Santa Clara Valley
Urban Runoff
Pollution Prevention Program

Watershed Monitoring and Assessment Program

Appendix A
SCVURPPP Creek Status Monitoring Report

Water Year 2014 (October 2013 – September 2014)

Submitted in compliance with Provision C.8.g.iii of NPDES Permit # CAS612008

March 15, 2015

PREFACE

In early 2010, several members of the Bay Area Stormwater Agencies Association (BASMAA) joined together to form the Regional Monitoring Coalition (RMC), to coordinate and oversee water quality monitoring required by the Municipal Regional National Pollutant Discharge Elimination System (NPDES) Stormwater Permit (MRP)[1]. The RMC includes the following participants:

- Clean Water Program of Alameda County (ACCWP)
- Contra Costa Clean Water Program (CCCWP)
- San Mateo County Wide Water Pollution Prevention Program (SMCWPPP)
- Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP)
- Fairfield-Suisun Urban Runoff Management Program (FSURMP)
- City of Vallejo and Vallejo Sanitation and Flood Control District (Vallejo)

This SCVURPPP Creek Status Monitoring Report complies with the MRP Reporting Provision C.8.g for Status Monitoring data (MRP Provision C.8.c) collected in Water Year 2014 (October 1, 2013 through September 30, 2014). Data presented in this report were produced under the direction of SCVURPPP using targeted and probabilistic monitoring designs as described herein.

Consistent with the RMC Creek Status and Long-Term Trends Monitoring Plan (BASMAA 2011), monitoring data were collected in accordance with the BASMAA RMC Quality Assurance Program Plan (QAPP; BASMAA, 2014a) and BASMAA RMC Standard Operating Procedures (SOPs; BASMAA, 2014b). Where applicable, monitoring data were derived using methods comparable with methods specified by the California Surface Water Ambient Monitoring Program (SWAMP) QAPP[2]. Data presented in this report were also submitted in electronic SWAMP-comparable formats by SCVURPPP to the San Francisco Bay Regional Water Quality Control Board (SFRWQCB) on behalf of SCVURPPP Co-permittees and pursuant to Provision C.8.g.

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[1] The San Francisco Bay Regional Water Quality Control Board (SFRWQCB) issued the MRP to 76 cities, counties and flood control districts (i.e., Permittees) in the Bay Area on October 14, 2009 (SFRWQCB 2009). The BASMAA programs supporting MRP Regional Projects include all MRP Permittees as well as the cities of Antioch, Brentwood, and Oakley, which are not named as Permittees under the MRP but have voluntarily elected to participate in MRP-related regional activities.

[2] The current SWAMP QAPP is available at: http://www.waterboards.ca.gov/water_issues/programs/swamp/docs/qapp/swamp_qapp_master090108a.pdf

LIST OF ACRONYMS

ACCWP	Alameda County Clean Water Program
AFDM	Ash Free Dry Mass
AFS	American Fisheries Society
ARP	Alum Rock Park
BASMAA	Bay Area Stormwater Management Agency Association
B-IBI	Benthic Macroinvertebrate Index of Biological Integrity
BMI	Benthic Macroinvertebrate
CCCWP	Contra Costa Clean Water Program
CDFW	California Department of Fish and Wildlife
CEDEN	California Environmental Data Exchange Network
CFU	Colony Forming Units
CRAM	California Rapid Assessment Method
CSBP	California Stream Bioassessment Protocol
CSCI	California Stream Condition Index
CTR	California Toxics Rule
CV	Coefficient of Variation
DO	Dissolved Oxygen
DPS	Distinct Population Segment
DQO	Data Quality Objectives
EDD	Electronic Data Delivery
EMAF	Ecological Monitoring and Assessment Framework
EPT	Ephemeroptera, Plecoptera, Tricoptera
FSURMP	Fairfield Suisun Urban Runoff Management Program
GRTS	Generalized Random Tessellation Stratified
HDI	Human Disturbance Index
IMR	Integrated Monitoring Report
MPC	Monitoring and Pollutants of Concern Committee
MQO	Measurement Quality Objective
MRP	Municipal Regional Permit
MUN	Municipal
MWAT	Maximum Weekly Average Temperature
NIST	National Institute of Standards and Technology
NPDES	National Pollution Discharge Elimination System
O/E	Observed to Expected
PAH	Polycyclic Aromatic Hydrocarbons
PEC	Probable Effects Concentrations
PHAB	Physical habitat assessments
pMMI	Predictive Multi-Metric Index
POTW	Publicly Owned Treatment Works
PRM	Pathogen-related Mortality
PSA	Perennial Streams Assessment
QAPP	Quality Assurance Project Plan

QA/QC	Quality Assurance/Quality Control
RMC	Regional Monitoring Coalition
RMP	Regional Monitoring Program
RPD	Relative Percent Difference
RWB	Reachwide Benthos
RWQCB	Regional Water Quality Control Board
SAFIT	Southwest Association of Freshwater Invertebrate Taxonomist
SCCWRP	Southern California Coastal Water Research Project
SCVURPPP	Santa Clara Valley Urban Runoff Pollution Prevention Program
SCVWD	Santa Clara Valley Water District
SFEI	San Francisco Estuary Institute
SFRWQCB	San Francisco Bay Regional Water Quality Control Board
SMCWPPP	San Mateo County Water Pollution Prevention Program
SOP	Standard Operating Protocol
SQT	Sediment Quality Triad
SSID	Stressor/Source Identification
STA	Standard Taxonomic Assessment
STE	Standard Taxonomic Effort
STV	Statistical Threshold Value
SWAMP	Surface Water Ambient Monitoring Program
TEC	Threshold Effects Concentrations
TKN	Total Kjeldahl Nitrogen
TNS	Target Non-Sampleable
TOC	Total Organic Carbon
TS	Target Sampleable
TU	Toxicity Unit
USEPA	Environmental Protection Agency
WQO	Water Quality Objective

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1.0 INTRODUCTION

This Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP or Program) Creek Status Monitoring Report complies with Reporting Provision C.8.g.iii of the Municipal Regional National Pollutant Discharge Elimination System (NPDES) Stormwater Permit (MRP) for Creek Status Monitoring data collected pursuant to MRP Provision C.8.c during Water Year 2014 (October 1, 2013 to September 30, 2014).

MRP Provision C.8.c 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 SCVURPPP has conducted monitoring in local creeks since 2002 to comply with requirements specified in its NPDES permit issued in 2001 by the San Francisco Bay Regional Water Quality Control Board (SFRWQCB or Water Board). In 2002, the Program developed a Multi-Year Receiving Waters Monitoring Plan defining monitoring and assessment activities designed to assess the condition of beneficial uses in creeks within the Santa Clara Valley. Seventy-three sampling locations in eleven watersheds were monitored between 2002 and 2007. Monitoring indicators included biological assessments, water and sediment chemistry, aquatic toxicity and pathogen indicators. The SCVURPPP also pilot tested the Sediment Quality Triad (SQT) in the Coyote Creek watershed during 2007 and 2008. The SQT evaluates multiple indicators including sediment chemistry, sediment toxicity and bioassessment data. In 2009, the SCVURPPP conducted biological assessments at twenty-two sampling locations in the Guadalupe River watershed.

Creek Status Monitoring required by Provision C.8.c of the MRP builds upon monitoring conducted between 2002 and 2009, is coordinated through the Regional Monitoring Coalition (RMC), and began on October 1, 2011. Creek status monitoring parameters, methods, occurrences, durations and minimum number of sampling sites are described in Table 8.1 of MRP Provision C.8.c. Monitoring results are evaluated to determine whether triggers are met requiring additional Monitoring Projects described in MRP Provision C.8.d.i. Results of Creek Status Monitoring conducted in Water Years 2012 and 2013 were submitted in the Integrated Monitoring Report (SCVURPPP 2014).

Provision C.8.a (Compliance Options) of the MRP allows Permitees 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 a number of the Bay Area Stormwater Agencies Association (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 water quality monitoring required by the MRP[3]. With notification of participation in the RMC, Permittees were required to commence water quality data collection by October 2011. Implementation of the RMC’s Creek Status and Long-Term Trends Monitoring Plan (BASMAA 2012) allows Permittees and the Water Board to modify their existing creek monitoring programs, and 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.

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[3] The San Francisco Bay Regional Water Quality Control Board (SFRWQCB) issued the five-year MRP to 76 cities, counties and flood control districts (i.e., Permittees) in the Bay Area on October 14, 2009 (SFRWQCB 2009). The BASMAA programs supporting MRP Regional Projects include all MRP Permittees as well as the cities of Antioch, Brentwood, and Oakley which are not named as Permittees under the MRP but have voluntarily elected to participate in MRP-related regional activities.

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 Jose, Santa Clara, Saratoga, Sunnyvale, Los Altos Hills, and Los Gatos; Santa Clara Valley Water District; and, Santa Clara County
Clean Water Program of Alameda County (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 Sanitation and Flood Control District

The goals of the RMC are to:

1. Assist Permittees in complying with requirements in MRP Provision C.8 (Water Quality Monitoring);
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., 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 MRP Provision C.8.c is described in the RMC Creek Status and Long-Term Trends Monitoring Plan (BASMAA 2012). The strategy includes local "targeted" monitoring and regional ambient/probabilistic 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 between aquatic life condition in urban and non-urban creeks). Table 1.2 provides a list of which parameters are included in the regional and local programs. This report includes data collected in Santa Clara County under both monitoring components.

Table 1.2. Creek Status Monitoring parameters in compliance with MRP Provision C.8.c and associated monitoring component.

Monitoring Elements of MRP Provision C.8.c	Monitoring Component	
	Regional Ambient (Probabilistic)	Local (Targeted)
Bioassessment & Physical Habitat Assessment	X	
Chlorine	X	
Nutrients	X	
Water Toxicity	X	
Sediment Toxicity	X	
Sediment Chemistry	X	
General Water Quality (Continuous)		X
Temperature (Continuous)		X
Pathogen Indicators		X
Stream Survey (CRAM)[1]		X

Notes: 1. Stream surveys under the SCVURPPP Monitoring Program were conducted at Regional Ambient Monitoring Component sites.

1.1 Watersheds Monitored by SCVURPPP

There are 13 major watersheds within the SCVURPPP jurisdictional boundaries and these watersheds comprise most of the Santa Clara Basin. The watersheds are mapped in Figure 1.1 and their major characteristics are listed in Table 1.3. The Santa Clara Basin – San Francisco Bay south of the Dumbarton Bridge and the 840 square miles that drain to it – is bounded by the Diablo Mountains on the east and the Santa Cruz Mountains to the west and south. Elevations range from sea level at the Bay to almost 4,000 feet in the Santa Cruz Mountains. There is a distinct transition in land use at 600 to 800 feet. Areas above this threshold have steeper slopes and are largely forest and rangeland; below this threshold, an urbanized landscape dominates. The following sections briefly describe the major watersheds, from east to west:

Coyote Creek Watershed

The Coyote Creek Watershed is the largest in the Santa Clara Basin, and covers approximately 320 square miles of area from the Diablo Range on the east side of the Basin to the valley floor. The Creek originates in the mountains northeast of the City of Morgan Hill and flows northwest for approximately 42 miles before entering the Lower South San Francisco Bay. At the base of the Diablo Range, the Creek is impounded by two dams, which form Coyote and Anderson Reservoirs.

Runoff upstream of Coyote Reservoir accounts for about 75 percent of the total runoff for the entire watershed. The boundary between the Diablo Range and the alluvial plain that forms the Santa Clara Valley floor is sharply defined. Four major tributaries flow from the mountains across this alluvial plain to Coyote Creek, including Upper Penitencia Creek, Upper Silver Creek, Lower Silver Creek, and Fisher Creek. The urbanized area of Coyote Creek watershed has dramatically increased since the 1960's, and continues to expand. Since this time, population has increased greatly, and agricultural and grazing lands have been converted to residential communities in the southern region of the Santa Clara Valley, and along the base of the Western Diablo range.

Coyote Creek has historically, and still does support the most diverse fish fauna among the Basin watersheds. It supports 10 to 11 native fish species out of the original 18. Species known to occur currently include Pacific lamprey, steelhead/resident rainbow trout, chinook salmon, California roach, hitch, Sacramento blackfish, Sacramento pikeminnow, Sacramento sucker, threespine stickleback, prickly sculpin, riffle sculpin, staghorn sculpin, and tule perch.

Lower Penitencia Creek Watershed

The Lower Penitencia Creek Watershed covers an area of about 30 square miles, half of which is on the western slopes of the Diablo Mountain Range on the east side of the Santa Clara Basin, and the other half on the valley floor. The major tributaries joining the Lower Penitencia Creek are the East Penitencia Channel and Berryessa Creek.

Lower Penitencia Creek flows from the foothills of the Diablo Range, through undeveloped, unincorporated County land, and continues westerly through largely residential neighborhoods in the Cities of Milpitas and San Jose, transitioning to higher density residential neighborhoods and industrial areas west of Interstate 680.

No native fish communities have been identified in Lower Penitencia Creek watershed.

Guadalupe River Watershed

The Guadalupe River Watershed covers an area of approximately 171 square miles. The headwaters lie in the eastern Santa Cruz Mountains near the summit of Loma Prieta. The Guadalupe River actually begins on the Valley floor at the confluence of Alamitos Creek and Guadalupe Creek, just downstream of Coleman Road in San Jose. From here it flows north, approximately 14 miles until it flows into the Lower South San Francisco Bay via Alviso Slough. On its journey, the Guadalupe River traverses through the town of Los Gatos, and the Cities of San Jose, Campbell, and Santa Clara, and is joined by three other tributaries: Ross, Canoas, and Los Gatos Creeks. The upper watershed is characterized by heavily forested areas with pockets of scattered residential areas. Residential density gradually increases to high density on the valley floor. Commercial development is focused along major surface streets. Industrial developments are located closer to the Bay, primarily downstream of the El Camino Real crossing. Six major reservoirs exist in the watershed: Calero Reservoir on Calero Creek, Guadalupe Reservoir on Guadalupe Creek, Almaden Reservoir on Alamitos Creek, Vasona Reservoir, Lexington Reservoir, and Lake Elsman on Los Gatos Creek. Guadalupe River watershed supports both warm and cold water native fish. Although much of the river is dominated by nonnative fish species, nine native fish species have been collected and/or observed during the last 20 years, including: Pacific lamprey, rainbow/steelhead trout, Chinook salmon, hitch, California roach, Sacramento sucker, threespine stickleback, riffle sculpin, and prickly sculpin. The Guadalupe River supports a reproducing steelhead trout population, as well as a small run of Chinook salmon.

San Tomas Aquino Creek Watershed

The San Tomas Aquino Creek Watershed covers an area of approximately 45 square miles. San Tomas Creek originates in the forested foothills of the Santa Cruz Mountains flowing in a northern direction through the cities of Campbell and Santa Clara, into Guadalupe Slough, and finally into Lower South San Francisco Bay. The major tributaries to San Tomas Aquino Creek include Saratoga, Wildcat, Smith and Vasona Creeks. Of these, Saratoga Creek drains the largest area 17 square miles) and joins San Tomas Creek 1.5 miles upstream of Highway 101. Due to its relatively large size, the Saratoga Creek subwatershed is often viewed as a distinct watershed even though it does not directly drain to Lower South San Francisco Bay.

