2.3%	Pass	No
		Hyalella azteca	Survival	%	100	98	2%	Pass	No
		Selenastrum capricornutum	Growth	cells/ml	2090000	7830000	-275%	Pass	No
		Sediment							
		Chironomus dilutus	Survival	%	96.2	41.2	57.2%	Fail	Yes
		Hyalella azteca	Survival	%	100	88.8	11.3%	Pass	No
	Resample August 18, 2021	**Water**							
		Ceriodaphnia dubia	Survival	%	100	100	0%	NA[1] (Pass)	No
			Reproduction	Num/Rep	28.1	28.2	-0.4%	Pass	No
205STE021 Stevens Creek	Original Sample June 23, 2021	**Water**							
		Ceriodaphnia dubia	Survival	%	100	60	40%	NA[1] (Fail)	No
			Reproduction	Num/Rep	44.3	19.1	56.9%	Fail	Yes
		Pimephales promelas	Survival	%	95	92.5	2.6%	Pass	No
			Growth	mg/ind	0.5	0.9	-72.8%	Pass	No
		Chironomus dilutus	Survival	%	100	85	15%	Pass	No
		Hyalella azteca	Survival	%	100	96	4%	Pass	No
		Selenastrum capricornutum	Growth	cells/ml	2090000	6560000	-214%	Pass	No
		Sediment							
		Chironomus dilutus	Survival	%	96.2	85.0	11.6%	Pass	No
		Hyalella azteca	Survival	%	100	93.8	6.3%	Pass	No
	Resample August 18, 2021	**Sediment**							
		Chironomus dilutus	Survival	%	93.8	75	20%	Pass	No

[1] TST analysis is not performed for survival endpoint - a percent effect <25% is considered a "Pass", and a percent effect ≥25% is considered a "Fail"

WY 2021 Toxicity Resampling Event, August 18, 2021

Due to a communication error between Program staff and field contractors, resampling of water and sediment samples that failed the TST test and had a Percent Effect greater than 50% was not successfully carried out. Email communications describing preliminary results of the June 23, 2021 samples were incorrect, attributing the failed *C. dilutus* result to the Stevens Creek sediment sample and the failed *C. dubia* (reproduction) result to the San Tomas Aquino water sample. Resampling instructions and actions were based on the incorrect email information. A review of QA/QC procedures was conducted, and SOPs were modified to prevent this in the future.

On August 18, 2021, a day of smokey conditions due to wildfires in the region (Figures 6.2 and 6.3), a water sample was collected from San Tomas Aquino Creek and tested for *C. dubia* endpoints; a sediment sample was collected from Stevens Creek and tested for *C. dilutus* toxicity. No evidence of toxicity was found in either of the follow-up samples (Table 6.1).

Figure 6.2. Stevens Creek (205STE021) downstream view. Top photo is June 23, 2021 and bottom is August 18, 2021.

Figure 6.3. San Tomas Aquino Creek (205STQ010) downstream view. Top photo is June 23, 2021 and bottom is August 18, 2021.

WY 2016 – WY 2021 Results Summary

Toxicity results from water and sediment samples collected in San Tomas Aquino and Stevens Creek from WY 2016 through WY 2021 are summarized in Table 6.2. Details of the toxicity tests conducted can be found in the UCMR for each associated year (SCVURPPP 2021, SCVURPPP 2019a, SCVURPPP 2018, SCVURPPP 2017). Details of WY 2019 toxicity test results are compiled with prior years in the Program's Integrated Monitoring Report (SCVURPPP 2020).

From WY 2016 through WY 2021, two sediment samples and five dry season water samples had observed toxicity relative to the laboratory control *and* a Percent Effect exceeding the MRP evaluation criteria of 50% (see Section 6.2.3 for an explanation of MRP triggers). There were an additional 12 dry season test results where significant toxicity was observed, but the Percent Effect did not exceed the MRP trigger threshold. For the wet weather water samples there were two with toxicity results exceeding the MRP evaluation criteria and two with toxicity but a Percent Effect below 50%. None of the follow-up tests exceeded the trigger threshold.

A review of the six-year toxicity summary in Table 6.2 reveals several findings:

- ***H. azteca*.** Toxicity to *H. azteca*, a test organism known to be sensitive to pyrethroid pesticides, was not observed in dry season sediment or water samples but was observed in the wet weather water samples collected in WY 2018. Pyrethroid pesticides tend to accumulate in sediment and pyrethroids in sediment samples collected synoptic with the dry season toxicity samples (summarized for WY 2016 – WY 2021 in Table 6.7) sometimes approach or exceed levels of concern (i.e., TU equivalent of 1.0), but these concentrations are not resulting in sediment toxicity to *H. azteca*. Furthermore, long-term monitoring of local creeks by the SPoT program suggests that pyrethroid concentrations in sediment have decreased since 2011/2012 (SCVURPPP 2019b). It is unknown whether the toxicity to *H. azteca* observed in the wet weather samples is related to pyrethroids suspended in the water column or some other toxic substance present in the creeks.
- ***C. dilutus.*** Toxicity to *C. dilutus*, a test organism known to be sensitive to neonicotinoids (e.g., imidacloprid) and fipronil, was observed in sediment and water samples collected during the dry season; and two sediment samples demonstrated a Percent Effect exceeding the MRP threshold for resampling. Toxicity to *C. dilutus* was not observed in the three wet weather samples collected in WY 2018. Although fipronil and its degradates are rarely detected in synoptic sediment samples, it appears plausible that the water quality impacts associated with pyrethroid pesticides may be decreasing, while impacts associated with their replacements (i.e., neonicotinoids) may be increasing as these types of pesticides have gained market share.
- ***C. dubia* (reproduction).** Of the 19 dry season samples where significant toxicity was observed, 50% were water samples with *C. dubia* reproduction toxicity. *C. dubia* is a water flea that is sensitive to a broad range of aquatic contaminants. However, the specific cause of the chronic *C. dubia* toxicity in San Tomas Aquino and Stevens Creek is unknown, not seemingly explained by the synoptic sediment chemistry results. It is possible that these toxicity results are erroneous artifacts of laboratory QA/QC procedures.

  In preparation for reissuance of the SWAMP QAPrP in 2013, the SWAMP Toxicity Work Group examined conductivity tolerance in freshwater toxicity test species with respect to the relationship between sample water conductivity and observed toxicity. It was determined that *C. dubia* survival and reproduction are negatively affected at high and low conductivities. The SWAMP Toxicity Work Group (2013) recommended "appropriate controls" when sample water has high (>1900 µS/cm) or low (<100 µS/cm) conductivities because the *C. dubia* test organisms cultivated in the laboratory under standard laboratory conditions (e.g., 310 to 360 µS/cm) may perish or experience reduced reproduction when exposed to the sample water. Considering these findings, SCVURPPP compiled the results of conductivity measurements taken from sample water associated with toxicity monitoring from WY 2012 through WY 2021 to compare with the laboratory water used in these toxicity tests and the results of the tests themselves. In almost all cases, it was found that the sample water conductivity was higher or lower by several hundred µS/cm compared to the laboratory control samples (a mean difference of approximately 433 µS/cm). However, no correlation was found between *C. dubia* toxicity and sample water/laboratory control water conductivity differences.

Statewide, there have been other reports of unexplained chronic *C. dubia* toxicity, within and between laboratory variability in the magnitude of toxicity, and suspicion of false positives. Recent analysis by SWAMP in conjunction with the Statewide Toxicity Provisions adopted by the State Water Board on December 1, 2020 indicates that *C. dubia* toxicity variability could arise from inconsistencies in QA procedures used by laboratories. A two-year Special Study requested by the State Water Board is currently underway, with a work plan developed by SCCWRP and a final report anticipated in December 2022. This study will contain recommendations for improvements to laboratory QA procedures associated with the *C. dubia* toxicity tests and may also yield related findings pertaining to the causes of spurious *C. dubia* toxicity (SWRCB 2020).

Table 6.2. Toxicity test result summary, WY 2016 – WY 2021. The Percent Effect is indicated for test results with toxicity relative to the lab control. Test results with toxicity exceeding the MRP trigger thresholds are highlighted.