Most of the San Tomas Aquino watershed is developed as high-density residential neighborhoods, with additional areas developed for commercial and industrial uses The majority of the San Tomas Aquino Creek channel has been modified and lined with concrete (from the Smith Creek confluence in the upper reaches downstream to Highway 101).Hitch is the only native fish found in San Tomas Aquino Creek.

Saratoga Creek, a major tributary to San Tomas Aquino Creek originates on the northeastern slopes of the Santa Cruz Mountains along Castle Rock Ridge at 3,100 feet in elevation. Saratoga creek flows for approximately 4.5 miles in an eastern direction through forested terrain, largely contained within Sanborn County Park. It continues for about 1.5 miles through the low-density residential foothill region of the Town of Saratoga and then for another 8 miles along the alluvial plain of the Santa Clara Valley, through the cities of San Jose and Santa Clara characterized by high-density residential neighborhoods.

Saratoga Creek supports both warm and cold water native fish assemblages. Three native fish species that have been found in the creek include California roach, Sacramento sucker and rainbow trout.

Calabazas Creek Watershed

The Calabazas Creek Watershed covers an area of approximately 20 square miles. This 13.3 mile long creek originates in the northeast-facing slopes of the Santa Cruz Mountains and flows into Lower South San Francisco Bay via Guadalupe Slough. Major tributaries to Calabazas Creek include Prospect, Rodeo, and Regnart Creeks. Additional sources of water to Calabazas Creek include the El Camino storm drain (and the Junipero Serra Channel). The Creek traverses through a small portion of unincorporated County land, and flows through the cities of Saratoga, Cupertino, Sunnyvale, San Jose, and Santa Clara. The upper reaches of Calabazas Creek, where it passes through unincorporated County jurisdiction, and into Saratoga, are rural and the creek is relatively untouched. Lower reaches of the Calabazas Creek Watershed are highly urbanized, predominantly with high-density residential neighborhoods. Areas of heavy industry exist between the Highway 101 and Central Expressway corridors. Commercial development is focused along El Camino Real, Wolfe Road, and Saratoga-Sunnyvale Road. Fish are extremely scarce in the Calabazas Creek upstream of Bollinger Road. Prickly sculpin is the one native species that has been collected and/or observed in Calabazas Creek within the last 20 years.

Stevens Creek Watershed

The Stevens Creek Watershed covers an area of approximately 29 square miles. The headwaters originate in the Santa Cruz Mountains and are mostly protected open space managed by the County and the Mid Peninsula Open Space District. In the upper watershed the mainstem flows southeast for about five miles along the San Andreas Fault, and another three miles northeast to the Stevens Creek Reservoir. From the Reservoir, the Creek flows northward for a total of 12.5 miles through the foothills in the Cities of Cupertino, and Los Altos, and across the alluvial plain through the cities of Sunnyvale, and Mountain View, finally draining into the Lower South San Francisco Bay. Below the reservoir, the watershed is largely developed as residential neighborhoods with commercial areas clustered along major surface streets such as El Camino Real.

Stevens Creek supports both warm and cold water native fish. Five native fish species that have been found in the creek include California roach, Sacramento sucker, threespine stickleback, rainbow/steelhead trout and Pacific lamprey.

Permanente Creek Watershed

The Permanente Creek Watershed covers an area of approximately 17.5 square miles. The headwaters originate near Black Mountain along the Montebello Ridge. Permanente Creek flows east through unincorporated County land for about five miles, then turns to the north at the base of the foothills and continues another eight miles along the valley floor traversing through the cities of Los Altos and Mountain View, finally draining to the Lower South San Francisco Bay. The major tributaries are the West Branch Permanente Creek and Hale Creek.

Unlike most watersheds in the Santa Clara Basin, the headwaters of the Permanente Creek are not protected as open space, but are developed for light industry and mining. Only the headwaters of the West Branch Permanente Creek are protected as open space by the Mid Peninsula Open Space District. The majority of the watershed downstream of this tributary confluence is developed as high-density residential neighborhoods, with commercial development clustered along major surface streets such as El Camino Real. Some heavy industry is clustered adjacent to Highway 101 in the lower watershed by the Bay.

Four species of native fishes have been collected and/or observed from Permanente Creek during the last 20 years: rainbow trout, California roach, Sacramento sucker, and threespine stickleback. The native fish assemblage primarily occurs in the reaches upstream of Interstate 280.

Adobe Creek Watershed

The Adobe Creek Watershed covers an area of approximately 10 square miles, of which roughly 7.5 square miles are mountainous and 2.5 square miles are on the valley floor. Adobe Creek originates on the northeastern facing slopes of the Santa Cruz Mountains and flows northerly over steep forested terrain until it meets the Middle, West and North Adobe Forks. Other major tributaries in the upper watershed are Moody and Purissima Creeks.

The drainage area above the confluence of the Adobe Forks is undeveloped open space. The remainder of the watershed primarily consists of residential development. Along the valley floor, Adobe Creek flows through Los Altos Hills, Los Altos, Palo Alto, and Mountain View. Adobe Creek is joined by Barron Creek west of Highway 101 and continues to flow through estuarine area with tidal influence until it drains into the Palo Alto Flood Basin and then the Lower South San Francisco Bay.

Four species of native fishes have been collected from Adobe Creek: California roach, Sacramento sucker, threespine stickleback, and prickly sculpin.

Matadero Creek Watershed

The Matadero Creek watershed covers an area of about 14 square miles, of which approximately 11 square miles are mountainous land, and 3 square miles are gently sloping valley floor. Matadero Creek originates in the foothills of the Santa Cruz Mountains and flows in a northeasterly direction for approximately eight miles until it discharges into the Palo Alto Flood Basin, and then drains into the Lower South San Francisco Bay. Major tributaries to Matadero Creek are Arastradero and Deer Creeks and Stanford Channel.

Through the foothills, Matadero Creek traverses through low-density residential development in the town of Los Altos Hills. As it nears the valley floor, it flows through the Stanford University Preserve and Campus, and then through residential, commercial, and industrial areas of Palo Alto. The portions of the watershed that fall in the northern part of the City of Palo Alto are predominantly residential, commercial and public/institutional.

Five species of native fishes have been collected and/or observed from Matadero Creek during the last 20 years: California roach, Sacramento blackfish, Sacramento sucker, threespine stickleback, and prickly sculpin.

Barron Creek Watershed

The Barron Creek Watershed covers an area of approximately three square miles of urban development between the Matadero and Adobe Creek watersheds. Barron Creek is approximately 5 miles long, originating in the low-density residential foothill region of the Town of Los Altos Hills and flowing in a northeasterly direction through residential, commercial, and industrial areas within the City of Palo Alto. The Creek joins neighboring Adobe Creek just upstream of Highway 101 and drains via a tide gate to the Lower South San Francisco Bay through the Palo Alto Flood Basin. It has no major tributaries.

Barron Creek has been greatly modified for flood control purposes; approximately 67 percent of the total length of creek bed has been hardened. Upstream of El Camino Real the creek is piped for much of its length. Natural channel sections occur immediately adjacent to Arastradero Road and at the Barron Creek Debris Basin. Downstream of El Camino Real, Barron Creek is contained in a concrete trapezoidal channel. During large storm events, high flows from Barron Creek may be diverted to Matadero Creek via the Barron Creek Bypass structure. No native fish communities have been identified upstream of the tidally influenced area of the creek.

San Francisquito Creek Watershed

San Francisquito Creek and its tributaries drain 47.5 square miles in northwestern Santa Clara and southeastern San Mateo counties. The watershed is bounded to the southwest by the Santa Cruz Mountains. San Francisquito Creek itself flows 12.5 miles from Searsville Dam to the Lower South San Francisco Bay and defines the border between San Mateo and Santa Clara Counties. San Francisquito Creek traverses unincorporated County, Stanford University land, the towns of Portola Valley and Woodside, as well as the cities of Menlo Park, Palo Alto, and East Palo Alto.

The upper watershed is comprised of undeveloped forest and grazing lands and low-density residential neighborhoods. On the valley floor, higher-density residential development exists along with commercial development focused on major surface streets. Stanford University occupies a large portion of the valley portion of the watershed as does the downtown portion of the City of Palo Alto.

The watershed is famous for its reproducing steelhead population. Besides steelhead, native fish found in the watershed are the California roach, Sacramento sucker, hitch, speckled dace, threespined stickleback, and prickly sculpin. Seven nonnative species also exist in the watershed. The threatened California red-legged frog lives along the Creek.

Sunnyvale East Channel

The Sunnyvale East Channel was constructed in 1967 to manage flooding that was becoming a problem due to subsidence of lands in the drainage area. The Sunnyvale East Channel watershed covers 7.1 square miles extending from central Cupertino northeastward through the City of Sunnyvale. The watershed draining to the Channel is located entirely on the alluvial plain of the Santa Clara Valley. The Channel is approximately 6 miles in length and extends from Interstate 280 in the south to Guadalupe Slough in the north. The channel is a man-made feature with no natural antecedent. One quarter of it runs through underground culverts. It drains to the Lower South San Francisco Bay via the Junipero Serra Channel and the Guadalupe Slough.

The Sunnyvale East Channel watershed is almost entirely urbanized with predominately residential development (59%), as well as commercial and industrial (23%). (SCVWD 2005b) The only contiguous open space area in the watershed is the Sunnyvale Baylands along the San Francisco Bay shoreline and smaller city-owned parks in Sunnyvale and Cupertino. No fish species are known to occur upstream of the tidally influenced area.

Sunnyvale West Channel

The Sunnyvale West Channel was constructed in 1964 to manage flooding that was becoming a problem due to subsidence of lands in the drainage area. The Channel watershed drains 7.5 square miles and is entirely located on the alluvial plain of the Santa Clara Valley. The channel originates in the urbanized sections of Sunnyvale and Mountain View. The Channel is approximately 3 miles in length, extending from Guadalupe Slough to Maude Avenue (SCVWD 2005b). From the upper end of the channel at Maude Avenue to Almanor Avenue, the Sunnyvale West Channel is a concrete pipe culvert. Downstream of Almanor Avenue to Mathilda Avenue, the channel is an earth-excavated channel. Sunnyvale West Channel drains to Lower South San Francisco Bay via the Moffett Channel and then the Guadalupe Slough.

The Sunnyvale West Channel watershed is almost entirely urbanized with mostly public/institutional development (31%), as well as industrial (25%) and residential (23%) areas (SCVWD 2005b). The only open space in the watershed is the Sunnyvale Baylands along the San Francisco Bay shoreline and several smaller city-owned parks in Sunnyvale. No fish species are known to occur upstream of the tidally influenced area.

Table 1.3. Characteristics of major watersheds within SCVURPPP boundary.

Watershed	Area (square miles)	Number 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	44.7%	46.5%	11.8%	36.3%	2.7%	2.7%
Barron	15.6	5	15.1	7.9	28.6	60.3%	60.5%	20.1%	7.3%	7.0%	5.1%
Calabazas	20.3	6	12.9	14.1	55.5	NA	54.5%	29.4%	8.8%	5.2%	2.1%
Coyote	321	53	670	36.4	146	11.1%	8.6%	3.7%	49.9%	29.6%	8.2%
Guadalupe	171	50	207	45.5	265	37.1%	29.6%	13.6%	34.7%	15.5%	6.6%
Lower Penitencia	28.6	13	29.2	20.8	61.6	42.9%	30.7%	19.0%	1.1%	38.7%	10.5%
Matadero	14.0	3	18	NA	NA	60.3%	57.1%	5.8%	8.9%	8.2%	20%
Permanente	17.3	7	NA	NA	NA	43.9%	46.3%	13.1%	35.0%	2.8%	2.8%
San Francisquito	42.8	25	90.6	4.8	15.3	20.8%	29.6%	5.2%	44.7%	15.0%	5.5%
San Tomas Aquino	44.8	15	50.5	15.5	79.3	60.1%	53.9%	18.8%	23.7%	0.8%	2.8%
Stevens	29.2	12	54.2	1.1	30.0	28.6%	24.5%	9.0%	49.2%	12.5%	4.8%
Sunnyvale East	7.1	0	0	6.2	26.6	82.2%	65.3%	31.8%	0%	0%	2.9%
Sunnyvale West	7.6	0	0	6.7	18.7	72.4%	20.9%	65.2%	0%	0%	13.9%

Source: http://www.scvurppp-w2k.com/watersheds.shtml
NA – not available

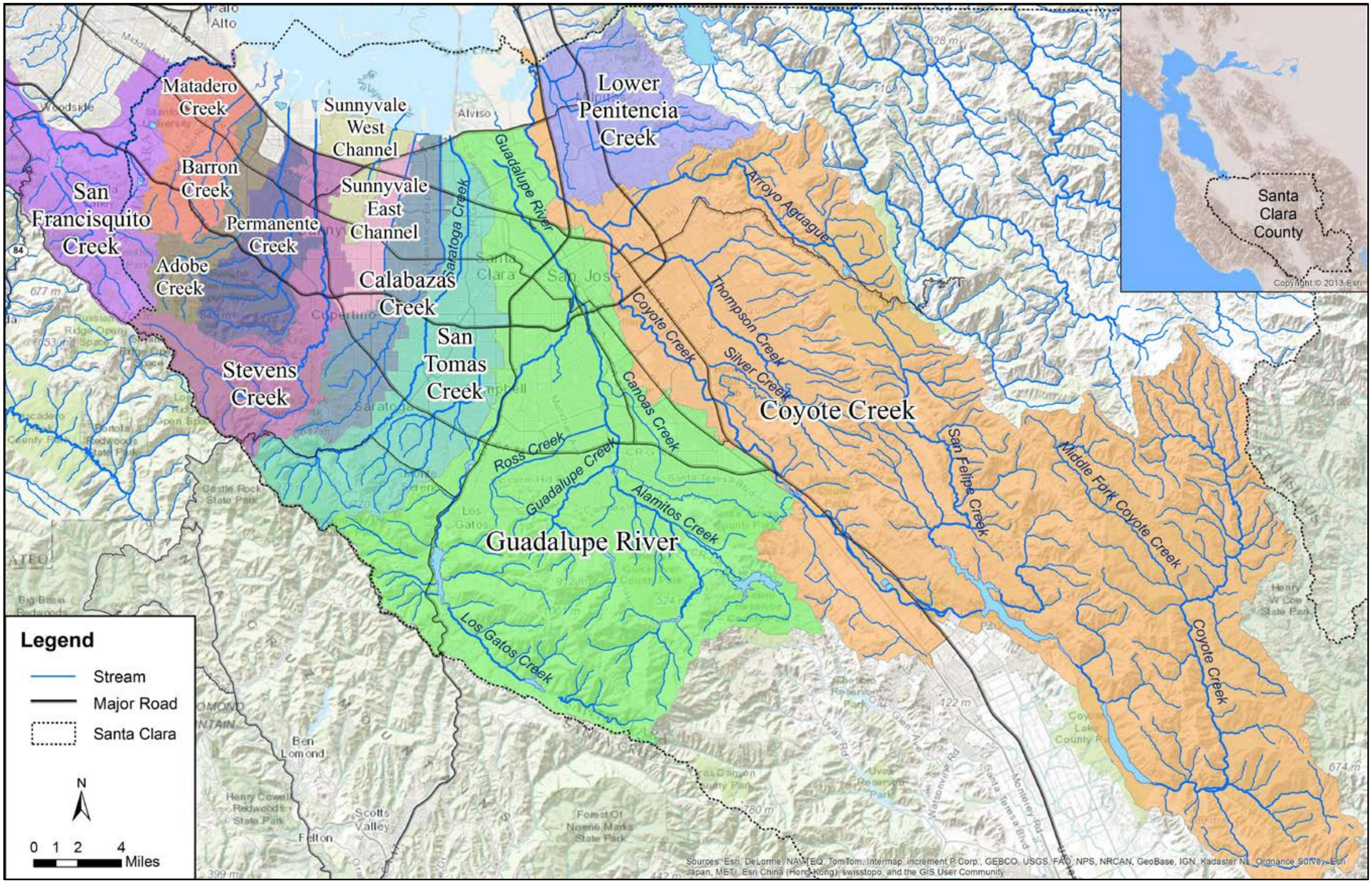

Figure 1.1. Watersheds within SCVURPPP jurisdictional boundaries.

1.2 Designated Beneficial Uses

Beneficial Uses in Santa Clara Valley creeks are designated by the SFRWQCB for specific water bodies and generally apply to all its tributaries. Uses include aquatic life, recreation, human consumption, and habitat. Table 1.4 lists Beneficial Uses designated by the SFRWQCB (2013) for water bodies monitored by SCVURPPP in Water Year 2014.

Table 1.4. Creeks monitored by SCVURPPP in Water Year 2014 and their Beneficial Uses (SFRWQCB 2013).

Waterbody	AGR	MUN	FRSH	GWR	IND	PROC	COMM	SHELL	COLD	EST	MAR	MIGR	RARE	SPWN	WARM	WILD	REC-1	REC-2	NAV
Adobe Creek									E						E	E	E	E	
Arroyo Aguague Creek									E			E	E	E	E	E	E	E	
Arroyo Calero			E						E			E	E	E	E	E	E	E	
Arroyo de las Coches													E		E	E	E	E	
Austrian Gulch Creek			E						E					E	E	E	E	E	
Calera Creek															E	E	E	E	
Canoas Creek															E	E	E	E	
Guadalupe Creek			E	E					E			E	E	E	E	E	E	E	
Guadalupe River				E					E			E	E	E	E	E	E	E	
Los Gatos Creek		E	E	E					E			P	E	P	E	E	E	P	
Lower Silver Creek															E	E	E	E	
Ross Creek				E											E	E	E	E	
San Tomas Aquino Creek									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	
Thompson Creek															E	E	E	E	

Notes:

COLD = Cold Fresh Water Habitat
FRSH = Freshwater Replenishment
GWR - Groundwater Recharge
MIGR = Fish Migration
MUN = Municipal and Domestic Water
EST = Estuarine (the Basin Plan assigns this beneficial use to slough portions of Plummer Creek; for this evaluation WARM is presumed applicable to freshwater portions)

NAV = Navigation
RARE= Preservation of Rare and Endangered Species
REC-1 = Water Contact Recreation
REC-2 = Non-contact Recreation

WARM = Warm Freshwater Habitat
WILD = Wildlife Habitat
P = Potential Use
E = Existing Use
L = Limited Use.
* = "Water quality objectives apply; water contact recreation is prohibited or limited to protect public health" (SFRWQCB 2013).

The remainder of this report describes the two components of the monitoring design (targeted and probabilistic) (Section 2.0); monitoring methods (Section 3.0); data analysis and interpretation methods (Section 4.0); results and discussion, including a statement of data quality, biological condition assessment, and stressor analysis (Section 5.0), and summary conclusions (Section 6.0).

2.0 MONITORING DESIGN

2.1 Targeted Monitoring Design

During Water Year 2014 (WY2014; October 1, 2013 – September 30, 2014) water temperature, general water quality, and pathogen indicators were monitored at selected sites using a targeted monitoring design based on the directed principle[4] 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?
3. What are the pathogen indicator concentrations at creek sites where there is potential for water contact recreation to occur?
4. What are the riparian conditions at bioassessment sampling stations? Are riparian assessments good indicators for condition of aquatic life use? Can they help identify stressors to aquatic life uses?

2.1.1 Targeted Site Selection

General Water Quality

General water quality data (dissolved oxygen, specific conductance, pH, and temperature) were collected at a total of three locations in the Stevens Creek watershed during WY2014 (Table 2.3, Figure 2.3). Two of the sampling stations were located at probabilistic sites (i.e., bioassessment sampling locations in 2014) within the urban area below Stevens Creek Reservoir. These locations were selected to provide water quality data in a reach that supports both rearing and spawning habitat for the existing steelhead population. A third sampling location was established near the urban boundary approximately three miles upstream of the Stevens Creek Reservoir. The upper station was selected to provide water quality data in a perennial reach of the creek upstream of the reservoir.

Temperature

Water temperature was monitored at five sites within the Stevens Creek watershed and at five sites within the Guadalupe Creek watershed during WY2014. Both creeks have dams at the base of the Santa Cruz Mountain foothills that are operated by the Santa Clara Valley Water District, primarily for ground water percolation during the dry season. Temperature stations were located both above and below reservoirs. Both creeks support rainbow trout/steelhead populations, as well as other native fishes.

Three of the five sites in Stevens Creek were located downstream of the Stevens Creek Reservoir; one site at Blackberry Farm; one site at McClellan Ranch and one site at stream gage within Lower Stevens Creek County Park. These locations were selected to provide temperature data in a reach that supports both rearing and spawning habitat for existing steelhead population. The remaining two sites were upstream of the reservoir; one site at the Sycamore Group Picnic Area and the other site adjacent to Stevens Creek Canyon Road (approximately 3 miles upstream of the reservoir). The upper station was selected to provide temperature data in perennial section of the creek upstream of the reservoir.

In Guadalupe Creek, water temperature was monitored at four locations below the Guadalupe Reservoir; one site downstream of Camden and Coleman intersection; one site at the stream gage near Shannon Oaks Lane; one site below the fish ladder; and one site approximately 0.5 mile downstream of the

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[4] 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."

reservoir. All three sites are located in a reach of Guadalupe Creek that can potentially support both rearing and spawning habitat for steelhead. The remaining site was located directly below the confluence of Rincon Creek, which was selected to provide temperature data in the reach upstream of the reservoir.

Pathogen Indicators

Pathogen indicator samples were collected at five sites located in municipal or county owned parks in areas with good public access to creeks and potential for recreational water contact. The five stations were also bioassessment sites sampled in WY2014.

2.2 Probabilistic Monitoring Design

Targeted monitoring may not give an accurate view of background conditions because site selection is biased toward sites where historical or existing water quality concerns have been identified. Therefore, the RMC augments targeted monitoring designs with an ambient (probabilistic) creek status design that was developed to remove bias from site selection. This design allows each individual RMC participating program to objectively assess stream ecosystem conditions within its program area (County boundary) while contributing data to answer regional management questions about water quality and beneficial use condition in San Francisco Bay Area creeks.

The RMC regional probabilistic monitoring design was developed to address the management questions listed below:

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?

These questions will be addressed for the RMC area after a suitable number of sites have been sampled, which is expected to occur after 3 or 4 years.

Table 2.1 illustrates the total number of sites that each RMC Permittee *planned* to sample within the MRP term at the outset of the monitoring program, including sampling efforts planned by SFRWQCB (approximately 2 sites per county per year). Approximately 80 percent of the sites are in urban areas and 20 percent are in non-urban areas[5]. Table 2.1 also illustrates the number of sampling years required to establish statistically representative sample sizes (30 samples) for each of the classified strata in the regional monitoring design[6]. In Santa Clara County, a statistically representative sample of urban sites

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[5] Some sites classified as urban, using the GIS may be considered for reclassification as non-urban based on actual land uses of the drainage area despite location inside municipal jurisdictional boundaries.

[6] 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 2014a).

was anticipated in Year 2 (WY2013) of the program. A statistically representative sample of non-urban sites is not anticipated until Year 5 (WY2016) of the program. Due to unforeseen field circumstances, the actual number of sites sampled and the percentage of urban and non-urban sites may vary. Such outcomes can be addressed in subsequent sampling years.

Table 2.1. Projected number of samples per monitoring year[a]; shaded cells indicate when a minimum sample size may be available to develop a statistically representative data set to address management questions related to condition of aquatic life.

Monitoring Year	RMC Area (Region-wide)		Santa Clara County		Alameda County		Contra Costa County		San Mateo County		Fairfield, Suisun City and Vallejo [b]	
Land Use	*Urban*	*Non-Urban*	*Urban*	*Non-Urban*	*Urban*	*Non-Urban*	*Urban*	*Non-Urban*	*Urban*	*Non-Urban*	*Urban*	*Non-Urban*
Year 1 (WY2012)	48	22	16	6	16	6	8	4	8	4	0	2
Year 2 (WY2013)	100	44	32	12	32	12	16	8	16	8	4	4
Year 3 (WY2014)	156	66	48	18	48	18	24	12	24	12	12	6
Year 4 (WY2015)	204	88	64	24	64	24	32	16	32	16	12	8
Year 5 (WY2016)	256	110	80	30	80	30	40	20	40	20	16	10

[a] Assumes SFRWQCB samples two non-urban sites annually in each RMC County.

[b] Assumes: FSURMP and Vallejo only monitor urban sites; FSURMP monitors 4 sites in Year 2, 3 and 5; and Vallejo monitors 4 sites in Year 3.

2.2.1 RMC Area

The RMC area encompasses 3,407 square miles of land in the San Francisco Bay Area. This includes the portions of the five participating counties that fall within the San Francisco Bay Regional Water Quality Control Board (SFRWQCB) boundary, as well as the eastern portion of Contra Costa County that drains to the Central Valley region (Figure 2.1). Creek status and trends monitoring is being conducted in non-tidally influenced, flowing water bodies (i.e., creeks, streams and rivers) interspersed among the RMC area. The water bodies monitored were drawn from a master list that included all perennial and non-perennial creeks and rivers that run through both urban and non-urban areas within the RMC area.

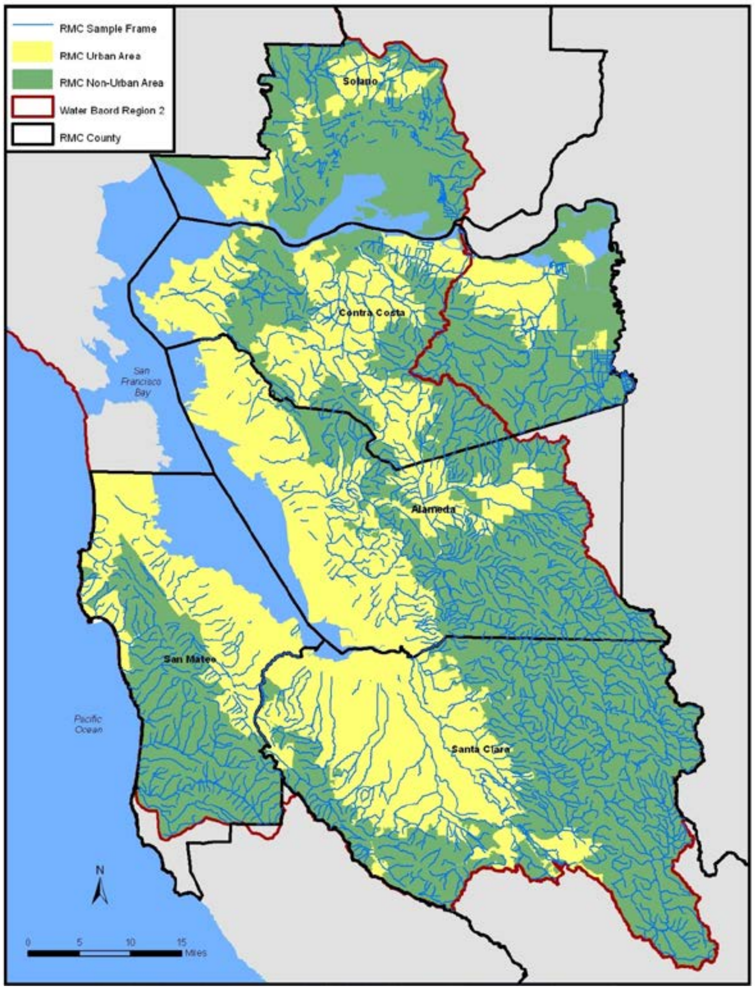

Figure 2.1. Map of BASMAA RMC area showing each member program's boundary and urban and non-urban areas.

2.2.2 Probabilistic Site Selection

The regional probabilistic design was developed using the Generalized Random Tessellation Stratified (GRTS) approach developed by the United States Environmental Protection Agency (USEPA) and Oregon State University (Stevens and Olson 2004). GRTS offers multiple benefits for coordinating amongst 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 recently 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 (SMC 2007). For the purpose of developing the RMC's probabilistic design, the 3,407-square mile RMC area is considered to represent the "sample universe."

Sample sites were selected and attributed using the GRTS approach from a sample frame consisting of a creek network geographic information system (GIS) data set within the RMC boundary (BASMAA 2012). This approach was agreed to by SFRWQCB staff during RMC workgroup meetings although it differs from that specified in MRP Provision C.8.c.iv., e.g., sampling on the basis of individual watersheds in rotation and selecting sites to characterize segments of a waterbody(s). The sample frame includes non-tidally influenced perennial and non-perennial creeks within five management units representing areas managed by the storm water programs associated with the RMC. The sample frame was stratified by management unit to ensure that MRP Provision C.8.c sample size requirements (SFRWQCB 2009) would be achieved.

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 future data coordination with these programs. The RMC sample frame 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 areas within the sample universe (i.e., 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.

Based on discussion during RMC Workgroup meetings, with SFRWQCB staff present, RMC participants weighted their sampling efforts so that annual sampling efforts are approximately 80% in urban areas and 20% in non-urban areas for the purpose of comparison. RMC participants coordinated with the SFRWQCB by identifying additional non-urban sites from their respective counties and providing a list of sites for SWAMP to conduct site evaluations. Since 2012, the SFRWQCB has supplemented the RMC monitoring efforts with 34 additional non-urban probabilistic sites within RMC jurisdiction. The total number of sites has been variable each year, with 6 sites in WY2012, 18 sites in WY2013 and 10 sites in WY2014. Information from these sampling events is included in the Site Evaluation summary (Section 2.2.3) but not included in either the results or discussion sections of this report.

2.2.3 Site Evaluation

Sites identified in the regional sample draw were evaluated by each RMC participant in chronological order using a two-step process described in RMC Standard Operating Procedure FS-12 (BASMAA 2014b), consistent with the procedure described by Southern California Coastal Water Research Project (SCCWRP) (2012). Each site was evaluated to determine if it met the following RMC sampling location criteria:

1. The location (latitude/longitude) provided for a site is located on or is within 300 meters of a non-impounded receiving water body[7];
2. Site is not tidally influenced;
3. Site is wadeable during the sampling index period;
4. Site has sufficient flow during the sampling index period to support standard operation procedures for biological and nutrient sampling.
5. Site is physically accessible and can be entered safely at the time of sampling;
6. Site may be physically accessed and sampled within a single day;
7. Landowner(s) grant permission to access the site[8].