Station ID	Creek	Date	Water Year	Season	Sediment		Water						
					C. dilutus	*H. azteca*	*C. dubia*		*P. promelas*		*C. dilutus*	*H. azteca*	*S. capricornutum*
					Survival	Survival	Survival	Reproduction	Survival	Growth	Survival	Survival	Growth
San Tomas Aquino Creek Dry Season Samples													
205STQ010	San Tomas Aquino Cr	7/11/2016	WY 2016	Dry	**Yes** (18%)	No	No	No	No	No	No	No	No
205STQ010	San Tomas Aquino Cr	7/13/2017	WY 2017	Dry	No	No	No	**Yes** (30%)	No	No	**Yes** (11%)	No	No
205STQ010	San Tomas Aquino Cr	7/17/2018	WY 2018	Dry	No	No	No	No	No	No	No	No	No
205STQ010	San Tomas Aquino Cr	7/23/2019	WY 2019	Dry	**Yes** (56%)	No	No	**Yes** (31%)	No	No	No	No	No
205STQ010	San Tomas Aquino Cr	8/28/2019	WY 2019	Dry [1]	No	--	No	--	--	--	--	--	--
205STQ010	San Tomas Aquino Cr	7/22/2020	WY 2020	Dry	No	No	No	**Yes** (67%)	No	No	**Yes** (31%)	No	No
205STQ010	San Tomas Aquino Cr	9/9/2020	WY 2020	Dry [1]	--	--	--	No	--	--	--	--	--
205STQ010	San Tomas Aquino Cr	6/23/2021	WY 2021	Dry	**Yes** (57%)	No	No	**Yes** (45%)	No	No	No	No	No
205STQ010	San Tomas Aquino Cr	8/18/2021	WY 2021	Dry [1]	--	--	No	No	--	--	--	--	--
Stevens Creek Dry Season Samples													
205STE021	Stevens Cr	7/11/2016	WY 2016	Dry	No	No	No	No	**Yes** (27%)	No	No	No	No
205STE021	Stevens Cr	7/13/2017	WY 2017	Dry	No	No	No	**Yes** (80%)	No	No	No	No	No
205STE021	Stevens Cr	8/15/2017	WY 2017	Dry [1]	--	--	No	No	--	--	--	--	--
205STE021	Stevens Cr	7/17/2018	WY 2018	Dry	No	No	No	No	No	No	**Yes** (24%)	No	No
205STE021	Stevens Cr	7/23/2019	WY 2019	Dry	No	No	No	**Yes** (73%)	No	No	**Yes** (18%)	No	No
205STE021	Stevens Cr	9/18/2019	WY 2019	Dry [1]	--	--	No	**Yes** (47%)	--	--	--	--	--
205STE021	Stevens Cr	7/22/2020	WY 2020	Dry	No	No	**Yes** (30%)	**Yes** (79%)	No	No	No	No	No
205STE021	Stevens Cr	9/9/2020	WY 2020	Dry [1]	--	--	--	No	--	--	--	--	--
205STE021	Stevens Cr	6/23/2021	WY 2021	Dry	No	No	**Yes** (40%)	**Yes** (57%)	No	No	No	No	No
205STE021	Stevens Cr	8/18/2021	WY 2021	Dry [1]	No	--	--	--	--	--	--	--	--
Wet Weather Samples													
205STQ010	San Tomas Aquino Cr	1/8/2018	WY 2018	Wet	--	--	No	No	No	No	No	**Yes** (56%)	No
205STQ010	San Tomas Aquino Cr	3/1/2018	WY 2018	Wet [1]	--	--	No	--	--	--	--	No	--
205STE021	Stevens Cr	1/8/2018	WY 2018	Wet	--	--	No	No	No	No	No	**Yes** (28%)	No
205CAL018	Calabazas Cr	1/8/2018	WY 2018	Wet	--	--	No	No	No	No	No	**Yes** (60%)	No
205CAL018	Calabazas Cr	3/1/2018	WY 2018	Wet [1]	--	--	No	--	--	--	--	**Yes** (12%)	--

[1] Resample.

6.3.2 Sediment Chemistry

Sediment chemistry results from WY 2021 were evaluated as potential stressors based on TEC and PEC quotients identified in the MRP as trigger thresholds (see Section 6.2.3). The Program also evaluated TU equivalents of pyrethroids and fipronil to inform stormwater management.

Table 6.3 lists concentrations and TEC quotients for sediment chemistry constituents (metals and total PAHs) collected in WY 2021 from Stevens Creek and San Tomas Aquino Creek. TEC quotients are calculated as the measured concentration divided by the highly conservative TEC value, per MacDonald et al. (2000)[22]. TECs are extremely conservative and are intended to identify concentrations below which harmful effects on sediment-dwelling organisms are unlikely to be observed. Both sites exceeded the trigger threshold from MRP of having at least one result exceeding the TEC and will be added to the list of trigger exceedances. At both sites, the constituents with TEC quotients ≥ 1.0 included nickel and chromium. Nickel and chromium are expected in watersheds draining hillsides underlain by serpentine formations, which is a common geological feature in Santa Clara County. Previous years also demonstrated similar chromium and nickel concentrations for the two sites (SCVURPPP 2021).

Table 6.4 lists concentrations and PEC quotients for sediment chemistry constituents (metals and total PAHs) collected in WY 2021. PECs are intended to identify concentrations above which toxicity to benthic-dwelling organisms are predicted to be probable. There was one PEC quotient that was found to be greater than 1.0 in both creeks. The PEC quotient for nickel, an abundant metal in local serpentine soils, was calculated to be 1.09 in both locations.

Table 6.3. Threshold Effect Concentration (TEC) quotients for WY 2021 sediment chemistry constituents. Bolded and shaded values indicate TEC quotient ≥ 1.0.

	TEC	205STE021 Stevens Creek		205STQ010 San Tomas Aquino Creek	
Metals (mg/kg DW)		**Concentration**	**Quotient**	**Concentration**	**Quotient**
Arsenic	9.79	2.4	0.25	2.8	0.29
Cadmium	0.99	0.22	0.22	0.22	0.22
Chromium	43.4	61	**1.41**	61	**1.41**
Copper	31.6	29	0.92	27	0.85
Lead	35.8	23	0.64	10	0.28
Nickel	22.7	53	**2.33**	53	**2.33**
Zinc	121	100	0.83	94	0.78
PAHs (ug/kg DW)					
Total PAHs	1,610	806 [a]	0.50 [a]	208 [a]	0.13 [a]

a. Concentration was below the method detection limit (MDL) for some PAHs. TEC quotient equivalents calculated using 1/2 MDL.

[22] MacDonald et al. (2000) does not provide TEC or PEC values for pyrethroids, fipronil, or carbaryl. Pesticides are compared to LC50 values in Table 6.5.

Table 6.4. Probable Effect Concentration (PEC) quotients for WY 2021 sediment chemistry constituents. Bolded and shaded values indicate PEC quotient ≥ 1.0.

	PEC	205STE021		205STQ010	
		Stevens Creek		San Tomas Aquino Creek	
Metals (mg/kg DW)		**Concentration**	**Quotient**	**Concentration**	**Quotient**
Arsenic	33.0	2.4	0.07	2.8	0.08
Cadmium	4.98	0.22	0.04	0.22	0.04
Chromium	111	61	0.55	61	0.55
Copper	149	29	0.19	27	0.18
Lead	128	23	0.18	10	0.08
Nickel	48.6	53	**1.09**	53	**1.09**
Zinc	459	100	0.22	94	0.20
PAHs (ug/kg DW)					
Total PAHs	22,800	806 [a]	0.04 [a]	208 [a]	0.009 [a]

[a] Concentration was below the method detection limit (MDL) for some PAHs. PEC quotient equivalents calculated using 1/2 MDL.

Table 6.5 lists the concentrations of pesticides measured in sediment samples collected in WY 2021, TOC-normalized concentrations, and TU equivalents for the pesticides for which there are published LC50 values in the literature. Many of the pesticides measured were below MDLs and the TU equivalents were calculated using ½ the MDL concentration. No individual constituent had a TU equivalent exceeding 1.0. The sum of all measured pyrethroid TUs was 0.5 for Stevens Creek and 0.7 for San Tomas Aquino Creek. The highest TU equivalent in both samples was for bifenthrin (0.27 in Stevens Creek and 0.49 in San Tomas Aquino Creek). This pesticide is considered to be the leading cause of pyrethroid-related toxicity in urban areas (Ruby 2013) and the most-commonly detected insecticide monitored by the DPR SWPP (Ensminger 2017).

Table 6.5. Pesticide concentrations and calculated toxic unit (TU) equivalents, June 23, 2021.

			205STE021 Stevens Creek			205STQ010 San Tomas Aquino Creek		
	Unit	LC50 [c, d]	Concentration	Normalized to TOC	TU Equivalent	Concentration	Normalized to TOC	TU Equivalent
Total Organic Carbon	%	NA	1.4	NA	NA	1.3	NA	NA
Pyrethroid								
Bifenthrin	µg/g dw	0.52	0.002	0.14	0.27	0.0033	0.25	0.488
Cyfluthrin, total	µg/g dw	1.08	0.0011	0.079	0.073	0.0011	0.08	0.078
Cypermethrin, total	µg/g dw	0.38	<0.00041 [a]	0.015	0.039	<0.00041 [a]	0.016	0.04
Deltamethrin/Tralomethrin	µg/g dw	0.79	0.001	0.071	0.090	<0.0005 [a]	0.019	0.024
Esfenvalerate/Fenvalerate, total	µg/g dw	1.54	<0.00054 [a]	0.019	0.013	<0.00054 [a]	0.021	0.013
Cyhalothrin, Total lambda-	µg/g dw	0.45	<0.00025 [a]	0.009	0.020	0.00026 [b]	0.020	0.044
Permethrin, Total	µg/g dw	10.83	<0.00045 [a]	0.016	0.0015	<0.00046 [a]	0.02	0.002
			Sum of TU Equivalents		**0.51**	Sum of TU Equivalents		**0.69**
Other MRP Pesticides of Concern								
Carbaryl	mg/Kg dw	NA [d]	<0.21 [a]	0.8	NA	<0.21 [a]	0.8	NA
Fipronil	ng/g dw	306	<0.41 [a]	14.6	0.048	<0.41 [a]	15.8	0.052
Fipronil Desulfinyl	ng/g dw	NA [d]	<0.41 [a]	14.6	NA	<0.41 [a]	15.8	NA
Fipronil Sulfide	ng/g dw	435	<0.41 [a]	14.6	0.034	<0.41 [a]	15.8	0.036
Fipronil Sulfone	ng/g dw	158	<0.41 [a]	14.6	0.09	<0.41 [a]	15.8	0.10

a. Concentration was below the method detection limit (MDL). TU equivalents calculated using ½ MDL.
b. TU equivalents calculated from concentration below the reporting limit (J-flagged).
c. Sources: Amweg et al. 2005 and Maund et al. 2002 for pyrethroids; Maul et al. 2008 for fipronil compounds.
d. No available LC50 value for Carbaryl or Fipronil Desulfinyl.