In the first step, these criteria were evaluated to the extent possible using a “desktop analysis.” Site evaluations were completed during the second step via field reconnaissance visits. Based on the outcome of site evaluations, sites were classified into one of three categories:

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[7] The evaluation procedure permits certain adjustments of actual site coordinates within a maximum of 300 meters.

[8] If landowners did not respond to at least two attempts to contact them either by written letter, email, or phone call, permission to access the respective site was effectively considered to be denied.

- **Target** – Target sites were grouped into two subcategories:
  - **Target Sampleable (TS)** - Sites that met all seven criteria and were successfully sampled.
  - **Target Non-Sampleable (TNS)** - Sites that met criteria 1 through 4, but did not meet at least one of criteria 5 through 7 were classified as TNS.
- **Non-Target (NT)** - Sites that did not meet at least one of criteria 1 through 4 were classified as non-target status.
- **Unknown (U)** - Sites were classified with unknown status when it could be reasonably inferred either via desktop analysis or a field visit that the site was a valid receiving water body and information for any of the seven criteria was unconfirmed.

Table 2.2 lists the total number of sites evaluated in Santa Clara County between WY2012 and WY2014, and their classification categories. A handful of the sites classified as non-urban were evaluated by the SFRWQCB for potential SWAMP sampling. Results of the site evaluation are illustrated in Figure 2.2 and described in further detail in Attachment A.

Table 2.2. Results of Probabilistic Site Evaluations for WY2012 through WY2014 by SCVURPPP.

Classification	WY2012		WY2013		WY2014		TOTAL	
	# of Sites	%	# of Sites	%	# of Sites	%	# of Sites	%
Target Sampleable (TS)	21	39	23	29	25	21	69	28
Target Non-Sampleable (TNS)	16	30	18	23	13	11	47	19
Non-Target (NT)	17	31	37	47	55	46	109	43
Unknown (U)	--	--	--	--	26	22	26	10
TOTAL SITES EVALUATED	54	100	78	100	119	100	251	100

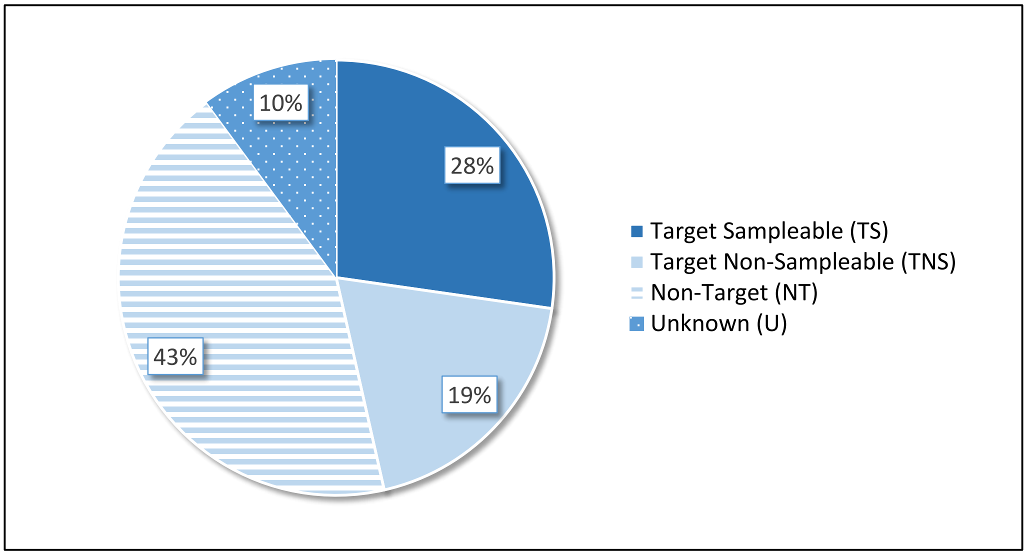

Figure 2.2. Results of Santa Clara County site evaluations for Water Years 2012-2014.

The complete list of target and probabilistic monitoring sites sampled by SCVURPPP in WY2014 is presented in Table 2.3. Monitoring locations with monitoring parameter(s) and year sampled are shown in Figure 2.3.

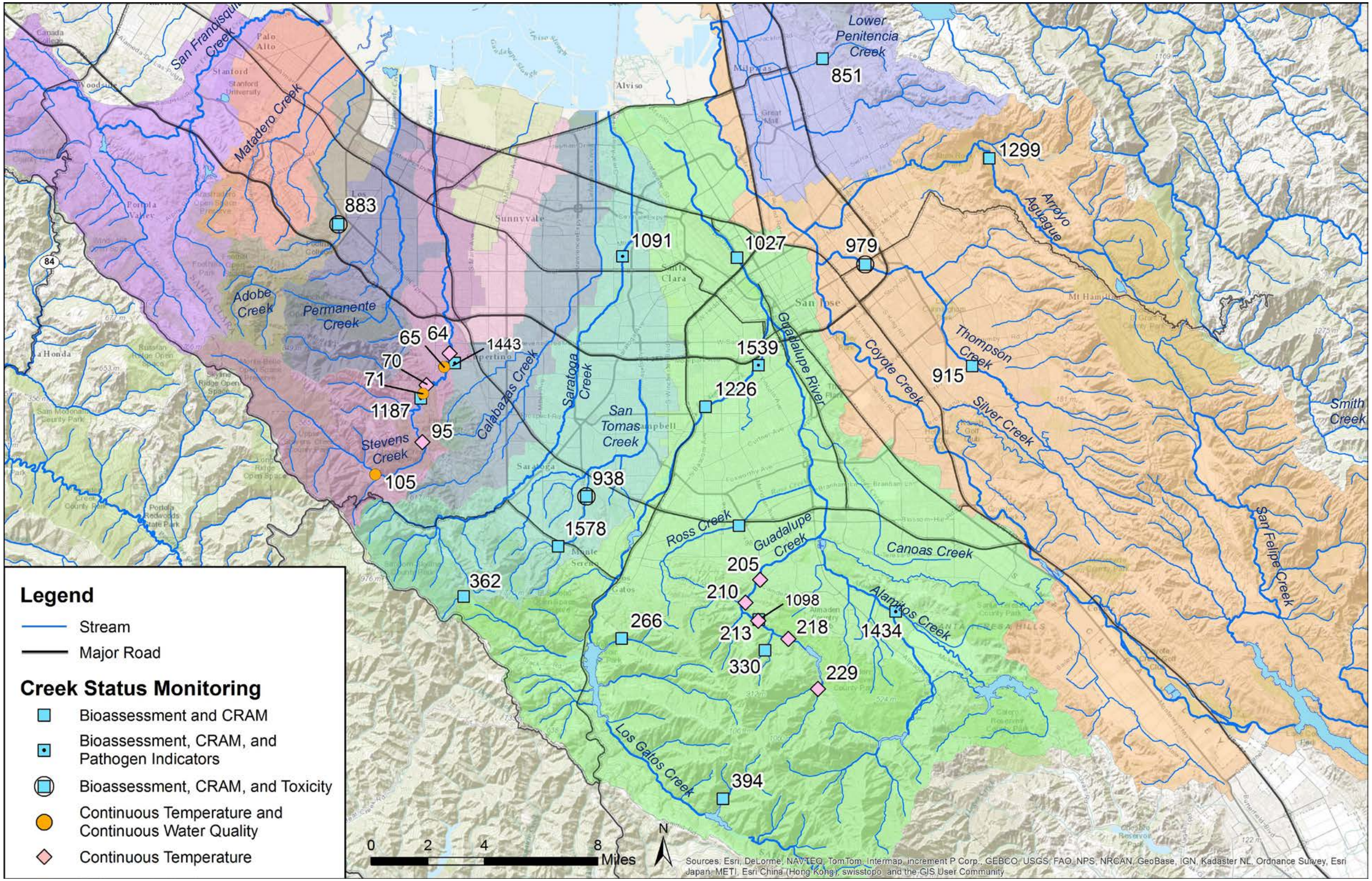

Figure 2.3. Map of SCVURPPP Program Area, major creeks, and sites monitored in WY2014.

Table 2.3. Sites and parameters monitored in WY2014 in Santa Clara County.

Map ID	Station Number	Watershed	Creek Name	Land Use	Latitude	Longitude	Probabilistic Monitoring		Targeted Monitoring			
							Bioassessment, Nutrients, General WQ	Toxicity, Sediment Chemistry	CRAM	Temp	Cont WQ	Pathogen Indicators
266	205R00266	Guadalupe River	Limekiln Creek	NU	37.20297	-121.97351	x		x			
330	205R00330	Guadalupe River	Hick's Creek	NU	37.19825	-121.90036	x		x			
362	205R00362	Guadalupe River	Lyndon Canyon	NU	37.21993	-122.05424	x		x			
394	205R00394	Guadalupe River	Austrian Gulch	NU	37.13783	-121.92191	x		x			
851	205R00851	Lower Penitencia Creek	Los Coches Creek	U	37.43828	-121.87107	x		x			
883	205R00883	Adobe Creek	Adobe Creek	U	37.37108	-122.11822	x	x	x			
915	205R00915	Coyote Creek	Thompson Creek	U	37.31356	-121.79463	x		x			
938	205R00938	San Tomas Aquino	San Tomas Aquino Creek	U	37.26063	-121.99153	x	x	x			
979	205R00979	Coyote Creek	Lower Silver Creek	U	37.35479	-121.84920	x	x	x			
1027	205R01027	Guadalupe River	Guadalupe River	U	37.35753	-121.91463	x		x			
1091	205R01091	Saratoga Creek	Saratoga Creek	U	37.35815	-121.97311	x		x			x
1098	205R01098	Guadalupe River	Guadalupe Creek	U	37.21056	-121.90357	x		x			
1187	205R01187	Stevens Creek	Stevens Creek	U	37.30044	-122.07617	x		x			x
1226	205R01226	Guadalupe River	Los Gatos Creek	U	37.29708	-121.93080	x		x			
1299	205R01299	Coyote Creek	Arroyo Aguague	U	37.39781	-121.78597	x		x			
1306	205R01306	Guadalupe River	Ross Creek	U	37.24872	-121.91370	x		x			
1434	205R01434	Guadalupe River	Arroyo Calero	U	37.21388	-121.83368	x		x			x
1443	205R01443	Stevens Creek	Stevens Creek	U	37.31478	-122.06098	x		x			x
1539	205R01539	Guadalupe River	Los Gatos Creek	U	37.31390	-121.90366	x		x			x
1578	205R01578	San Tomas Aquino	San Tomas Aquino Creek	U	37.24035	-122.00593	x		x			
64	205STE064	Stevens Creek	Stevens Creek		37.31873	-122.06143				x		
65	205STE065	Stevens Creek	Stevens Creek		37.31321	-122.06412				x	x	
70	205STE070	Stevens Creek	Stevens Creek		37.30592	-122.07321				x		
71	205STE071	Stevens Creek	Stevens Creek		37.30253	-122.07487					x	
95	205STE095	Stevens Creek	Stevens Creek		37.28269	-122.07527				x		
105	205STE105	Stevens Creek	Stevens Creek		37.26958	-122.09925				x	x	
205	205GUA205	Guadalupe River	Guadalupe Creek		37.22685	-121.90283				x		
210	205GUA210	Guadalupe River	Guadalupe Creek		37.21748	-121.91031				x		
213	205GUA213	Guadalupe River	Guadalupe Creek		37.21018	-121.90386				x		
218	205GUA218	Guadalupe River	Guadalupe Creek		37.20280	-121.88845				x		
229	205GUA229	Guadalupe River	Guadalupe Creek		37.18241	-121.87341				x		

3.0 MONITORING METHODS

Water quality data were collected in accordance with SWAMP-comparable methods and procedures described in the BASMAA RMC Standard Operating Procedures (SOPs; BASMAA 2014b) and associated Quality Assurance Project Plan (QAPP; BASMAA 2014a). These documents and the RMC Creek Status and Long-Term Trends Monitoring Plan (BASMAA 2012) are updated as needed to maintain their currency and optimal applicability. Where applicable, monitoring data were collected using methods comparable to those specified by the California Surface Water Ambient Monitoring Program (SWAMP) QAPP[9], and were submitted in SWAMP-compatible format to the SFRWQCB. The 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. The SOPs relevant to the monitoring discussed in this report are listed in Table 3.1.

Table 3.1. Standard Operating Procedures (SOPs) pertaining to creek status monitoring.

SOP #	SOP
FS-1	Benthic Macroinvertebrate and Algae Bioassessments, and Physical Habitat Measurements
FS-2	Water Quality Sampling for Chemical Analysis, Pathogen Indicators, and Toxicity Testing
FS-3	Field Measurements, Manual
FS-4	Field Measurements, Continuous General Water Quality
FS-5	Continuous Temperature Measurements
FS-6	Collection of Bedded Sediment Samples
FS-7	Field Equipment Cleaning Procedures
FS-8	Field Equipment Decontamination Procedures
FS-9	Sample Container, Handling, and Chain of Custody Procedures
FS-10	Completion and Processing of Field Datasheets
FS-11	Site and Sample Naming Convention
FS-12	Ambient Creek Status Monitoring Site Evaluation

3.1 Field Data Collection Methods

3.1.1 Bioassessments

In accordance with the RMC QAPP (BASMAA 2014a) 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 (roughly defined as at least 0.5-inch of rainfall within a 24-hour period). During WY2014, a significant storm occurred on April 1st and bioassessments were initiated during the week of April 21st 2014, approximately 20 days following the last storm event. With guidance from SFRWQCB staff, bioassessments began prior to the 30 day grace period due to rapidly declining volume of spring flows and lack of sampleable sites as the result of an extended period of drought.

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[9] The current SWAMP QAPP is available at: http://www.waterboards.ca.gov/water_issues/programs/swamp/docs/qapp/swamp_qapp_master090108a.pdf

Benthic Macroinvertebrates

Each bioassessment sampling site consisted of an approximately 150-meter stream reach that was divided into 11 equidistant transects placed perpendicular to the direction of flow. The sampling position within each transect alternated between 25%, 50% and 75% distance of the wetted width of the stream. Benthic macroinvertebrates (BMIs) were collected from a 1 square foot area approximately 1 m downstream of each transect (see SOP FS-1, BASMAA 2014b). The benthos were disturbed by manually rubbing coarse substrate followed by disturbing the upper layers of substrate to a depth of 4-6 inches to dislodge any remaining invertebrates into the net. Slack water habitat procedures were used at transects with deep and/or slow moving water (Ode 2007). Material collected from the eleven subsamples was composited in the field by transferring the entire sample into one or two 1000 ml wide-mouth jar(s) and preserving it with 95% ethanol.

Algae

Filamentous algae and diatoms were collected using the Reach-Wide Benthos (RWB) method described in SOP FS-1 (BASMAA 2014b). Algae samples were collected synoptically with and immediately after BMI sample collection. The sampling position within each transect was the same as used for BMI sampling; however, samples were collected six inches upstream of the BMI sampling position. The algae were collected using a range of methods and equipment, depending on the particular substrate occurring at the site (i.e., erosional, depositional, large and/or immobile, etc) per SOP FS-1. Erosional substrates included any material (substrate or organics) small enough to be removed from the stream bed, but large enough in size to isolate an area equal in size to a rubber delimiter (12.6 cm2 in area). When a sample location along a transect was too deep to sample, a more suitable location was selected, either on the same transect or from one further upstream.

Algae samples were collected at each transect prior to moving on to the next transect. Sample material (substrate and water) from all eleven transects was combined in a sample bucket, agitated, and a suspended algae sample was then poured into a 500 mL cylinder, creating a composite sample for the site. A 45 mL subsample was taken from the algae composite sample and combined with 5 mL glutaraldehyde into a 50 mL sample tube for taxonomic identification of soft algae. Similarly, a 40 mL subsample was extracted from the algae composite sample and combined with 10 mL of 10% formalin into a 50 mL sample tube for taxonomic identification of diatoms. Laboratory processing included identification and enumeration of 300 natural units of soft algae and 600 diatom valves to the lowest practical taxonomic level.

The algae composite sample was also used for collection of chlorophyll a and ash free dry mass (AFDM) samples following methods described in Fetscher et al (2009). For the chlorophyll a sample, 25 mL of the algae composite volume was removed and run through a glass fiber filter (47 mm, 0.7 um pore size) using a filtering tower apparatus. The AFDM sample was collected using a similar process using pre-combusted filters. Both samples were placed in whirlpaks, covered in aluminum foil and immediately placed on ice for transportation to laboratory.

3.1.2 Physical Habitat

Physical habitat assessments (PHAB) were conducted at each BMI bioassessment sampling event using the PHAB protocols described in Ode (2007) (see SOP FS-1, BASMAA 2014b). Physical habitat data were collected at each of the 11 transects and at 10 additional inter-transects (located between each main transect) by implementing the “Basic” level of effort, with the following additional measurements/assessments as defined in the “Full” level of effort (as prescribed in the MRP): water depth and pebble counts, cobble embeddedness, flow habitat delineation, and instream habitat complexity. At algae sampling locations, additional assessment of presence of micro- and macroalgae was conducted during the pebble counts. In addition, water velocities were measured at a single location in the sample reach (when possible) using protocols described in Ode (2007).

3.1.3 Physio-chemical Measurements

General water quality parameters (dissolved oxygen, temperature, specific conductivity, and pH) were measured concurrent with BMI bioassessment sampling using multi-parameters probes according to SOP FS-3 (BASMAA 2014b). Direct field measurements or grab samples for field measurement purposes are collected from a location where the stream visually appears to be completely mixed. Ideally this is at the centroid of the flow, but site conditions do not always allow centroid collection. Measurements should occur upstream of sampling personnel and equipment and upstream of areas where bed sediments have been disturbed, or prior to such bed disturbance. Field meters are calibrated prior to use and results are recorded on the Field Meter Calibration Record form.

3.1.4 California Rapid Assessment Method for Riverine Wetlands (CRAM)

Assessments using the California Rapid Assessment Method (CRAM) were conducted at the same locations (and reach lengths) monitored for the RMC probabilistic design (i.e., biological and physical habitat assessments, nutrients and physical chemical water quality). CRAM was conducted at bioassessment locations to assess the utility of using CRAM data to explain the aquatic biological condition. CRAM is performed within a defined riparian Assessment Area (AA) and is composed of the following subcategories: 1) buffer and landscape context; 2) hydrology; 3) physical structure; and 4) biotic structure. Procedures describing methods for scoring riparian attributes are described in Collins et al. (2008).

3.1.5 Nutrients and Conventional Analytes

Water samples were collected at probabilistic sites for nutrients and conventional analytes using the Standard Grab Sample Collection Method as described in SOP FS-2 (BASMAA 2014b). Sample containers were rinsed using ambient water and completely filled and recapped below water surface whenever possible. An intermediate container was used to collect water for all sample containers with preservative already added in advance by laboratory. Sample container size and type, preservative type and associated holding times for each analyte are described in Table 1 of SOP FS-9, including field filtration where applicable. Syringe filtration method was used to collect samples for analyses of Dissolved Ortho-Phosphate and Dissolved Organic Carbon. All sample containers were labeled and stored on ice for transportation to laboratory.

3.1.6 Chlorine

Water samples were collected and analyzed for free and total chlorine using a Pocket Colorimeter^{TM} II and DPD Powder Pillows according to SOP FS-3 (BASMAAS 2014b). If concentrations exceed 0.08 mg/L the site is immediately resampled. Chlorine measurements in water are conducted up to twice annually: during spring bioassessments and concurrently with dry season toxicity and sediment chemistry monitoring.

3.1.7 Water Toxicity

Samples were collected at three probabilistic sites for water toxicity. The required number of 4-L labeled amber glass bottles were filled and placed on ice to cool to <6°C. Bottle labels include station ID, sample code, matrix type, analysis type, project ID, and date and time of collection. The laboratory was notified of the impending sample delivery to meet the 24-hour sample delivery time requirement. Procedures used for sampling and transporting samples are described in SOP FS-2 (BASMAA 2014b).

3.1.8 Sediment Toxicity & Chemistry

Sediment samples were collected at three probabilistic sites in June 2014[10] for toxicity and chemical analysis. Before conducting sampling, field personnel surveyed the proposed sampling area for appropriate fine-sediment depositional areas before stepping into the stream, to avoid disturbing possible sediment collection sub-sites. Personnel carefully entered the stream and started sampling at the closest appropriate reach, continuing upstream. Sediment samples were collected from the top 2 cm of sediment in a compositing container, thoroughly homogenized, and then aliquotted into separate jars for chemical or toxicological analysis using standard clean sampling techniques (see SOP FS-6, BASMAA 2014b). Sample jars were submitted to respective laboratories per SOP FS-13 (BASMAA 2014b).

3.1.9 Continuous Temperature Monitoring

Digital temperature loggers (Onset HOBO Water Temp Pro V2) were programmed to record data at 60-minute intervals and were deployed at targeted sites from April through September. Procedures used for calibrating, deploying, programming and downloading data are described in RMC SOP FS-5 (BASMAA 2014b).

3.1.10 Continuous General Water Quality Measurements

Water quality monitoring equipment recording dissolved oxygen, temperature, conductivity, and pH at 15-minute intervals (YSI 6600 data sondes) was deployed at targeted sites for two 2-week periods: once during spring season and once during summer. Procedures used for calibrating, deploying, programming and downloading data are described in RMC SOP FS-4 (BASMAA 2014b).

3.1.11 Pathogen Indicators Sampling

Sampling techniques for pathogen indicators (fecal coliform and *E. coli*) included direct filling of containers at targeted sites and immediate transfer of samples to analytical laboratories within specified holding time requirements. Procedures used for sampling and transporting samples are described in RMC SOP FS-2 (BASMAA 2014b).

3.2 Laboratory Analysis Methods

RMC participants, including SCVURPPP, agreed to use the same laboratories for individual parameters, developed standards for contracting with the labs, and coordinated quality assurance issues. 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 RMC QAPP (BASMAA 2014a). Analytical laboratory methods, reporting limits and holding times for chemical water quality parameters are also reported in BASMAA (2014a). Analytical laboratory contractors 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
- BioVir Laboratories, Inc. – Pathogen indicators

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[10] Table 8-1 of the MRP specifies that sediment toxicity and chemistry parameters are collected during the dry season, defined as July 1st – September 30th. Under guidance from Regional Water Board staff, Program staff collected sediment samples approximately one month prior to the beginning of the dry season to avoid potential dry channel conditions during a drought year. This was the preferred option over potentially selecting new sampling location(s) that were not dry.

4.0 DATA ANALYSIS AND INTERPRETATION METHODS

This section describes methods used to analyze the monitoring data. The analyses include a preliminary condition assessment involving analysis of the biological data to characterize biological conditions within Santa Clara County. The condition assessment is based upon bioassessment scores and seeks to answer management question #2 ***(Are conditions in local receiving water supportive of or likely supportive of beneficial uses?***). The physical, chemical, and toxicity data are analyzed to identify potential stressors that may be impacting water quality and biological conditions and to answer management question #1 ***(Are water quality objectives, both numeric and narrative, being met in local receiving waters, including creeks, rivers, and tributaries?***). An important part of data analysis is review of all field data sheets and laboratory reports for compliance with the SOPs (BASMAA 2014b) and QAPP (BASMAA 2014a).

As the cumulative sample sizes increase through monitoring conducted in future years (Table 2.1), it will be possible to develop a statistically representative data set to address the management questions comparing urban and non-urban conditions and long-term trends. Some comparisons are made in this report using WY2014 data and a condition assessment using bioassessment data from the all three years of the program is in development.

4.1 Biological Condition Indicators

Assemblages of freshwater organisms are commonly used to assess the biological integrity of water bodies because they provide direct measures of ecological condition (Karr and Chu 1999). Benthic macroinvertebrates (BMIs) are an essential link in the aquatic food web, providing food for fish and consuming algae and aquatic vegetation (Karr and Chu, 1999). The presence and distribution of BMIs can vary across geographic locations based on elevation, creek gradient, and substrate (Barbour et al., 1999). These organisms are sensitive to disturbances in water and sediment chemistry, and physical habitat, both in the stream channel and along the riparian zone. Because of their relatively long life cycles (approximately one year) and limited migration, BMIs are particularly susceptible to site-specific stressors (Barbour et al., 1999). Algae are increasingly being used as indicators of water quality as they form the autotrophic base of aquatic food webs and exhibit relatively short life cycles that respond quickly to chemical and physical changes (Fetscher et al. 2013b). Diatoms have been found to be particularly useful for interpreting some causes of environmental degradation (Hill et al. 2000).

Indices of biological integrity (IBIs) are analytical tools that calculate a site condition score based on a series of biological metrics representing taxonomic richness, composition, tolerance and functional feeding groups. IBI development in California is better established for BMIs (i.e., B-IBIs) than for algae. Regional benthic macroinvertebrate IBIs have been developed and tested extensively for four regions of California, including Southern California (Ode et al. 2005), Northern California (Rehn et al. 2005), Eastern Sierra Nevada (Herbst et al. 2009) and the Central Valley (Rehn et al. 2008).

A new assessment tool for BMI data has been developed by the State Water Board to support the development of the State's Biological Integrity Assessment Implementation Plan. The California Stream Condition Index (CSCI) is an assessment tool based on benthic macroinvertebrates that is designed to provide both site-specificity and statewide consistency (i.e., can be applied to all perennial wadeable streams within all ecoregions of California). The performance of the CSCI is supported by the use of a large reference data set that represents the full range of natural conditions in California; and by the development of site-specific models for predicting biological communities. The site-specific model is based on two components:

1) taxonomic completeness, as measured by the ratio of observed-to-expected taxa (O/E); and
2) ecological structure, measured as a predictive multi-metric index (pMMI) that is based on reference conditions (Mazor et al. 2013).

The CSCI is computed as the average of the sum of O/E and pMMI.

The State Board is continuing to evaluate the performance of CSCI in a regulatory context and RWQCB staff has indicated that it will be referenced as a trigger in the re-issuance of the MRP (anticipated effective in 2015). To further test the performance of the CSCI as a biological condition assessment tool, SCVURPPP applied the CSCI to evaluate BMI data collected for Creek Status Monitoring Project.

The State Water Board is developing and testing assessment tools for benthic algae data as a measure of biological condition and identification of potential stressors. A comprehensive set of stream algal IBIs that include metrics for both diatoms and soft-algae, have recently been developed and tested in Southern California (Fetscher et al. 2013a). The study evaluated a total of 25 IBIs comprising of either single-assemblage metrics (i.e., either diatoms or soft algae) or combinations of metrics presenting both assemblages (i.e, “hybrid” IBI). The study identified four high performing IBIs including three hybrid IBIs and one single-assemblage IBI for diatoms. The performance was assessed by the IBIs responsiveness to stress. The H20 IBI was also tested in other ecoregions of the state and showed relatively good performance in Chapparal region, which includes the San Francisco Bay Area (Fetscher et al. 2013b). As a result, the H20 IBI (Algal IBI) was used to evaluate the algae samples collected at SCVURPPP probabilistic sites. The Algae IBI results should be considered preliminary until additional research shows that these tools perform well for data collected in Santa Clara County.

4.1.1 Benthic Macroinvertebrate Data Analysis

California Stream Condition Index Score

Benthic macro-invertebrate (BMI) data collected from 20 probabilistic sites in Santa Clara County in WY2014 were used to calculate CSCI scores. The laboratory analytical methods identified BMIs at a Level 1 Standard Taxonomic Level of Effort, with the additional effort of identifying chironomids (midges) to subfamily/tribe instead of family (Chironomidae). The taxonomic resolution and life stage information for all BMI data was compared and revised when necessary to match the SWAMP master taxonomic list. The CSCI method is dependent on a site’s position within the ecosystem (e.g., climate) and its watershed characteristics (e.g., elevation, soils) (Mazor et al. in review). Delineations for the drainage area upstream of each BMI sampling location were compiled or created in ArcGIS were created using existing GIS watershed/catchment data developed for Santa Clara County (Mattern et al. 2003). In most cases, the existing watershed/catchments required editing the polygon to adjust the downstream edge of the drainage area to the sampling locations.

To develop the CSCI scores, eight additional GIS datasets were compiled from the California Department of Fish and Wildlife and analyzed in ArcGIS to calculate a range of environmental predictors for each sampling location. Site elevation, temperature, and precipitation values were obtained directly at the sampling location. Elevation range was calculated from the difference in elevation in the watershed of the lowest and highest values. Summer precipitation, soil bulk density, soil erodibility, and soil phosphorus content are predictors that are averaged across each watershed, and are calculated in ArcGIS using a zonal statistics tool (http://www.arcgis.com/). The environmental predictors and BMI data were formatted into comma delimited files and used as input for the RStudio statistical package and the necessary CSCI program scripts provided by SCCWRP staff. The CSCI program includes a subsampling routine that produces a standardized number of 500 BMIs. The program output includes a summary table that averages CSCI scores over 20 iterations and calculates O/E and pMMI metrics. The output table also flags sites with inadequate numbers of unambiguous taxa (i.e., CSCI requires at least 360 unambiguous taxa).

Assessing Biological Condition

The CSCI scores were evaluated using condition categories developed by Mazor et al. (in review). Four classes were defined using a distribution of scores at reference calibration sites throughout the State of California (Table 4.1). The categories are described as "likely intact" (greater than 30th percentile of reference site scores); "possibly intact" (between the 10th and the 30th percentiles); "likely altered" (between the 1st and 10th percentiles; and "very likely altered" (less than the 1st percentile).

Table 4.1. Condition categories used to evaluate CSCI scores.

CSCI Score	Category
$\geq$ 0.92	Likely Intact
0.79 – 0.92	Possibly Intact
0.63 – 0.79	Likely Altered
$\leq$ 0.63	Very Likely Altered

4.1.2 Algae Bioassessment

The hybrid IBI ("H20") developed by Fetscher et al. (2013a) for the Draft Southern California Algae IBI, was used to assess biological condition for each SCVURPPP probabilistic site. The Algae IBI "H20" is comprised of the following eight metrics ("d" indicates that a given metric is based on diatoms and "s" indicates soft algae; of the latter, "sp" indicates that the metric is based on relative species numbers):

- Proportion nitrogen heterotrophs (d)
- Proportion requiring >50% dissolved oxygen saturation (d)
- Proportion sediment tolerant (highly motile) (d)
- Proportion halobiontic (d)
- Proportion low N indicators (d)
- Proportion high Cu indicators (s, sp)
- Proportion high DOC indicators (s, sp)
- Proportion low TP indicators (s, sp)

The algae data were compiled, formatted and sent to the Moss Landing Marine Laboratory where "H2O" scores were calculated using the SWAMP Reporting Module. No condition categories have been established for algae IBIs to date, nor has the State Water Board proposed their use in a regulatory context. However, "H2O" scores may be of value in spatial and time series trends analyses.