In compliance with the MRP, a grain size analysis was conducted on both WY 2021 sediment samples (Table 6.6). The Stevens Creek (205STE021) sample was 15.3% fines (i.e., 8.48% clay and 6.82% silt); and the San Tomas Aquino Creek (205STQ010) sample was 21.7% fines (i.e., 6.97% clay and 14.72% silt).

Table 6.6. Summary of grain size for the two locations sampled in Santa Clara County during WY 2021.

Grain Size (%)		205STE021 Stevens Creek	205STQ010 San Tomas Aquino Creek
Clay	<0.0039 mm	8.48%	6.97%
Silt	0.0039 to <0.0625 mm	6.82%	14.72%
Sand	V. Fine 0.0625 to <0.125 mm	4.02%	9.43%
	Fine 0.125 to <0.25 mm	11.75%	26.76%
	Medium 0.25 to <0.5 mm	24.88%	0%
	Coarse 0.5 to <1.0 mm	22.7%	5.84%
	V. Coarse 1.0 to <2.0 mm	21.36%	4.48%
Granule	2.0 to <4.0 mm	15.6%	6.86%
Pebble	Small 4 to <8 mm	3.52%	1.33%
	Medium 8 to <16 mm	0%	0%
	Large 16 to <32 mm	0%	0%
	V. Large 32 to <64 mm	0%	0%

Note: Sum of grain size values for both sites is greater than 100% due to the laboratory analytical methods used.

WY 2016 – WY 2021 Summary

Between WY 2016 and WY 2021, no sediment samples had PEC quotients that exceeded 1.0 for analytes other than chromium and nickel. Chromium and nickel are excluded from this PEC/TEC analysis because they are contributed primarily by serpentine formations present naturally in the watersheds where monitoring occurred. Excluding chromium and nickel, there were four samples in the WY 2016 through WY 2021 dataset with TEC quotients ≥ 1.0, the more conservative of the two sediment chemistry evaluation criteria. The constituents and locations with TEC quotients ≥ 1.0 included:

- Total PAHs from Stevens Creek in WY 2017 and WY 2018; and
- Zinc and copper from Stevens Creek and San Tomas Aquino Creek in WY 2020.

Table 6.7 lists TU equivalents for pesticides with LC50s available in the literature and concentrations for pesticides without LC50s for sediment samples collected in WY 2016 - WY 2021. Carbaryl has not been detected in any sample. Fipronil and its degradates[23] (desulfinyl, sulfide, sulfone) have been detected at TOC-normalized concentrations below the LC50 in three samples, both WY 2016 samples and the WY 2020 sample from San Tomas Aquino Creek. The sum-of-pyrethroids TU equivalents ranged from 0.11 (Stevens Creek in WY 2017) to 1.3 (Stevens Creek in WY 2020). Since WY 2016, two samples collected from Stevens Creek in 2016 and 2020 have had a sum-of-pyrethroids TU equivalent ≥ 1.0. There are no apparent trends in TU equivalents for pesticides in San Tomas Aquino Creek or Stevens Creek between WY 2016 and WY 2021.

[23] Fipronil degrades via UV exposure, oxidation, and hydrolysis to form four principal degradates: fipronil desulfinyl, fipronil sulfide, fipronil sulfone, and fipronil amide. The degradates tend to be more stable and persistent than the parent compound; therefore, SCVURPPP added the first three of the degradates to the monitoring program in WY 2017.

Table 6.7. Toxicity Unit (TU) equivalent summary for Santa Clara County sediment samples, WY 2014 – WY 2021. See Table 6.5 for WY 2021 concentration data.

Analyte			Pyrethroids								Other MRP Pesticides of Concern				
			Bifenthrin	Cyfluthrin	Cypermethrin	Deltamethrin	Esfenvalerate	Lambda-cyhalothrin	Permethrin	**Sum Pyrethroids**	Carbaryl	Fipronil	Fipronil desulfinyl	Fipronil sulfide	Fipronil sulfone
		LC50 [c]	0.52 (µg/g dw)	1.08 (µg/g dw)	0.38 (µg/g dw)	0.79 (µg/g dw)	1.54 (µg/g dw)	0.45 (µg/g dw)	10.83 (µg/g dw)	-	NA [d]	306 (ng/g dw)	NA [d]	435 (ng/g dw)	158 (ng/g dw)
Station ID	**Creek**	**Date**													
205STQ010	San Tomas Aquino	7/11/2016	0.39	0.15	0.15 [b]	0.11 [b]	<MDL	<MDL	0.03	**0.88** [a]	<MDL	0.01 [b]	-	-	-
205STQ010	San Tomas Aquino	7/13/2017	0.07 [b]	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	**0.22** [a]	<MDL	<MDL	<MDL	<MDL	<MDL
205STQ010	San Tomas Aquino	7/17/2018	0.39	0.15	0.15 [b]	0.11 [b]	<MDL	<MDL	0.03	**0.88** [a]	<MDL	<MDL	<MDL	<MDL	<MDL
205STQ010	San Tomas Aquino	7/23/2019	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	**0.43** [a]	<MDL	<MDL	<MDL	<MDL	<MDL
205STQ010	San Tomas Aquino	7/22/2020	0.54	0.08	0.07	<MDL	<MDL	0.06	0.01	**0.77** [a]	<MDL	<MDL	<MDL	<MDL	0.12
205STQ010	San Tomas Aquino	6/23/2021	0.49	0.08	<MDL	<MDL	<MDL	0.04 [b]	<MDL	**0.69** [a]	<MDL	<MDL	<MDL	<MDL	<MDL
205STE021	Stevens Creek	7/11/2016	0.78	0.13	0.03 [b]	0.19	0.02 [b]	0.03 [b]	0.03	**1.21** [a]	<MDL	0.01 [b]	-	-	-
205STE021	Stevens Creek	7/13/2017	0.07	<MDL	0.02 [b]	<MDL	<MDL	<MDL	0.002	**0.11** [a]	<MDL	<MDL	<MDL	<MDL	<MDL
205STE021	Stevens Creek	7/17/2018	0.12 [b]	<MDL	0.03 [b]	0.10	<MDL	<MDL	<MDL	**0.29** [a]	<MDL	<MDL	<MDL	<MDL	<MDL
205STE021	Stevens Creek	7/23/2019	0.15 [b]	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	**0.40** [a]	<MDL	<MDL	<MDL	<MDL	<MDL
205STE021	Stevens Creek	7/22/2020	0.59	0.14	0.31	<MDL	<MDL	0.26	<MDL	**1.3** [a]	<MDL	<MDL	<MDL	<MDL	<MDL
205STE021	Stevens Creek	6/23/2021	0.27	0.07	<MDL	0.09	<MDL	<MDL	<MDL	**0.51** [a]	<MDL	<MDL	<MDL	<MDL	<MDL

‘dw = dry weight
a. Total calculated using 1/2 MDLs for some individual pyrethroids.
b. TU equivalents calculated from concentration below the reporting limit (J-flagged).
c. Sources: Amweg et al. 2005 and Maund et al. 2002 for pyrethroids; Maul et al. 2008 for fipronil compounds
d. No available LC50 value for Carbaryl or Fipronil Desulfinyl.

6.3.3 Pesticides in Water

During WY 2018, water samples were taken during wet weather events at three sites in Calabasas Creek, San Tomas Aquino Creek, and Stevens Creek to fulfill Provision C.8.g.iii.(3) of the MRP, which requires aquatic toxicity testing and monitoring of water column pesticide concentrations. Results were reported in the WY 2018 UCMR (SCVURPPP 2019a). Statistically significant toxicity was observed in the water samples from all three sites (Table 6.2), and the magnitude of toxicity observed at the Calabazas and San Tomas Aquino Creek sites required the collection of follow-up samples. It was not necessary, however, to add any these sites to the list of potential SSID project locations based on the follow-up sample results where toxicity was not observed because the Percent Effect was below the 50% threshold. The concentrations of most pesticides, except for bifenthrin and fipronil compounds for some samples, were below the MDL, meaning that these analytes were reported as non-detects. There are no WQOs specified in the San Francisco Bay Basin Plan for water column pesticide analytes. As a result, no WQO or MRP trigger threshold exceedance analysis was performed on the wet weather pesticide data.

6.3.4 Additional Monitoring Efforts

Throughout the monitoring period associated with the results described in this report, several programs external to the RMC conducted similar pesticides and toxicity monitoring studies within California. These studies provide valuable data for comparison against SCVURPPP findings to view regional water quality in a broader spatial and temporal context, ultimately providing more accurate and complete answers to the management questions set forth by the MRP.

DPR SWPP Monitoring

Mentioned previously in this document, the DPR SWPP is one of the largest pesticide monitoring and management efforts currently being undertaken in California. Pesticide studies conducted by the DPR SWPP evaluate the frequency of pesticide detections at any concentration and make use of USEPA aquatic benchmarks for many pesticide compounds (USEPA 2016). DPR provides web access to their monitoring reports which contain detailed analyses of USEPA aquatic benchmark exceedance rates. DPR also maintains the Surface Water Database (SURF) to provide public access to quantitative pesticide data from a wide array of surface water monitoring studies. This database could be queried in the future to allow for the leverage of DPR monitoring data in more complex analyses of MRP pesticide data.

In WY 2017, DPR conducted two studies in Northern and Southern California that involved pesticides and toxicity monitoring at urban sites in Alameda, Contra Costa, Placer, Sacramento, Santa Clara (Guadalupe River – see Figure 6.1), Los Angeles, Orange, and San Diego Counties. Both water and sediment samples were collected and analyzed for a wide range of pesticide compounds. In both the Northern and Southern California studies, bifenthrin and fipronil were found to be among the most frequently detected pesticides. Additionally, pyrethroid concentrations were found to be above their USEPA minimum benchmarks for toxicity to aquatic life for most samples with the exception of cyfluthrin. The studies also state that the detection frequencies of most pyrethroids have remained consistent over recent years (Budd 2018 and Ensminger 2017).

In WY 2018, DPR conducted two urban monitoring studies in Northern and Southern California that collected water and sediment samples in the same counties sampled during WY 2017. Similar to WY 2017, bifenthrin was among the most frequently detected insecticides in water samples from both the Northern and Southern California WY 2018 studies. In the Northern California study, bifenthrin was the most frequently detected insecticide and second most frequently detected compound in water samples with a detection frequency (DF) of 76%. In the Southern California study, bifenthrin was the most frequently detected pyrethroid insecticide and the fifth most frequently detected compound in water samples with a DF of 72%. Fipronil and its degradates were also detected at high rates in water samples from the Northern and Southern California studies. While fipronil itself only had a DF of 48% in the Northern California study, fipronil and its degradates collectively had a DF of 72%. Out of these compounds, fipronil sulfone was found at the highest rate with a DF of 70%. Fipronil was also found at a high rate during the Southern California study with a DF of 76%. Its degradates were also found in a large portion of samples, with fipronil sulfone again being the most found with a DF of 67%. Sediment samples from Northern and Southern California were collected and analyzed for bifenthrin and eight other pyrethroids, but concentrations of fipronil and its degradates were not measured. In both studies, bifenthrin was detected in all samples and was also responsible for the greatest magnitude of TUs (Budd 2019 and Ensminger 2019).

In WY 2019, DPR collected water and sediment samples in the same Northern Californian counties targeted during WY 2018. Bifenthrin and fipronil were the most detected insecticides with 41% DF and 37% DF, respectively. Three of fipronil's five degradates were observed and collectively accounted for 61% DF; when combined with the fipronil DF, fipronil and its degradates had an aggregate 98% DF. Bifenthrin and fipronil both exceeded their lowest USEPA aquatic benchmarks in 34% of all detections. There were no benchmark exceedances for fipronil degradates, yet fipronil sulfone had a 32% DF. Perhaps the biggest conclusion from this DPR study was the observed differences between outfall and stream monitoring and between wet and dry weather monitoring. Bifenthrin and fipronil detections at storm drain outfalls had 73-91% DFs compared to 23-37% in waterways. There was little observed difference between dry and wet events in storm drain outfalls for bifenthrin and fipronil, yet waterways that lacked bifenthrin detections during dry events demonstrated a large increase in bifenthrin (up to 70% DF) during rain events. Likewise, fipronil had 10% DF in waterways during dry events but increased to 50% DF during rain events. Fipronil degradates also exhibited differences in dry weather and storm event monitoring concentrations. Fipronil desulfinyl had equal detection during dry and wet monitoring events, fipronil amide and sulfone had a 36 and 34 percentage point increase in DF, respectively (Ensminger 2020).

In WY 2020, DPR collected water and sediment samples in the same Northern Californian counties targeted during WY 2019. Bifenthrin was the second most detected insecticide at 60% DF and fipronil with a 33% DF. Both bifenthrin and fipronil were observed to exceed their USEPA aquatic benchmarks in 53% and 27% of all detections, respectively. Three of fipronil's degradates were measured: fipronil sulfone had a 29% DF and exceeded its benchmark 2% of the time; fipronil amide was measured at 11% DF and fipronil desulfinyl had 7% DF. Fipronil degradates collectively amounted to 47% DF and when combined with fipronil reflect an aggregate 80% DF (Ensminger 2021).

Findings from the WY 2017-WY 2020 DPR studies generally corroborate the results garnered from SCVURPPP pesticides monitoring. Bifenthrin has been the most frequently detected pesticide in samples collected by SCVURPPP from WY 2016 through WY 2021. Notably, although fipronil and its degradates were frequently detected during the DPR studies, they were seldom found at detectable levels in SCVURPPP samples.

SPoT Monitoring Program

The SPoT Monitoring Program conducts annual dry season monitoring (subject to funding constraints) of sediments collected from a statewide network of large rivers. The goal of the SPoT Program is to investigate long-term trends in water quality. Sites are targeted in bottom-of-the-watershed locations with slow water flow and appropriate micromorphology to allow deposition and accumulation of sediments, including stations near the mouth of Coyote Creek and the Guadalupe River (Phillips et al. 2014) (Figure 6.1). In most years, sediments are analyzed for toxicity, metals, PCBs, mercury, organic pollutants, and pesticides, including pyrethroids, and fipronil and its degradates. The most recent technical report prepared by SPoT program staff was published in 2020 and describes ten-year trends from the initiation of the program in 2008 through 2017 (Phillips et al. 2020).

Toxicity testing of sediment was conducted by SPoT in Santa Clara County watersheds using indicator organisms *H. azteca*, which is sensitive to pyrethroids, and *C. dilutus*, added in 2015 to assess neonicotinoid and fipronil impacts. Toxicity samples were evaluated using the TST statistical approach (Phillips et al. 2020).

- ***H. azteca***. In Guadalupe River, chronic *H. azteca* toxicity has not been observed in the entire dataset and acute *H. azteca* has not been observed since 2014. In Coyote Creek, both acute and chronic *H. azteca* toxicity have been observed but there is a trend of decreasing toxicity.

- ***C. dilutus***. In Guadalupe River, neither acute nor chronic *C. dilutus* toxicity have been observed since monitoring for this organism began in 2015. In Coyote Creek, *acute C. dilutus* toxicity has not been observed, but moderate chronic *C. dilutus* was observed in at least one sample.

The SpoT toxicity results contrast with SCVURPPP monitoring results from Stevens Creek and San Tomas Aquino Creek. SCVURPPP has not detected acute *H. azteca* toxicity in sediment samples from these creeks but has observed acute *C. dilutus* toxicity in two of six samples from San Tomas Aquino Creek. The MRP does not require analysis of chronic toxicity endpoints for sediment samples.

The SPoT sediment chemistry results from Guadalupe River and Coyote Creek do not show statistically significant trends in sum-of-pyrethroid concentrations or sum-of-fipronil-and-its-degradates concentrations over the 2008 – 2017 dataset reviewed by Philips et al. (2020). A review of SpoT data from 2008 to 2020 downloaded from CEDEN suggests the following findings that are in line with SCVURPPP data from Stevens Creek and San Tomas Aquino:

- **Coyote Creek.** Dry season pyrethroid concentrations in Coyote Creek peaked in July 2012 (674 ng/g). This concentration was largely driven by cyfluthrin, which was measured at 539 ng/g, a concentration 26 times higher than the next highest cyfluthrin measurement (20.2 ng/g in September 2012) and 90 times higher than the average cyfluthrin concentration in the dataset sans July 2012. In most other years, the individual pyrethroid with the highest concentration in Coyote Creek is bifenthrin. Although fipronil has only been detected twice in Coyote Creek during the years it was monitored by SPoT (2013 – 2020), its degradates (fipronil desulfinyl, fipronil sulfide, fipronil sulfone) are usually found at measurable concentrations, with no obvious long-term trends.

- **Guadalupe River.** Similar to Coyote Creek, sum-of-pyrethroid concentrations in Guadalupe River peaked in 2012 (165 ng/g) but was driven by a high permethrin concentration that year (76 ng/g) rather than cyfluthrin (21.7 ng/g). In most other years, the individual pyrethroid with the highest concentration in Guadalupe River is bifenthrin. Fipronil has never been detected in Guadalupe River but its degradates (fipronil sulfone, fipronil sulfide, and fipronil desulfinyl) have been detected. More recent samples have detections of at least two degradates. A significant decrease in PAHs has also been observed in the Guadalupe River.

7.0 CONCLUSIONS AND RECOMMENDATIONS

This section includes conclusions and recommendations from review of the WY 2021 Creek Status and Pesticides & Toxicity Monitoring data that are presented in the previous sections of this report.

In WY 2021, in compliance with provisions C.8.d and C.8.g of the MRP and the BASMAA RMC Creek Status and Long-Term Trends Monitoring Plan (BASMAA 2012), SCVURPPP continued to implement a monitoring design that was initiated in WY 2012. The strategy includes a regional ambient/probabilistic bioassessment monitoring component and a component based on local targeted monitoring for general water quality parameters and pesticides/toxicity. The combination of these monitoring designs allows each individual RMC participating program (including SCVURPPP) to assess the status of beneficial uses in local creeks within its Program (jurisdictional) area, while also contributing data to answering management questions at the regional scale (e.g., differences between aquatic life condition in urban and non-urban creeks).