4.2 Physical Habitat Indicators

Physical habitat indicators include measurements/assessments made during the bioassessment and during the California Riparian Assessment Method (CRAM). Physical habitat measurements were used to assess both the physical habitat condition and were evaluated as potential stressors to the biological condition as represented by CSCI and Algal IBI scores.

Riparian condition data (i.e., CRAM) were used to assess the overall condition of the health of stream ecosystem resources and to develop hypotheses regarding the causes of their observed conditions (SCVWD 2011). Riparian assessment data can also supplement biological and physical habitat data collected at bioassessment sites to investigate potential stressors to aquatic health. Previous studies in Southern California (Solek et al. 2011) have demonstrated high correlation between benthic macroinvertebrate communities (as measured by IBI) and riparian condition.

Physical Habitat Condition

Three qualitative PHAB parameters (epifaunal substrate/cover, sediment deposition, and channel alteration) are assessed on a reachwide bases during each bioassessment. Each parameter can be scored for a range of 0-20 and the sum of the PHAB parameters result in scores that range from 0 – 60. Higher PHAB scores reflect higher quality habitat. Physical habitat endpoints (e.g., % algal cover, % canopy cover, % sands and fines) were measured at each transect and averaged to obtain a reachwide measure of physical habitat condition. Additional variables that characterize the relative amount of development within the watershed drainage areas upstream of each sampling location (e.g., % impervious) were derived using a GIS.

CRAM is also applied to bioassessment reach. The CRAM score is based on the assessment and scoring of four different attributes: 1) Buffer and Landscape Connectivity; 2) Hydrology; 3) Physical Structure; and 4) Biotic Structure. The four attribute scores are summed and averaged to obtain the total CRAM score.

Stressor Assessment

Spearman rank correlation statistical tests were used to estimate the degree of correlation between PHAB parameters, physical habitat endpoints, CRAM scores, and water quality parameters with the biological condition scores (CSCI and Algal IBI).

4.3 Stressor/WQO Assessment

Water and sediment chemistry and toxicity data generated during WY2014 were analyzed and evaluated to identify potential stressors that may be contributing to degraded or diminished biological conditions, including exceedances of water quality objectives (WQOs). Per Table 8.1 of the MRP (SFRWQCB 2009), creek status monitoring data must be evaluated with respect to specified “Results that Trigger a Monitoring Project in Provision C.8.d.i.” The trigger criteria listed in Table 8.1 were used 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 are listed in Table 4.4. For the purposes of the stressor assessment, CSCI scores below 0.79 were considered as indicators of substantially degraded aquatic communities (see Table 4.1). Additional details on selected parameters (nutrients, toxicity, sediment chemistry, temperature, dissolved oxygen and pathogen indicators) are provided below Table 4.2.

4.3.1 Nutrients and Conventional Analytes

A search for relevant water quality standards or accepted thresholds was conducted using available sources, including the San Francisco Basin Water Quality Control Plan (Basin Plan) (SFRWQCB 2013), the California Toxics Rule (CTR) (USEPA 2000), and various USEPA sources. Of the eleven water quality constituents monitored in association with the bioassessment monitoring (referred to collectively as “Nutrients” in MRP Table 8.1), water quality standards or established thresholds are available only for ammonia (unionized form), chloride, and nitrate (for waters with MUN beneficial use only).

For ammonia, the 0.025 mg/L standard provided in the Basin Plan applies to the unionized fraction, as the underlying criterion is based on unionized ammonia, which is the more toxic form. Conversion of monitoring data from the measured total ammonia to unionized ammonia was therefore necessary. The conversion was based on a formula provided by the American Fisheries Society (AFS, internet source), and includes calculation from total ammonia, as well as field-measured pH, temperature, and specific conductance.

For chloride, a Secondary Maximum Contaminant Level (MCL) of 250 mg/L applies to those waters with MUN beneficial use and Title 22 drinking water, per the Basin Plan (Table 3-5), Title 22 of the California Code of Regulations (CDPH, internet source), and the USEPA Drinking Water Quality Standards (USEPA, internet source). For all other waters, the water quality criterion of 230 mg/L established by USEPA (2009) (USEPA Water Quality Criteria) for the protection of aquatic life is assumed to apply. The aquatic life criterion is a four-day average value, while the Secondary MCL is a maximum value.

Table 4.2. Water Quality Objectives and thresholds used for trigger evaluation

Monitoring Parameter	Objective/Trigger Threshold	Units	Source
Bioassessment			
CSCI	≤ 0.795 (likely and very likely altered classes)	NA	Mazor et al. in review
Nutrients and Conventional Analytes	20% of results at each monitoring site exceed one or more established standard or threshold - applies to these parameters jointly		
Ammonia, unionized	0.025	mg/L	SF Bay Basin Plan Ch. 3, p. 3-7
Chloride	230 (4 day avg.; applies to freshwater aquatic life)	mg/L	USEPA Nat'l. Rec. WQ Criteria
Chloride	250 (secondary maximum contaminant level; MUN waters, Title 22 Drinking Waters)	mg/L	SF Bay Basin Plan Ch. 3, Table 3-5; CA Code Title 22; USEPA Drinking Water Stds. Secondary MCL
Nitrate as N	10 (applies to MUN and Title 22 Drinking Waters only)	mg/L	SF Bay Basin Plan Ch. 3, Table 3-5; CA Code Title 22; USEPA Drinking Water Stds. Primary MCL; USEPA Nat'l. Rec. WQ Criteria (Human Health)
Chlorine			
Free & Total Chlorine	> 0.08 for initial result, > 0.08 for retest result (if needed)	mg/L	USEPA
Water Column Toxicity			
Selenastrum capricomutum (Growth), *Ceriodaphnia dubia* (Survival/Reproduction), Fathead Minnow (Survival/Growth) & *Hyalella azteca* (Survival)	< 50% of Control Result for initial test, < 50% of Control Result for retest (if needed)	NA	MRP Table 8.1
Sediment Toxicity			
Hyalella azteca (Survival/Growth)	Toxicity results are statistically different than, and < 20% of Control		MRP Table H-1
Sediment Chemistry			
Grain Size and TOC	None	NA	
MacDonald et al. 2000 Analytes; Pyrethroids from MRP Table 8.4	Three or more chemicals exceed Threshold Effects Concentrations (TECs), mean Probable Effects Concentrations (PEC Quotient greater than 0.5, or pyrethroids Toxicity Unit (TU) sum is greater than 1.0	NA	MRP Table H-1
General Water Quality Parameters	20% of results at each monitoring site exceed one or more established standard or threshold - applies individually to each parameter		
Conductivity	None	NA	
Dissolved Oxygen	WARM < 5.0, COLD < 7.0	mg/L	SF Bay Basin Plan Ch. 3, p. 3-4
pH	> 6.5, < 8.5 [1]	pH	SF Bay Basin Plan Ch. 3, p. 3-4
Temperature	COLD water 7-day mean < 19^{o}; COLD and WARM shall not increase > 2.8^{o} above natural receiving water temp	^{o}C	USEPA 1977 & SF Bay Basin Plan, Ch. 3, p. 3-6
Temperature	Same as General Water Quality for Temperature (See Above)		
Pathogen Indicators			
Fecal coliform	≥ 400	MPN/ 100ml	SF Bay Basin Plan Ch. 3
E. coli	≥ 410	MPN/ 100ml	USEPA 2012

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

The nitrate Primary MCL applies to those waters with MUN beneficial use, per the Basin Plan (Table 3-5), Title 22 of the California Code of Regulations, and the USEPA Drinking Water Quality Standards.

4.3.2 Water and Sediment Toxicity

The laboratory determines whether a sample is "toxic" by statistical comparison of the results from multiple test replicates of selected aquatic species in the environmental sample to multiple test replicates of those species in laboratory control water. The threshold for determining statistical significance between environmental samples and control samples is fairly small, with statistically significant toxicity often occurring for environmental test results that are as high as 90% of the Control. Therefore, there is a wide range of possible toxic effects that can be observed – from 0% to approximately 90% of the Control values.

For water sample toxicity tests, MRP Table 8.1 identifies toxicity results of less than 50% of the Control as requiring follow-up action. For sediment sample tests, MRP Table H-1 identifies toxicity results more than 20% less than the control as requiring follow-up action.[11] Therefore, samples that are identified by the lab as toxic (based on statistical comparison of samples vs. Control at $p = 0.05$) are evaluated to determine whether the result was less than 50% of the associated Control (for water samples) or statistically different and more than 20% less the Control (for sediment samples).

4.3.3 Sediment Chemistry

Sediment chemistry results are evaluated as potential stressors in three ways, based on the following criteria from MRP Table H-1.

- Calculation of threshold effect concentration (TEC) quotients; determine whether site has three or more TEC quotients greater than or equal to 1.0;[12]
- Calculation of probable effect concentration (PEC) quotients; determine whether site has mean PEC quotient greater than or equal to 0.5; and,
- Calculation of pyrethroid toxic unit (TU) equivalents as sum of TU equivalents for all measured pyrethroids; determine whether site has sum of TU equivalents greater than or equal to 1.0.

For sediment chemistry trigger criteria, TECs and PECs are as defined in MacDonald et al., 2000. For all non-pyrethroid contaminants specified in MacDonald et al. (2000), the ratio of the measured concentration to the respective TEC value was computed as the TEC quotient. All results where a TEC quotient was equal to or greater than 1.0 were identified. PEC quotients were also computed for all non-pyrethroid sediment chemistry constituents, using PEC values from MacDonald et al. (2000). For each site the mean PEC quotient was then computed, and sites where the mean PEC quotient was equal to or greater than 0.5 were identified. Pyrethroid TU equivalents were computed for individual pyrethroid results, based on available literature values for pyrethroids in sediment LC50 values.[13] Because organic carbon mitigates the toxicity of pyrethroid pesticides in sediments, the LC50 values were derived on the basis of TOC-normalized pyrethroid concentrations. Therefore, the pyrethroid concentrations as reported by the lab were divided by the measured total organic carbon (TOC) concentration at each site, and the TOC-normalized concentrations were then used to compute TU equivalents for each pyrethroid. Then for each site, the TU equivalents for the various individual pyrethroids were summed, and sites where the summed TU was equal to or greater than 1.0 were identified.

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[11] Footnote #162 to Table H-1 of the MRP reads, "Toxicity is exhibited when Hyallela (sic) survival statistically different than and < 20 percent of control"; this is assumed to be intended to read "…statistically different than and more than 20 percent less than control".

[12] This assumes that there is a typographical error in Table H-1 and that the criterion is meant to read, "3 or more chemicals exceed TECs".

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

4.3.4 Temperature

Sullivan et al. (2000) is referenced in Table 8.1 of the MRP as a potential source for applicable threshold(s) to use for evaluating water temperature data, specifically for creeks that have salmonid fish communities. The report summarizes results from previous field and laboratory studies investigating the effects of water temperature on salmonids of the Pacific Northwest and lists acute and chronic thresholds that can potentially be used to define temperature criteria. The authors identified annual maximum temperature (acute) and maximum 7-day weekly average temperature (MWAT) chronic indices as biologically meaningful thresholds. They found the MWAT index to be most correlated with growth loss estimates for juvenile salmonids, which can be used as a threshold for evaluating the chronic effects of temperature on summer rearing life stage.

Previous studies conducted by EPA (1977) identified a MWAT of 19°C for steelhead and 18°C for coho salmon. Using risk assessment methods, Sullivan et al (2000) identified lower thresholds of 17°C and 14.8°C for steelhead and coho respectively. The risk assessment method applied growth curves for salmonids over a temperature gradient and calculated the percentage in growth reduction compared to the growth achieved at the optimum temperature. The risk assessment analysis estimated that temperatures exceeding a threshold of 17°C would potentially cause 10% reduction in average salmonid growth compared to optimal conditions. In contrast, exceedances of the 19°C threshold derived by EPA (1977) would result in a 20% reduction in average fish growth compared to optimal conditions.

The San Francisco Bay Region Water Quality Control Board (Water Board) is currently applying the temperature thresholds suggested by Sullivan et al. (2000) (i.e., MWAT of 17°C and 14.8°C for steelhead and coho salmon, respectively) to evaluate temperature data for the 303(d) listing process of impaired water bodies (SFRWQCB 2013). The Water Board has also applied these thresholds in evaluating temperature data collected at reference sites in the San Francisco Bay Area (SFRWQCB 2012).

Several important factors should be considered when selecting the appropriate temperature thresholds for evaluating data collected from creeks that support salmonid fish communities in the San Francisco Bay Area region. The thresholds presented in Sullivan et al. (2000) are based on data collected from creeks in the Pacific Northwest region, which exhibits different patterns of temperature associated with climate, geography and watershed characteristics compared to creeks supporting steelhead and salmon in Central California. Furthermore, a single temperature threshold may not apply to all creeks in the San Francisco Bay Area due to high variability in climate and watershed characteristics within the region. .

Sullivan et al.'s (2000) risk assessment approach to establishing water temperature thresholds for salmonids focuses on juvenile growth rates. Several studies, however, demonstrate that Central California Coast (CCC) Steelhead Distinct Population Segment (DPS)[14] have adapted feeding behaviors and life history strategies to deal with higher water temperatures characteristic of the southern end of their range. Smith and Li (1983) have observed that juvenile steelhead will tolerate warmer temperatures when food is abundant by moving into riffle habitats to increase feeding success. Steelhead will also move into coastal estuaries to feed during the summer season when stream conditions become stressful to the fish (Moyle 2008). Sogard et al. (2012) determined that steelhead growth rates were higher during winter-spring season compared to summer fall season in Central California coastal creeks, whereas the opposite was true for steelhead in creeks of the Central Valley. Railsback and Rose (1999) concluded that juvenile growth rate during the summer season was more dependent on food availability and consumption than temperature.

These studies demonstrate that the application of temperature thresholds to evaluate steelhead growth and survival is challenging, and may promote management actions that do not improve ecological conditions. In cases where low flow conditions in concert with high temperatures during summer season are impacting steelhead populations, management actions that improve food availability (e.g., increase

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[14] CCC steelhead DPS includes all populations between Russian River and south to Aptos Creek. Also included are all drainages of San Francisco, San Pablo and Suisun Bays eastward at the confluence of the Sacramento and San Joaquin Rivers.

summer flow) may better address factors that are more critically limiting steelhead production. For monitoring, fish size thresholds at critical life stages such as smolting may be a much better indicator for understanding viability of steelhead populations (Atkinson et al. 2011).