Conclusions from Creek Status and Pesticides & Toxicity Monitoring conducted during WY 2021 in the Santa Clara Valley are based on the management questions presented in Section 1.0 of this report:

1) *Are water quality objectives, both numeric and narrative, being met in local receiving waters, including creeks, rivers, and tributaries?*
2) *Are conditions in local receiving water supportive of or likely supportive of beneficial uses?*

The first management question is addressed primarily through the evaluation of monitoring data with respect to WQOs and triggers defined in the MRP. A summary of trigger exceedances observed for each site in WY 2021 is presented in Table 7.1. In compliance with Provision C.8.e.i of the MRP, SCVURPPP coordinates with the RMC to maintain a comprehensive list of all monitoring results from the region exceeding trigger thresholds. Sites where triggers are exceeded may indicate potential impacts to aquatic life or other beneficial uses and are considered for future evaluation of SSID projects.

The second management question is addressed primarily by assessing indicators of aquatic biological health using BMI and algae data. The indices of biological integrity based on BMI and algae data (i.e., CSCI and ASCI) are direct measures of aquatic life beneficial uses. Biological condition scores are compared to physical habitat and water quality data collected synoptically with bioassessments to evaluate whether any correlations exist that may explain the variation in biological condition scores. Continuous monitoring data (temperature, DO, pH, and specific conductance) are evaluated with respect to COLD and WARM freshwater aquatic habitat beneficial uses. Pathogen indicator data are used to assess REC-1 (water contact recreation) beneficial uses.

All monitoring and data validation were conducted using methods consistent with the BASMAA RMC QAPP (BASMAA 2020) and SOPs (BASMAA 2016). Recommendations for future monitoring are described in Section 7.3.

7.1 Conclusions

7.1.1 Bioassessment Monitoring

In WY 2021, bioassessment monitoring was conducted at twenty sites in compliance with provision C.8.d.i of the MRP. Sites were sampled for BMIs, benthic algae, and nutrients. Physical habitat and general water quality parameters were also measured at each site. In WY 2021, all twenty bioassessment surveys were conducted at targeted sites. The targeted (rather than probabilistic) approach to bioassessment monitoring was initiated in WY 2021 because the Master List from which probabilistic sites are selected was exhausted for the Santa Clara County area in WY 2020.

Management questions associated with the probabilistic monitoring design (*What is the condition of aquatic life in creeks in the RMC area; are WQOs met and are beneficial uses supported?, What are major stressors to aquatic life in the RMC area?, What are the long-term trends in water quality in creeks over time?)* were addressed in prior reports. In particular, the Program's WY 2019 IMR (SCVURPPP 2020) evaluated eight years (WY 2012 – WY 2019) of SCVURPPP bioassessment data, and BASMAA (2019) analyzed five years (WY 2012 – WY 2016) of regional probabilistic data.

The WY 2021 targeted monitoring design focused on providing context for thirteen fish survey locations that are regularly monitored by Valley Water to assess condition of steelhead populations. WY 2012 targeted monitoring also focused on building multi-year datasets for bioassessment sites that were previously sampled.

CSCI scores and water quality data were compared to applicable WQOs and triggers identified in the MRP. Sites with results that exceed WQOs and triggers are added to the comprehensive list of exceedances that is maintained by the Program, consistent with provision C.8.e of the MRP (see Section 7.3).

Biological Condition Assessment

Stream condition is assessed using three different types of indices/tools: the BMI-based CSCI, the benthic algae-based ASCI, and the physical habitat-based IPI. Of these three, the CSCI is the only tool with an MRP trigger threshold for follow-up SSID consideration.

The CSCI scores across the 20 sites sampled in WY 2021 ranged from 0.48 to 1.07, with 16 of the sites having scores below the MRP trigger threshold of 0.795.

- The four sites above the MRP threshold (i.e., in the "likely intact" and "possibly altered" condition categories) had relatively low impervious area in their contributing watersheds (≤ 2 percent). Two of the high-scoring sites are located in upper reaches of Guadalupe Creek between Coleman Ave and the Guadalupe Reservoir dam; one site is in Saratoga Creek, just upstream of the Saratoga Springs Event Center, and one site is in Stevens Creek at the Valley Water stream gage upstream of Stevens Creek Reservoir.
- There are seven sites with CSCI scores in the "likely altered" condition category (≥ 0.63 to <0.79). Most of these sites have moderately low impervious area (2% to 5%) in their contributing watersheds and are located downstream of major reservoirs. The nine sites with CSCI scores in the "very likely altered" condition category (<0.63) had a range of impervious areas (1% to 13%) in their contributing watersheds.

The ASCI Hybrid (a tool that uses diatom and soft algae data) scores ranged from 0.48 to 0.98 across the 20 sites.

- Seven sites had ASCI Hybrid scores in the two higher condition categories (scores > 0.86). These sites included all four locations in Saratoga Creek, two lower elevation sites in Guadalupe Creek, and the highest elevation site in Stevens Creek. Three of these sites also received CSCI scores in the upper two condition categories.
- Six sites had ASCI Hybrid scores in the "likely altered" (> 0.75 to < 0.86) condition category. Four of these sites had relatively low urban development in their contributing watershed area (impervious area less 4%). The remaining two sites are located in Los Gatos Creek and have moderate urban development in their contributing watersheds (impervious area 7% and 13%).
- The remaining seven sites were ranked as "very likely altered" (ASCI Hybrid score < 0.75). These sites included three locations in Los Gatos Creek, two locations in Alamitos Creek, one in Calero Creek, and one in Stevens Creek below the reservoir.

Physical habitat conditions, as represented by IPI scores, ranged from 0.94 to 1.22 across the 20 bioassessment sites sampled in WY 2021 (Table 2.5). All sites had IPI scores in the top two condition categories (≥ 0.84). Most of the bioassessment sites were in natural channels with minimal modification and relatively wide riparian corridors.

Overall, biological conditions across all the sites were likely impacted by low flow conditions as the result of dry winter (rainfall amounts one of the lowest on record). In WY 2021, the last significant storm event of the year was in January (approximately 3 months prior to bioassessment sampling).

<u>Comparison Between Fish Survey and Bioassessment Data</u>

Thirteen of the WY 2021 bioassessment sites were selected to overlap sites surveyed by Valley Water to assess the condition of steelhead populations. Fish survey data collected by Valley Water in WY 2020 at these 13 bioassessment sites were compiled and evaluated with the bioassessment data collected by the Program to assess whether there was an association between fish metrics and biological condition scores. Fish data include estimated number of native fish, including number and density of juvenile steelhead (total fish per meter length), and total number of native fish species.

No clear correlation between biological condition, based on CSCI and ASCI Hybrid scores, and any of the fish population metrics was observed. In general, CSCI and ASCI Hybrid scores were relatively low across all 13 fish survey locations, except for three sites in Guadalupe Creek, which scored in the upper two condition categories for either CSCI or ASCI Hybrid scores. Site CG004 in Guadalupe Creek appeared to have the best overall conditions for both fish (i.e., relatively high numbers of juvenile steelhead trout and riffle sculpin) and biological condition (i.e., CSCI = 0.93, ASCI Hybrid = 0.87).

Several sites with low CSCI scores had relatively larger numbers of juvenile steelhead trout. All three sites in Stevens Creek and the upper site in Alamitos Creek, had juvenile steelhead trout densities greater than 0.1 fish/meter, but had CSCI scores in the lowest condition category, ranging between 0.48 and 0.59.

The lack of relationship between CSCI scores and steelhead trout populations may be explained by differences in the life stages and residence times for fish and BMI assemblages. Juvenile steelhead life stage in the creek typically spans between one and two years. During this period, steelhead trout can be highly mobile, spawning and rearing in different creek segments, and potentially migrating to other areas in search of food or to avoid stressors (e.g., high temperatures, low DO). In contrast, BMI are much more short-lived, less mobile, and thus, more sensitive to episodic and/or seasonal changes in water quality and physical habitat conditions.

Valley Water monitoring results of juvenile steelhead trout condition in WY 2020 suggest food resources are not limiting growth. Fish condition, as measured by body size, was relatively consistent across all four creeks, with mean relative weights (i.e., weights measured for steelhead captured across all sites within each creek) ranging between 100 and 110%. The mean relative weights for all creeks were within the range considered optimal for juvenile steelhead.

The BMI data were analyzed to assess potential food resources for juvenile steelhead trout across the thirteen sites.

- The highest overall BMI abundance occurred in samples collected at sites in Guadalupe Creek (Table 2.12). Precent individuals of Ephemeroptera and Plecoptera taxa (EP Taxa), a preferred food source, were highest (16%) at sites in Arroyo Calero Creek. Worms were most abundant at lower elevation site in Alamitos Creek and all three sites in Stevens Creek. Amphipods were only observed at sites in Arroyo Calero.
- In contrast, chironomids, a taxon that colonizes disturbed habitat, were by far the most abundant across all sites, with the exception of sites in Arroyo Calero. New Zealand Mud Snails, an invasive exotic, were relatively abundant in two lower elevation sites in Stevens and the upper site in Arroyo Calero.
- Zooplankton drift (too small to capture in nets used for BMI sampling) originating from upstream reservoirs may also be an important food source for steelhead.

Additional studies are needed to determine what BMI taxa juvenile steelhead trout are consuming in sites within the Santa Clara Valley. Existing data suggest that steelhead are likely feeding on available food sources, which are variable across sites and dependent on flow conditions.

<u>Temporal Variability in Biologic Condition</u>

Changes in biological conditions, based on CSCI scores, were evaluated at 13 targeted sites by comparing CSCI scores calculated using WY 2021 BMI data to scores calculated at the same sites during events prior to 2021. In general, CSCI scores were relatively consistent across sampling events between the two timeframes. Eight sites had minimal scoring differences, ranging between 0.01 to 0.07 points. Larger differences in CSCI scores (> 0.15 points) were observed at the remaining five sites. CSCI scores dropped 0.2 – 0.3 points at one site in Guadalupe Creek and two sites in Saratoga Creek. In contrast, CSCI scores increased 0.15 to 0.24 at one site in Los Gatos Creek and one site in Stevens Creek. It is not clear if the larger differences in CSCI scores at these five sites can be attributed to flow conditions or impacts from other stressors.

7.1.2 Continuous Monitoring for Temperature and General Water Quality

Continuous monitoring of water temperature and general water quality in WY 2021 was conducted in compliance with provision C C.8.d.iii – iv of the MRP. Hourly temperature measurements were recorded at nine sites in the Upper Penitencia Creek watershed from April through September. General water quality parameters (specific conductance, DO, pH, and temperature) were recorded continuously (15-minute interval) at four sites in Lost Gatos Creek during two 1 to 2-week periods in spring (Event 1) and summer (Events 2.1 or 2.2). Monitoring was conducted to address the following management questions from the BASMAA RMC Creek Status and Long-Term Trends Monitoring Plan (BASMAA 2012):

1. *What is the spatial and temporal variability in water quality conditions during the spring and summer season?*
2. *Do general water quality measurements indicate potential impacts to aquatic life?*

Sites with continuous monitoring results exceeding the MRP trigger criteria and/or WQOs are added to the list of trigger exceedances maintained by the Program.

<u>Temperature</u>

For the second year in a row, continuous temperature monitoring was conducted along stream reaches in Upper Penitencia Creek and its tributary Arroyo Aguague within Alum Rock Park. These reaches were targeted for temperature monitoring because they convey perennial flow and support rearing and spawning habitat for steelhead and other native fishes (Stillwater Sciences 2006). In general, water temperatures in WY 2021 were lower at the upstream sites compared to the downstream locations in Upper Penitencia Creek and Arroyo Aguague. Temperatures at all stations followed a similar pattern with temperatures gradually increasing from the time loggers were deployed in April through early-August, and then leveling off and perhaps even gradually decreasing until the loggers were removed on September 1, 2021. Within this overall pattern there were several multi-day spikes in water temperature corresponding to local heat waves. Although few instantaneous measurements exceeded the maximum MRP threshold of 24°C, more than two MWAT values at seven of the nine stations exceeded the MRP threshold of 17°C; thus these sites were added to the list of trigger exceedances that is maintained by the Program. Based on descriptive statistics (minimum, maximum, average), WY 2021 temperatures were slightly lower than those recorded in WY 2020. Exceedances of the MWAT trigger may not be of concern in Santa Clara County because the MWAT threshold was developed for streams of the Pacific Northwest, a cooler region with inherently lower water temperatures (Sullivan et al. 2000).

<u>General Water Quality</u>

Continuous general water quality monitoring was conducted at four stations in Los Gatos Creek. Monitoring results for temperature, pH, and specific conductance followed predictable patterns at all four sites during the two events. Unfortunately, most of the DO results at the uppermost site (205R03630) were rejected three to four days into each event due to sensor failure. A substantial number of instantaneous measurements exceeded the maximum MRP temperature threshold of 24°C. In addition, all four sites exceeded the MRP triggers for MWAT. The MRP trigger for DO was exceeded at all stations during Event 1, and at two stations (LG004 and 205R03530) during Event 2. All four stations were added to the list of sites with trigger exceedances.

7.1.3 Pathogen Indicators

Pathogen indicator monitoring in WY 2021 was conducted in compliance with provision C.8.d.v of the MRP. Samples for pathogen indicator analysis were collected during one monitoring event at five sites that, while generally not considered "bathing beaches," are located within creekside parks or along trails with a potential for public access to water. Most of the stations targeted in WY 2021 were also sampled in prior years. The overall goal of pathogen indicator monitoring is to assess whether WQOs are being met (i.e., supportive of REC-1 beneficial uses).

In WY 2021, no samples exceeded the MRP trigger or the more conservative statewide WQO for *E. coli*. Two samples, collected from Los Gatos Creek at Vasona Park (205LGA400) and Stevens Creek at Blackberry Farm (205STE064), did exceed the MRP trigger for enterococci. Enterococci was not adopted by the State for use as a pathogen indicator in freshwaters; therefore, there is no WQO to use for comparison. A review of pathogen indicator monitoring results from the same stations in prior years suggest that pathogen indicator densities at the monitoring stations are highly variable.

It is important to recognize that pathogen indicators do not directly represent actual pathogen concentrations and do not distinguish among sources of bacteria. Sources of pathogen indicator bacteria in the targeted creeks may include homeless encampments, wildlife, pets, leaking septic systems/sanitary sewers, and regrowth of bacteria in the environment. It is the human sources of bacteria that are of primary concern for REC-1 health risks. As a result, the comparison of pathogen indicator results to pathogen indicator thresholds may not indicate that a health risk is present, and therefore should be interpreted cautiously.

7.1.4 Chlorine Monitoring

In compliance with Provision C.8.c.ii, free chlorine and total chlorine residual were measured at 20 sites concurrent with bioassessment surveys. While chlorine residual is generally not a concern in Santa Clara Valley urban creeks, monitoring results suggest there are occasional free chlorine and total chlorine residual exceedances in the County. Trigger exceedances that are observed are usually the result of a one-time potable water discharges (e.g., pool dewatering) that are difficult to trace. Furthermore, chlorine in surface waters can dissipate from volatilization and reaction with dirt and organic matter. In WY 2021, there was one exceedance of the MRP trigger for chlorine, a result that was greater than 0.1 mg/L. This result was followed up immediately by County staff with field evaluations and public education material distribution. It was suspected that a fire hydrant leak caused this one-time exceedance, and it was properly managed. The Program will continue to monitor chlorine in compliance with the MRP and will follow-up with illicit discharge staff as needed.

7.1.5 Pesticides and Toxicity Monitoring

Toxicity testing of water and sediment samples and sediment chemistry monitoring, collectively referred to as pesticides and toxicity monitoring, was conducted during WY 2021 in compliance with provision C.8.g of the MRP. Samples were collected from Stevens Creek and San Tomas Aquino Creek at the same stations that were monitored for pesticides and toxicity during WY 2016 to WY 2020.

Data Evaluation Summary

Five toxicity test species are analyzed in water samples and two test species in sediment samples. The test organism *H. azteca*, required for water and sediment samples is known to be sensitive to pyrethroid pesticides. The test organism *C. dilutus*, is known to be sensitive to neonicotinoids. A two-tiered approach is applied to assess toxicity. First, organism responses from ambient samples are compared to responses from appropriate laboratory control samples using a statistical comparison. This is followed by a comparison to a “threshold value” or “Percent Effect” that indicates the magnitude of the difference in response. If the MRP trigger threshold of 50 Percent Effect is exceeded, a follow-up sample is collected.

Sediment chemistry data for metals and PAHs are compared to Threshold Effect Concentrations (TECs) and Probable Effect Concentrations (PECs) published by MacDonald et al. (2000). Most samples in Santa Clara County have chromium and nickel concentrations that exceed the TEC and PEC. These metals are naturally occurring in the serpentine formations that underly mountains and hills in the region. Sediment chemistry data for pyrethroid and fipronil pesticides are compared to TOC-normalized LC50s, calculated as TU equivalents.

WY 2021 Results

In WY 2021, SCVURPPP conducted dry weather pesticides and toxicity monitoring at two stations (Stevens Creek and San Tomas Aquino Creek). In San Tomas Aquino, statistically significant toxicity to *C. dubia* (reproduction) was observed in the water sample and statistically significant toxicity to *C. dilutus* was observed in the sediment sample. The magnitude of the toxic effects in the sediment sample exceeded the MRP trigger of 50 Percent Effect for *C. dilutus*, but the threshold was not exceeded for *C. dubia* in water. Therefore, a follow-up sample was warranted for *C. dilutus* in sediment. However, the follow up sample was not carried out due to an error in communication between SCVURPPP and the field subcontractor. Instead of retesting a sediment sample for *C. dilutus* (survival), a secondary water test for *C. dubia* was collected on August 18, 2021. The results from the secondary water test resulted in a less than significant effect for *C. dubia* (survival and reproduction).

In Stevens Creek, statistically significant toxicity to *C. dubia* (reproduction) was also observed in the water sample with a Percent Effect above the follow up threshold of 50%. However, the follow-up sample was not successfully carried out due the error in communication between SCVURPPP and the field subcontractor. Instead of collecting a water sample to test for *C. dubia* chronic toxicity, a second sediment sample was collected on August 18, 2021 and tested for *C. dilutus* toxicity.