We recommend using thresholds identified in EPA (1977) (i.e., MWAT of 19°C for steelhead and 18°C for coho salmon) for interpretation of temperature data collected during the Creek Status Monitoring Project in 2012. These thresholds are consistent with results from thermal tolerance studies by Myrick and Cech (2000) that demonstrated maximum growth rates for California rainbow trout population to be near 19°C. Myrick (1998) also demonstrated that growth rates for steelhead at 19°C were greatly increased when food ration level was highest.

More data and analyses of temperature and salmonid growth rates is needed from creeks in the Central California Coast and San Francisco Bay Region to better understand the effects of temperature on salmonid fish population dynamics. In addition, other indicators (e.g., fish size) should be evaluated in combination with temperature to effectively evaluate salmonid ecological conditions. For these reasons, we recommend not using thresholds identified by Sullivan et al (2000) as they are based on a risk analysis that assumes optimal growth rates for salmonids using data that are likely not applicable to local watershed conditions.

The Basin Plan's water temperature Water Quality Objective states that "temperature shall not be increased by more than 2.8°C above natural receiving water temperature". This criterion is difficult to apply to sites where natural receiving water temperature is not known. This criterion may be applicable in situations where temperature is dramatically altered (e.g., imported water) and water temperature data is collected above and below a POTW outfall. In addition, there is no recommended criterion to use for warm water fish communities, which are more adapted to higher temperatures. At this time, SCVURPPP intends to continue prioritizing temperature monitoring at sites that are designated with a cold water habitat (COLD) beneficial use (SFRWQCB 2013) or that support salmonid fish communities.

4.3.5 Dissolved Oxygen

The Basin Plan (SFRWQCB 2013) lists Water Quality Objectives for dissolved oxygen in non-tidal waters as follows: 5.0 mg/L minimum for waters designated as warm water habitat (WARM) and 7.0 mg/L minimum for waters designated as COLD. Although these WQOs provide suitable thresholds to evaluate triggers, further evaluation may be needed to determine the overall extent and degree that COLD and/or WARM beneficial uses are supported at a site. For example, further analyses may be necessary at sites in lower reaches of a waterbody that may not support salmonid spawning or rearing habitat, but may be important for upstream or downstream fish migration. In these cases, dissolved oxygen data will be evaluated for the salmonid life stage and/or fish community that is expected to be present during the monitoring period. Such evaluations of both historical and current ecological conditions will be made, where possible, when evaluating water quality information.

4.3.6 Pathogen Indicators

Water Quality Objectives listed in the Basin Plan for fecal coliform are based on five consecutive samples that are collected over an equally spaced 30-day period. The WQOs for Water Contact Recreation (REC-1) include concentrations for the calculated geometric mean (< 200 MPN/100ml) and the 90th percentile (< 400 MPN/100ml). The monitoring design for pathogen indicators was to collect single water samples at individual water bodies, which is not consistent with the sampling requirements stated in the aforementioned WQOs. As a result, the threshold for a single sample maximum concentration of fecal coliform of 400 MPN/100ml was used as the basis for analyzing which results might trigger further evaluation.

While the Basin Plan does not include WQOs for *E. coli*, the EPA has established similar criteria for *E. coli* in primary contact recreational waters to protect human health (USEPA 2012). The 2012 USEPA recommendations supersede the 1986 recommendations and no longer distinguish between different levels of beach usage. USEPA recommended water quality criteria for *E. coli* consist of a geometric mean of 126 CFU/100ml for samples collected in any 30-day interval and a statistical threshold value (STV) of 410 CFU/100ml. The STV approximates the 90th percentile of data and is used as the basis for evaluating *E. coli* results which might trigger a monitoring project under MRP Provision C.8.d.i. evaluation criteria. In this evaluation, the Most Probable Number (MPN) of bacteria colonies given by the analytical method is compared directly with the Colony Forming Units (CFUs) of the USEPA recommendations.

Two important issues should be considered when evaluating bacterial indicator organisms: 1) there is an imperfect correlation between bacterial indicator organisms and pathogens of public health concern; and 2) the potential for human exposure to the water bodies of interest is uncertain. Water Quality Objectives and Criteria for pathogen indicators were derived from epidemiological studies of people recreating at bathing beaches that received bacteriological contamination via treated human wastewater. Therefore, applying these thresholds to data collected from creeks where exposure via recreation is infrequent and ingestion of the water is highly unlikely, is highly questionable. Additionally, sources of fecal indicators in the watershed are likely non-human given the understanding of watershed sources. Recent research indicates that the source of fecal contamination is critical to understanding the human health risk associated with recreational waters and that the risk in recreational waters varies with various fecal sources (USEPA 2012). Thus, comparison of fecal indicator results in Santa Clara Valley creeks to WQOs and criteria may not be appropriate and should be interpreted cautiously.

4.3.7 Quality Assurance/Quality Control

Data quality assessment and quality control procedures are described in detail in the BASMAA RMC QAPP (BASMAA 2014a). They generally involve the following the steps described in the following paragraphs.

Data Quality Objectives (DQOs) were established to ensure that data collected are of adequate quality and sufficient for the intended uses. DQOs address both quantitative and qualitative assessment of the acceptability of data. The qualitative goals include representativeness and comparability. The quantitative goals include specifications for completeness, sensitivity (detection and quantization limits), precision, accuracy, and contamination. To ensure consistent and comparable field techniques, pre-survey field training and in-situ field assessments were conducted. Field training and inter-calibration exercises were conducted to ensure consistency and quality of CRAM and bioassessment data. Field audits by Water Board staff were conducted to evaluate field crews on proper use of bioassessment protocols.

Data were collected according to the procedures described in the relevant SOPs, including appropriate documentation of data sheets and samples, and sample handling and custody. Laboratories providing analytical support to the RMC were selected based on demonstrated capability to adhere to specified protocols. Standard methods for CRAM are included in Collins et al. (2008).

Duplicate samples were collected at 10% of the sites sampled to evaluate precision of field sampling methods. Ten percent of the total number of BMI samples collected was submitted to the California Department of Fish and Wildlife (CDFW) Aquatic Bioassessment Laboratory for independent assessment of taxonomic accuracy, enumeration of organisms and conformance to standard taxonomic level. All data were thoroughly reviewed for conformance with QAPP requirements and field procedures were reviewed for compliance with the methods specified in the relevant SOPs. Data quality was assessed and qualifiers were assigned as necessary in accordance with SWAMP requirements.

Following completion of the field and laboratory work, the field data sheets and laboratory reports were reviewed by the SCVURPPP Program Quality Assurance Officer, and compared against the methods and protocols specified in the SOPs and QAPP. The findings and results were evaluated against the relevant DQOs to provide the basis for an assessment of programmatic data quality. A summary of data quality steps associated with water quality measurements is shown in Table 4.3. The data quality assessment consisted of the following elements:

- Conformance with field and laboratory methods as specified in SOPs and QAPP, including sample collection and analytical methods, sample preservation, sample holding times, etc.

- Numbers of measurements/samples/analyses completed vs. planned, and identification of reasons for any missed samples.
- Temperature data was checked for accuracy by comparing measurements taken by HOBOs with NIST thermometer readings in room temperature water and ice water prior to deployment.
- General water quality data was checked for accuracy by comparing measurements taken before and after deployment with measurements taken in standard solutions to evaluate potential drift in readings.
- Quality assessment laboratory procedures for accuracy and precision (i.e., laboratory duplicates, laboratory blanks, laboratory control samples, and matrix spikes) were implemented, and data which did not mean DQOs were assigned the appropriate flag.
- Field crews participated in two inter-calibration exercises prior to field assessments and attended a debriefing meeting at the end of field assessments to assess consistency among RMC field crews.

Table 4.3. Data quality steps implemented for temperature and general water quality monitoring.

Step	Temperature (HOBOs)	General Water Quality (sondes)
Pre-event calibration / accuracy check conducted	X	X
Readiness review conducted	X	X
Check field datasheets for completeness	X	X
Post-deployment accuracy check conducted	X	X
Post-sampling event report completed	X	X
Post-event calibration conducted	X	X
Data review – compare drift against SWAMP MQOs		X
Data review – check for outliers / out of water measurements	X	X

5.0 Results and Discussion

In this section, following a brief statement of data quality, the biological data are evaluated to produce a preliminary condition assessment for aquatic life in SCVURPPP creeks. The physical, chemical, and toxicity monitoring data are then evaluated against the trigger criteria shown in Table 4.4 (Tables 8.1 and H-1 of the MRP) to provide a preliminary identification of potential stressors. Data evaluation and interpretation methods are described in Section 4.0. The results of the stressor assessment have been used to develop source identification projects.

5.1 Statement of Data Quality

A comprehensive QA/QC program was implemented by SCVURPPP, covering all aspects of the probabilistic and targeted monitoring. In general, QA/QC procedures were implemented as specified in the RMC QAPP (BASMAA, 2014a), and monitoring was performed according to protocols specified in the RMC SOPs (BASMAA, 2014b), and in conformity with SWAMP protocols. Details of the results of evaluations of laboratory-generated QA/QC results are included in Attachment B. Issues noted by the laboratories and/or field crews are summarized below.

5.1.1 Bioassessment

Prior to sampling in WY2014, field training and inter-calibration exercises with four other field crews were conducted to ensure consistency and quality of bioassessment data. While there are no quantitative methods to assess quality assurance of physical habitat conditions, it was clear from the results that measurements taken by the SCVURPPP field crew rarely deviated from those of other crews.

The field crew was audited once during the field season by a representative of SWAMP to ensure consistency with SWAMP protocols. This audit is also intended to ensure consistency among RMC participants. Audits conducted by SWAMP did not result in any notable issues needing to be addressed regarding field procedures. Field sampling protocols, sample handling, documentation and packaging/delivery of samples were all executed properly as required by the QAPP and in accordance with the RMC SOPs. All field instruments were properly calibrated and cleaned within the necessary time restrictions.

Several biological assessment sites had to be sampled along a shortened reach (less than 150 m), and in some cases, stream characterization points may have been moved along the reach due to physical limitations or obstructions. Efforts were made to minimize the distance between the target collection location and the more accessible replacement location. Collection of algae samples was difficult at several sites due to varying levels of algal growth, making it challenging to collect a distinguishable clump for analysis.

Issues with the BMI laboratory analysis were noted, as follows:

- During BMI taxonomic QA analysis, one minor counting discrepancy and one minor taxonomic discrepancy were noted between the original BioAssessment Services results and the QA recount conducted by the CDFW Aquatic Bioassessment Laboratory. *Menetus opercularis* was identified by BioAssessment Services to the subfamily/tribe level (*Menetus)*, but was identified to the species level by the CDFW Aquatic Bioassessment Laboratory. Additionally, the CDFW laboratory noted that a Tanytarsini larva was found in the Orthocladiinae vial and a Chironomini pupa was found with the Orthocladiinae pupae. Because Tanytarsini and Chironomini were both identified correctly in the sample, these likely represent oversights or sorting errors rather than true misidentifications.
- In accordance with the QAPP, BMIs were assessed to the Southwest Association of Freshwater Invertebrate Taxonomist (SAFIT) Standard Taxonomic Effort (STE) Level 1. BMIs from WY2014 will be re-analyzed to SAFIT STE Level 2 at a later date.

Issues with the algae laboratory analysis were noted, as follows:

- The only challenges to the qualitative macroalgae qualitative analysis were finding reproductive structures for species-level identification for Oedogonium and Spirogyra.
- Macroalgae was present in eight of the 22 total algae samples (20 samples and two duplicates). Those samples were subsequently analyzed for the presence of epiphytes.
- Detritus and lack of algae on the slides were the main issues with the microalgae samples. For more than half of the samples, the initially concentrated subsamples (from 10 ml to 1 ml) were diluted to 2, 3 or 5 ml, and 0.05 ml was placed on the slide to help disseminate the detritus and silt. Many samples were very sparse. Fewer than 20 algal counting entities were recorded in 8 samples. At least 150 algal (but less than 300) counting entities were recorded in 9 samples and 300 units were recorded in the remaining 5 samples.
- Similarly, for diatom analysis, the large amount of detritus made identification of the valves and capturing quality synoptic reference images somewhat difficult. Five taxa were not identified to species level. All samples reached the target 600-valve count.
- Five diatom and algae taxa found in SCVURPPP samples were not included in the existing SWAMP list of taxonomic identifications. The laboratory is working with SWAMP to reconcile the differences.

5.1.2 Nutrients and Conventional Analytes

Caltest Laboratories analyzed all water chemistry samples for the SCVURPPP in WY2014. Caltest performed all internal QA/QC requirements as specified in the QAPP and reported their findings to the RMC. Key water chemistry Measurement Quality Objectives (MQOs) are listed in RMC QAPP Tables 26-1, 26-2, 26-5, and 26-7.

Several issues were noted with respect to water chemistry analyses, as follows:

- In past years, free chlorine measurements were sometimes greater than total chlorine residual measurements. As a result, the SCVURPPP field crew made sure that water for both tests was drawn from the same sample as opposed to drawing one sample after the other. The introduction of the HACH Pocket Colorimeter II in WY2014 as a replacement for the ChemMetrics test kits using in previous years improved the reliability of the chlorine readings. However, there was a learning curve associated with the new instrument and the following issues arose:
    - Sample vials may have been over filled at the initial chlorine site, diluting the test reagent, leading to a lower chlorine reading. These data points have been flagged as questionable.
    - The sample vials were found to have been stained over time from the test reagent, while the vial used to zero the instrument was still clear. As a result, some chlorine readings were very high. The field crew returned to sites with suspiciously high readings to resample chlorine, making sure to zero the instrument with the stained sample vial. The original readings were rejected and replaced with the new readings. As this issue was discovered early on, only three sites were resampled.
- A limited number of lab sample results for nutrients and conventional parameters were flagged due to minor QA/QC issues. These results were not thought to affect the validity of sample results and were not rejected. Included were the following:
    - In one batch, low level contamination was measured in the chloride laboratory blank. Three samples were associated with this batch and their results were flagged, but not rejected. Laboratory personnel concluded that the lab blank contamination did not affect the sample results because only results above the Reporting Limit (RL) but less than 10 times the result in the blank would be considered invalid and rerun. As chloride results for the three samples in the batch were greater than 10 times the lab blank value, the results were considered valid.
    - Several matrix spike (MS) and matrix spike duplicate (MSD) percent recoveries (PR) exceeded the MQO range listed in the RMC QAPP for various conventional analytes including chloride, dissolved organic carbon (DOC), nitrite, Total Kjeldahl Nitrogen (TKN), and silica. The affected samples have been assigned the appropriate flag.
- In accordance with the QAPP, field duplicates were collected at two (10%) of the 20 SCVURPPP sites sampled this year. Lab results of water chemistry field duplicate results are shown in Attachment B. The MQO for relative percent difference (RPD) was exceeded for three constituents (carbonate, Total Kjeldahl Nitrogen, and phosphorus) at the first site and three constituents (orthophosphate, chlorophyll a, and ash free dry mass) at the second site. With the exception of carbonate, these are the same constituents that have exceeded MQOs in prior years of sampling. Due to the nature of chlorophyll a and AFDM collection, discrepancies are to be expected due to the potential natural variability in algae production within the reach and the collection of field duplicates at different locations along each transect (as specified in the protocol). Discrepancies between other constituents are attributed to timing, i.e., not collecting the duplicate at the exact moment the original sample is collected. Field crews will continue to make an effort in subsequent years to collect the original and duplicate samples in an identical fashion.