Pesticide concentrations in the WY 2021 sediment samples were all very low, most below the MDL. When normalized to TOC, the sum of the TU equivalents calculated for pyrethroid pesticides were 0.5 in Stevens Creek and 0.7 in San Tomas Aquino. Fipronil and its degradates were all below the MDL.

WY 2016 – WY 2021 Data Summary

The results of pesticides and toxicity monitoring conducted in San Tomas Aquino and Stevens Creek during WY 2016 through WY 2021 were analyzed to identify trends.

- Toxicity to *H. azteca*, a test organism known to be sensitive to pyrethroid pesticides, was not observed in dry season sediment or water samples but was observed in the wet weather water samples collected in WY 2018.

- Toxicity to *C. dilutus*, a test organism known to be sensitive to neonicotinoids (e.g., imidacloprid) and fipronil, was observed in sediment and water samples collected during the dry season. Two of the *C. dilutus* tests in sediment samples resulted in a Percent Effect exceeding the MRP threshold for resampling.
- Of the 19 dry season samples where significant toxicity was observed, half were water samples with *C. dubia* reproduction toxicity. *C. dubia* is a water flea that is sensitive to a broad range of aquatic contaminants. However, the specific cause of the chronic *C. dubia* toxicity in San Tomas Aquino and Stevens Creek is unknown, and not seemingly explained by the synoptic sediment chemistry results. It is possible that the chronic *C. dubia* toxicity observed in water samples are false positives resulting from inconsistencies in laboratory QA procedures. Statewide, there have been other reports of unexplained chronic *C. dubia* toxicity, and the State Water Board is currently carrying out a Special Study to examine the issue.

Between WY 2016 and WY 2021, no sediment samples in San Tomas Aquino or Stevens Creek had PEC quotients that exceeded 1.0 for analytes other than chromium and nickel. When chromium and nickel (present in local native soils) are excluded, four samples in the WY 2016 through WY 2021 dataset had TEC quotients ≥ 1.0, the more conservative of the two sediment chemistry evaluation criteria. These include total PAHs from Stevens Creek in WY 2017 and WY 2018, and zinc and copper from Stevens Creek and San Tomas Aquino Creek in WY 2020. Overall, detection frequencies for bifenthrin and fipronil were on par with results from the DPR Northern California study (Ensminger 2021) and *H. azteca* toxicity responses were similar to SPoT monitoring in Coyote Creek and Guadalupe River (Phillips et al. 2020).

The pesticides and toxicity data collected from WYs 2014 through 2021 provide a reference to inform management decisions regarding water quality improvement in Santa Clara County watersheds and guide the planning of future monitoring in the area.

7.2 WY 2021 Trigger Assessment

The MRP requires analysis of the monitoring data to identify candidate sites for SSID projects. Trigger thresholds against which to compare the data are provided for most monitoring parameters in the MRP and are described in the foregoing sections of this report. Stream condition was assessed based on CSCI scores that were calculated using BMI data. Nutrient data were evaluated using applicable water quality standards from the Basin Plan (SFBRWQCB 2017). Water and sediment chemistry and toxicity data were evaluated using numeric trigger thresholds specified in the MRP. In compliance with provision C.8.e.i of the MRP, all monitoring results exceeding trigger thresholds are added to a list of candidate SSID projects that will be maintained throughout the permit term. Table 7.1 lists sites with trigger exceedances based on WY 2021 Creek Status and Pesticides & Toxicity monitoring data. Trigger and WQO exceedances from WY 2014 through WY 2020 were reported in the IMR (SCVURPPP 2020) and prior UCMRs (SCVURPPP 2015, 2016, 2017, 2018, and 2019a, 2021). As described in Part B of this UCMR, the required number of SSID projects have been completed.

Additional data analysis is provided in the previous sections of this report and should be considered prior to selecting and defining SSID and other follow-up projects. The analyses include review of physical habitat and water chemistry data to identify potential stressors that may be contributing to degraded or diminished biological conditions. Analyses in this report also include historical and spatial perspectives that help provide context and deeper understanding of the trigger exceedances.

Table 7.1. Summary of SCVURPPP Trigger Threshold Exceedance Analysis, WY 2021. "No" indicates samples were collected but did not exceed the MRP trigger; "Yes" indicates an exceedance of the MRP trigger.

Station ID	Creek	Bioassessment [1]	Nutrients [2]	Chlorine [3]	Water Toxicity [4]	Sediment Toxicity [4]	Sediment Chemistry [5]	Continuous Temperature [6]	Dissolved Oxygen [7]	pH [8]	Specific Conductance [9]	Pathogen Indicators [10]
AC002	Alamitos Creek	Yes	No	No	--	--	--	--	--	--	--	--
AC004	Alamitos Creek	Yes	No	Yes	--	--	--	--	--	--	--	--
CC001	Arroyo Calero	Yes	No	No	--	--	--	--	--	--	--	--
CC003	Arroyo Calero	Yes	No	No	--	--	--	--	--	--	--	--
GC003	Guadalupe Creek	Yes	No	No	--	--	--	--	--	--	--	--
GC004	Guadalupe Creek	No	No	No	--	--	--	--	--	--	--	--
GC006	Guadalupe Creek	No	No	No	--	--	--	--	--	--	--	--
LG002	Los Gatos Creek	Yes	No	No	--	--	--	--	--	--	--	--
LG003	Los Gatos Creek	Yes	No	No	--	--	--	Yes	Yes	No	No	--
LG004	Los Gatos Creek	Yes	No	No	--	--	--	Yes	Yes	No	No	--
205R01930	Los Gatos Creek	Yes	No	No	--	--	--	Yes	Yes	No	No	--
205R03530	Los Gatos Creek	Yes	No	No	--	--	--	Yes	Yes	No	No	--
205R01706	Saratoga Creek	Yes	No	No	--	--	--	--	--	--	--	--
205R02474	Saratoga Creek	Yes	No	No	--	--	--	--	--	--	--	--
205R03562	Saratoga Creek	Yes	No	No	--	--	--	--	--	--	--	--
205R00170	Saratoga Creek	No	No	No	--	--	--	--	--	--	--	--
SC002	Stevens Creek	Yes	No	No	--	--	--	--	--	--	--	--
SC004	Stevens Creek	Yes	No	No	--	--	--	--	--	--	--	--
SC006	Stevens Creek	Yes	No	No	--	--	--	--	--	--	--	--
205STE095	Stevens Creek	No	No	No	--	--	--	--	--	--	--	--
205COY121	Upper Penitencia Cr	--	--	--	--	--	--	Yes	--	--	--	--
205COY132	Upper Penitencia Cr	--	--	--	--	--	--	Yes	--	--	--	--
205COY135	Upper Penitencia Cr	--	--	--	--	--	--	Yes	--	--	--	--
205COY140	Upper Penitencia Cr	--	--	--	--	--	--	No	--	--	--	--
205COY142	Upper Penitencia Cr	--	--	--	--	--	--	Yes	--	--	--	--
205COY145	Upper Penitencia Cr	--	--	--	--	--	--	No	--	--	--	--
205AAG010	Arroyo Aguague	--	--	--	--	--	--	Yes	--	--	--	--
205AAG015	Arroyo Aguague	--	--	--	--	--	--	Yes	--	--	--	--
205AAG025	Arroyo Aguague	--	--	--	--	--	--	Yes	--	--	--	--
205LGA420	Los Gatos Creek	--	--	--	--	--	--	--	--	--	--	No
205LGA400	Los Gatos Creek	--	--	--	--	--	--	--	--	--	--	Yes
205LGA060	Los Gatos Creek	--	--	--	--	--	--	--	--	--	--	No
205STE065	Stevens Creek	--	--	--	--	--	--	--	--	--	--	No
205STE064	Stevens Creek	--	--	--	--	--	--	--	--	--	--	Yes
205STE021	Stevens Creek	--	--	--	No	Yes	Yes	--	--	--	--	--
205STQ010	San Tomas Aquino Cr	--	--	--	Yes	No	Yes	--	--	--	--	--

Notes:

1. CSCI score ≤ 0.795.
2. Unionized ammonia (as N) ≥ 0.025 mg/L, nitrate (as N) ≥ 10 mg/L, chloride > 250 mg/L.
3. Free chlorine or total chlorine residual ≥ 0.1 mg/L.
4. Test of Significant Toxicity = Fail and Percent Effect ≥ 50 % in initial and follow-up samples.
5. TEC or PEC quotient ≥ 1.0 for any constituent.
6. Two or more weekly average temperature values exceed MWAT of 17.0°C or 20% of results ≥ 24°C.
7. Twenty percent of continuous monitoring results = DO < 7.0 mg/L in COLD streams or DO < 5.0 mg/L in WARM streams.
8. Twenty percent of continuous monitoring results = pH < 6.5 or pH > 8.5.
9. Twenty percent of continuous monitoring results = specific conductance > 2000 uS.
10. Enterococcus ≥ 130 cfu/100ml or *E. coli* ≥ 410 cfu/100ml.

7.3 Recommendations

The recommendations presented in this section are directed towards the implementation of monitoring requirements in Provisions C.8.d and C.8.g through the remainder of the term during which MRP 2.0 remains in effect. At this time, it is anticipated that MRP 2.0 will be replaced with MRP 3.0 in July 2022. Thus, the current monitoring requirements will likely be in effect throughout most of WY 2022. Based on review of the Tentative Order, it appears likely that all Creek Status Monitoring will be eliminated under MRP 3.0.

The following recommendations are based on findings from ten years (WY 2012 through WY 2021) of Creek Status and Pesticides/Toxicity monitoring conducted by SCVURPPP, as well as reflections on other monitoring, data analysis, and policy development projects being conducted in the region and statewide.

- **Biological Condition Assessment.** The probabilistic sample draw for sites in Santa Clara County has been exhausted. As a result, similar to WY 2021, SCVURPPP will select all 20 WY 2022 bioassessment sites on a targeted basis. Program staff will work with SCVURPPP Permittees and stakeholders to identify WY 2022 bioassessment sites.

- **Continuous Monitoring for Temperature and General Water Quality** has been an effective tool in supporting SSID studies and evaluating the condition of cold-water habitat (COLD) and warm water habitat (WARM) beneficial uses. Program staff will work with SCVURPPP Permittees and stakeholders to identify WY 2022 continuous monitoring sites.

- **Pathogen Indicator Monitoring.** The Program will continue to comply with Provision C.8.d.v requirements by collecting five samples for pathogen indicator analysis.

- **Chlorine Monitoring**. The Program will continue to comply with Provision C.8.d.ii requirements by measuring free and total chlorine in 20 samples. Measurements will be made synoptic with bioassessment monitoring.

- **Pesticides and Toxicity Monitoring** will be conducted during the dry season at the same two stations targeted in WYs 2016 through 2021: Stevens Creek and San Tomas Aquino Creek. The full dataset from these stations (WY 2016 – WY 2021) will be evaluated in the WY 2022 UCMR.

7.4 Management Implications

The Creek Status and Pesticides and Toxicity Monitoring program (consistent with Provisions C.8.d and C.8.g of the MRP) implemented by SCVURPPP focuses on assessing the water quality condition of urban creeks in the Santa Clara Valley and identifying stressors and sources of impacts observed.

This *Urban Creeks Monitoring Report Part A: Creek Status and Pesticides & Toxicity Monitoring* presents bioassessment and stressor data collected in WY 2021, and builds on the findings of the Program's *Integrated Monitoring Report* (SCVURPPP 2020) which presented a comprehensive review of data collected in WY 2012 through WY 2019, as well as the WY 2020 UCMR (SCVURPPP 2020). Bioassessment data suggest that most urban streams in the Santa

Clara Valley have *likely altered* or *very likely altered* populations of aquatic life indicators (e.g., BMIs, algae). These poor stream conditions are likely the result of long-term changes in stream hydrology, channel geomorphology, in-stream habitat complexity, and other modifications to the watershed and riparian areas associated with the urban development that has occurred over the past 60-plus years. Additionally, episodic or site-specific increases in temperature (particularly in lower creek reaches or reaches directly below reservoirs) may not be optimal for aquatic life in some local creeks. In contrast, non-urban creeks are generally in good biological condition with good water quality.

The Program and its Co-permittees are actively implementing many stormwater management programs to address stressors and associated sources of water quality conditions observed in local creeks, with the goal of protecting these natural resources. For example:

- In compliance with provision C.3 of the MRP, new and redevelopment projects in the Bay Area are now designed to more effectively reduce water quality and hydromodification impacts associated with urban development. Low impact development (LID) and Green Stormwater Infrastructure (GSI), such as rainwater harvesting and use, infiltration, and biotreatment are required as part of development and redevelopment projects. In addition, Green Infrastructure planning is now part of all municipal projects. These LID and GSI measures are expected to reduce the impacts of urban runoff and associated impervious surfaces on stream health. The Program maintains a GSI Database that tracks these projects and illustrates their geographic scope.
- In compliance with provision C.7 of the MRP, the Program and its Co-permittees are implementing in-person and virtual stormwater outreach activities through the Watershed Watch Campaign (Campaign) that encourages citizens and youth to make watershed-friendly choices. Pollution prevention messages are delivered at eight to ten community events per year, communicating the value and protection of creeks' natural resources to citizens both in plain non-scientific wording and multiple native languages (e.g., Spanish, Vietnamese, Chinese). Media advertising, such as the Earthquakes' and Sharks' collaborations, teach citizens how to dispose properly of litter, hazardous wastes, and car wash water. The Campaign also conducts numerous activities and sessions to educate children about watersheds and urban runoff pollution prevention through the Don Edwards San Francisco Bay National Wildlife Refuge, including watershed-focused field trips, marsh walks, gardening events, bird watching, and wildlife observation. Additionally, the Campaign supports the musical assembly program, ZunZun that engages students through music and theatre while teaching them about stormwater, watersheds, and pollution prevention topics. These efforts are expected to encourage watershed-positive behavior change in Santa Clara Valley residents.
- In compliance with provision C.9 of the MRP, the Program and Co-permittees are implementing pesticide toxicity control programs that focus on source control and pollution prevention measures. The control measures include the implementation of integrated pest management (IPM) policies/ordinances, public education and outreach programs, pesticide disposal programs, and sustainable landscaping requirements for new and redevelopment projects. These efforts will eventually be supplemented by the statewide Urban Pesticides Amendments which will seek to manage pesticide usage via state and federal pesticide regulatory authorities such as DPR and USEPA. The anticipated result is a reduction in pyrethroids and other pesticides in urban stormwater runoff and a reduction in the magnitude and extent of toxicity in local creeks. The Urban Pesticides Amendments team is also proposing a statewide monitoring program that will substitute for pesticides and toxicity monitoring requirements in MS4 permits, such as

the MRP. The goal is to generate useful data at minimal cost and standardize information at the statewide level. The Draft Amendments will likely be released for public review sometime in 2022 with adoption anticipated in 2023. At this time, the mechanism for implementing the statewide monitoring program is uncertain.

- Trash loadings to local creeks have been reduced through implementation of new control measures in compliance with provision C.10 of the MRP and other efforts by Co-permittees to reduce the impacts of illegal dumping directly into waterways. These actions include the installation and maintenance of trash capture systems, the adoption of ordinances to reduce the impacts of litter prone items, enhanced institutional controls such as street sweeping, and the on-going removal and control of direct dumping. The MRP establishes a mandatory trash load reduction schedule, minimum areas to be treated by trash full capture systems, and requires development and implementation of receiving water monitoring programs for trash.
- In compliance with provisions C.2 (Municipal Operations), C.4 (Industrial and Commercial Site Controls), C.5 (Illicit Discharge Detection and Elimination), and C.6 (Construction Site Controls) of the MRP, Co-permittees continue to implement programs that are designed to prevent non-stormwater discharges during dry weather and reduce the exposure of contaminants to stormwater and sediment in runoff during rainfall events.
- In compliance with provision C.13 of the MRP, copper in stormwater runoff is reduced through implementation of controls such as architectural and site design requirements, prohibition of discharges from water features treated with copper, and industrial facility inspections.
- Mercury and polychlorinated biphenyls (PCBs) in stormwater runoff are being reduced through implementation of the respective Total Maximum Daily Load (TMDL) water quality restoration plans. In compliance with provisions C.11 (mercury) and C.12 (PCBs) of the MRP, the Program will continue to identify sources of these pollutants and will implement control actions designed to achieve minimum load reduction goals. In WY 2020, SCVURPPP documented all existing and planned mercury and PCBs control measures to demonstrate attainment of the goals. Most control measures have multiple stormwater treatment benefits such as peak flow reduction and removal many potential pollutants. Monitoring activities conducted in WY 2021 that specifically target mercury and PCBs are described in the Pollutants of Concern Monitoring Data Report that is included as Part C of this UCMR.
- The stormwater community recognizes that illicit discharges from the increasing number of homeless encampments are having a significant impact on the quality of receiving waters, particularly with respect to bacteria and trash pollutants. Program staff are working with Regional Water Board staff to identify opportunities to address this issue in MRP 3.0.

In addition to the Program and Co-permittee controls implemented in compliance with the MRP, numerous other efforts and programs designed to improve the biological, physical and chemical condition of local creeks are underway. For example, the Valley Water's Integrated Water Resources Master Plan (IWRMP) or "One Water Plan" is an ongoing, multi-year process to develop a framework for long-term management of Santa Clara County water resources. The One Water Plan identifies, prioritizes and implements activities at a watershed scale to meet flood protection, water supply, water quality and environmental stewardship goals and objectives. Additionally, the Santa Clara Basin Stormwater Resource Plan[24] supports the development and implementation of MRP-required GSI Plans and includes a prioritized list of multi-benefit GSI project opportunities that may be eligible for future State implementation grant funds.

Through the continued implementation of MRP-associated and other watershed stewardship programs, SCVURPPP anticipates that stream conditions and water quality in local creeks will continue to improve over time. In the near term, toxicity observed in creeks should decrease as pesticide regulations better incorporate water quality concerns during the pesticide registration process. In the longer term, control measures implemented to “green” the “gray” infrastructure and disconnect impervious areas constructed over the course of the past 60-plus years will take longer to implement. Consequently, it may take several decades to observe the benefits of these important, large-scale watershed improvements in our local creeks. Long-term creek status monitoring programs designed to detect these changes over time are therefore necessary for our collective understanding of the condition, trends, and health of our local waterways.

[24] https://scvurppp.org/swrp/docs-maps/

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ATTACHMENTS

Attachment 1

QA/QC Report

Attachment 2

SCVURPPP Bioassessment Data, WY 2021