- The QAPP requires field blanks to be collected and analyzed at a frequency of 5% of all samples collected for these parameters; this equates to a total of three such samples for the RMC total of 60 samples regionwide. The 5% requirement was exceeded in WY2014. Two were collected at SMCWPPP sites, two were collected at ACCWP sites, and two more were collected at CCCWP sites. Caltest analyzed these water chemistry field blank samples and detected no contaminants.
- Laboratory reports list the continuing calibration verification PR range as 85-115% or 90-110% for some conventional analytes (nutrients) while the RMC QAPP lists the PR as 80-120% for all conventional analytes in water.

5.1.3 Toxicity

Two of the three aquatic toxicity samples collected during a storm in February 2014 (sites 205R00883 and 205R00979) were affected during testing by pathogen-related mortality (PRM), a fairly common cause of interference in aquatic sample toxicity tests with ambient surface waters. PRM was observed in one replicate for the first site and in two test replicates for the second site. The EPA testing manual indicates that a coefficient of variation (CV) greater than 40% may be indication of pathogen interference; however, there is no mandate that the CV must be greater than 40%. For site 205R00883, the survival CV was 12.4% and the growth CV was 4.3%. For site 205R00979, the survival CV was 6.1% and the growth CV was 5.0%. Although the test CVs were not greater than 40% for these samples, it was clear from the photographs provided by the laboratory that PRM was present. As PRM was not observed in the Laboratory Control treatment, the laboratory concluded that the PRM was not related to the source of the test organisms or laboratory practices. Because no toxicity to *Pimephales promelas* (i.e., fathead minnow) was observed in these samples, PRM protocols were not pursued.

5.1.4 Sediment Chemistry

Caltest Laboratories performed all sediment chemistry analyses for SCVURPPP, with the exception of the grain size distribution and total organic carbon (TOC) analyses, which were sub-contracted by Caltest to Soil Control Laboratories. Caltest conducted all QA/QC requirements as specified in the RMC QAPP and reported their findings to the RMC. Key sediment chemistry MQOs are listed in RMC QAPP Tables 26-4, 26-6, and 26-7. Several issues were reported by the analytical laboratory (Caltest), and the sediment chemistry data were qualified accordingly. These issues included the following:

- The continuing calibration verification (laboratory control sample) percent recovery for zinc and three PAHs (benz(a)anthracene, benzo(a)pyrene, perylene) slightly exceeded the MQO range specified by the RMC QAPP for synthetic organic compounds.
- The MSD relative percent difference (RPD) exceeded the RMC QAPP MQOs for two organochlorides (DDT (p,p') and endrin) and several PAHs (benz(a)anthracene, benzo(b)fluoranthene, benzo(a)pyrene, benzo(e)pyrene, benzo(g,h,i)perylene, chrysene, fluoranthene, and pyrene).

In addition, the following issues with sediment chemistry were noted in WY2014:

- The RMC QAPP lists the maximum RPD for inorganic analytes (metals) as 25%, while the laboratory report lists the maximum as 30% for most metals and 35% for mercury.
- The maximum RPD for synthetic organics listed in the sediment laboratory report lists ranges from 30 to 50% for most analytes, and are much higher for gamma-BHC (Lindane) and p,p'-DDT at 52% and 59%,respectively. However, the RMC QAPP lists the MQO as less than 25% RPD for all synthetic organics.
- These discrepancies in maximum RPD resulted in several analytes not being flagged in laboratory reports when they should have been. These were flagged by the program in data submittals. All other analyte groups (metals, pyrethroids, etc.) had relatively low RPDs.

The RMC QAPP requires collection and analysis of duplicate sediment samples at a rate of 10% of total samples collected. For WY2014, SMCWPPP collected one sediment sample field duplicate to account for the 10 sediment sites monitored by the RMC in 2014. The sediment sample and field duplicate were collected together using the Sediment Scoop Method described in the RMC SOP, homogenized, and then distributed to two separate containers. Of the 70 constituents analyzed, 96%, or 67, of those constituents met the RPD MQO listed in the RMC QAPP for the sediment chemistry field duplicate sample. Only cis-permethrin and three particle size results (granule, coarse clay, and medium clay) exceeded the RPD MQO of 25%.

Lab results of the sediment chemistry field duplicates are shown in Attachment B. [Note that because of the variability in reporting limits, values less than the Reporting Limit (RL) were not evaluated for sediment RPDs.] That RPDs fall outside of control limits for field duplicates should not be surprising in that the control limits associated with SWAMP comparable programs are identical between lab duplicates and field duplicates, even though sources of variability are much larger associated with field duplicates.

5.1.5 Targeted Monitoring

Field data sheets and laboratory reports were reviewed by the local Program Quality Assurance Officer, and the results evaluated against the relevant MQOs. Results were compiled for the qualitative metrics (representativeness and comparability), as well as the quantitative metrics (completeness, precision, accuracy). The following summarizes the results of the data quality assessment:

- Temperature data (from HOBOs) was collected at 10 targeted site locations in 2014, a small increase over the required 8 locations, and insurance in the event that field equipment is lost or damaged or that streams dried up prior to the end of the sampling period. As a result, over 100% of the expected data was captured.
- Continuous water quality data (temperature, pH, dissolved oxygen, specific conductivity) was collected at three sites during two two-week periods in the spring and summer resulting in over 100% of the expected data results.
- Continuous water quality data met measurement quality objectives (accuracy) for all parameters and are included in Table 5.1.
- Two laboratory duplicates were run on ACCWP and CCCWP pathogen indicator samples. The RPDs for *E.coli* exceeded the target ranges specified in the RMC QAPP, but only one RPD for fecal coliform exceeded the MQO. Given the nature of pathogen indicator sampling, these results are not surprising.
- .
- No contamination was detected in pathogen laboratory blanks.

Table 5.1. Dissolved oxygen, pH and specific conductivity drift over two two-week monitoring events in WY2014.

Parameter	Measurement Quality Objectives	205STE065		205STE071		205STE105	
		Event 1	Event 2	Event 1	Event 2	Event 1	Event 2
Dissolved Oxygen (mg/l)	± 0.5 mg/L or 10%	0.23	-0.15	-0.2	0.7%	-0.06	0.07
pH 7.0	± 0.2	0.07	-0.1	0.06	0.14	-0.01	-0.05
pH 10.0	± 0.2	0.06	0.1	0	0.15	0.02	-0.04
Specific Conductance (uS/cm)	± 10%	0.3%	-0.3%	-0.1%	0.1%	0.6%	0.2%

5.2 Condition Assessment

This section addresses the core management question ***"Are conditions in local receiving water supportive of or likely supportive of beneficial uses?"*** or more specifically, ***"What is the condition of aquatic life in creeks in Santa Clara County?"*** The RMC probabilistic monitoring design provides an unbiased framework for data evaluation that, with adequate sample size (n=30), will allow a condition assessment of ambient aquatic life within known estimates of precision. Over 30 samples have been collected and analyzed in Santa Clara County; however, this report only evaluates the 20 sites sampled in WY2014 and therefore, a full condition assessment was not conducted for this report.

Although the data set is not *yet* sufficient to develop statistically representative conclusions addressing the second core management question (***"To what extent does the condition of aquatic life in urban and non-urban creeks differ in Santa Clara County?"),*** comparisons are made between the two types of sites. At least 30 samples from each creek type (urban and non-urban) would be required for statistically representative conclusions.

5.2.1 Benthic Macroinvertebrates

Biological condition, presented as CSCI score, for the 20 probabilistic sites sampled in Santa Clara County during WY2014 are listed in Table 5.2 and illustrated in Figure 5.1. The range of CSCI scores is 0.32 to 1.28, with a median score of 0.61. Site characteristics related to land use classification, flow status[15], and channel modification status[16] are presented in the table for reference.

Using the condition categories for CSCI presented in this report, four sites (20%) scored as "likely intact," four sites (20%) scored as "possibly intact," one site (5%) scored as "likely altered," and eleven sites (55%) scored as "very likely altered" (Table 5.6). The sites rated as "likely intact" included all three non-urban sites with perennial flow and one "urban" site[17] (1299) located on Arroyo Aguague in an undeveloped portion of Alum Rock Park.

The four sites rated as possibly intact were all urban and perennial. One of the "urban" sites (1098) was located on Guadalupe Creek at the edge of Mid-Peninsula Regional Open Space District land in a concrete channel just upstream of a fish ladder. The remaining twelve sites rated as likely or very likely altered were all urban, with the exception of the site on Limekiln Creek (266) which was classified as non-urban, but located downstream of a rock quarry (Table 5.6). Three of the twelve sites were classified as highly modified channels.

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[15] Flow status was based on visual observations at each site made during fall season of 2013 or 2014.

[16] Highly modified channels were defined as having armored bed and banks (e.g., concrete, gabion, rip rap) for majority of the reach or characterized as highly channelized earthen levee.

[17] Some sites classified as "urban" are actually located in less- or undeveloped areas due to assumptions inherent in the probabilistic monitoring design.

Table 5.2. CSCI scores and condition categories for probabilistic sites sampled in WY2014 (n=20). Condition categories developed by Mazor et al. (in review) are shown for each site.

Station Code	Creek	Land Use[1]	Modified Channel	Flow[2]	CSCI	
					Score	Condition Category
205R00330	Hick's Creek	NU	N	P	1.28	Likely Intact
205R00394	Austrian Gulch	NU	N	P	1.25	Likely Intact
205R00362	Lyndon Canyon	NU	N	P	1.10	Likely Intact
205R01299	Arroyo Aguague	U	N	NP	0.95	Likely Intact
205R01098	Guadalupe Creek	U	Y	P	0.92	Possibly Intact
205R01434	Arroyo Calero	U	N	P	0.82	Possibly Intact
205R00938	San Tomas Aquino Creek	U	N	P	0.81	Possibly Intact
205R00883	Adobe Creek	U	N	P	0.80	Possibly Intact
205R01443	Stevens Creek	U	N	P	0.72	Likely Altered
205R01539	Los Gatos Creek	U	N	P	0.61	Very Likely Altered
205R01226	Los Gatos Creek	U	N	P	0.59	Very Likely Altered
205R01187	Stevens Creek	U	N	P	0.58	Very Likely Altered
205R00266	Limekiln Creek	NU	N	NP	0.57	Very Likely Altered
205R00851	Los Coches Creek	U	N	NP	0.55	Very Likely Altered
205R01578	San Tomas Aquino Creek	U	N	NP	0.55	Very Likely Altered
205R01027	Guadalupe River	U	N	P	0.50	Very Likely Altered
205R00979	Lower Silver Creek	U	Y	P	0.49	Very Likely Altered
205R01306	Ross Creek	U	Y	P	0.46	Very Likely Altered
205R00915	Thompson Creek	U	N	P	0.46	Very Likely Altered
205R01091	Saratoga Creek	U	Y	P	0.32	Very Likely Altered

[1] NU = non-urban, U = urban (as classified by the GIS-based probabilistic monitoring design)

[2] P = perennial, NP = non-perennial

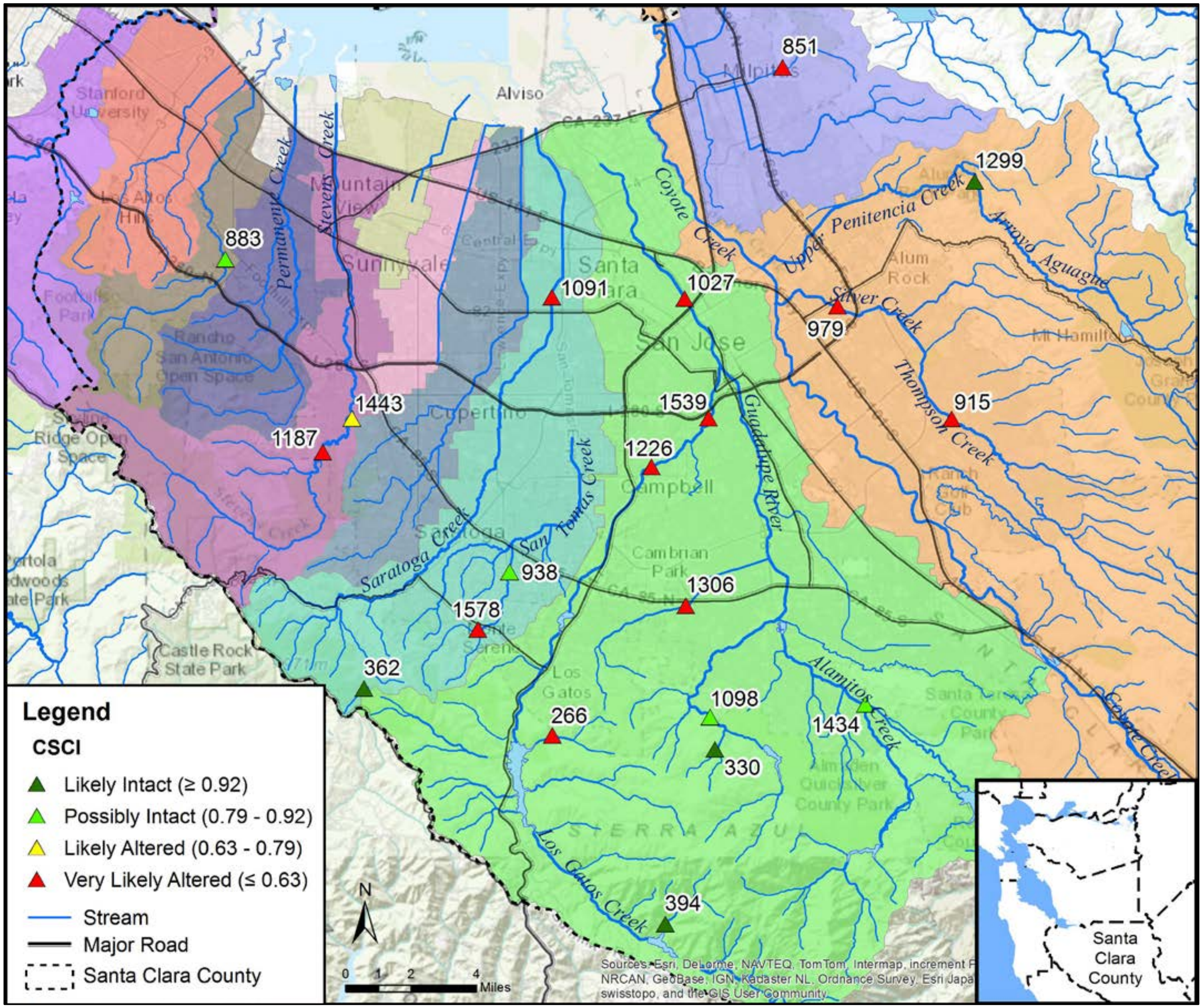

Figure 5.1. Location and CSCI condition category for 20 probabilistic sites sampled in WY2014, Santa Clara County.

Table 5.2 lists the land use (urban or non-urban) and flow class (perennial or non-perennial) for each probabilistic site. There was very little difference in CSCI scores between perennial (n=16) and non-perennial (n=4) sites (Figure 5.2). The CSCI scores were generally lower for sites classified as urban[18] compared to non-urban sites (Figure 5.3).

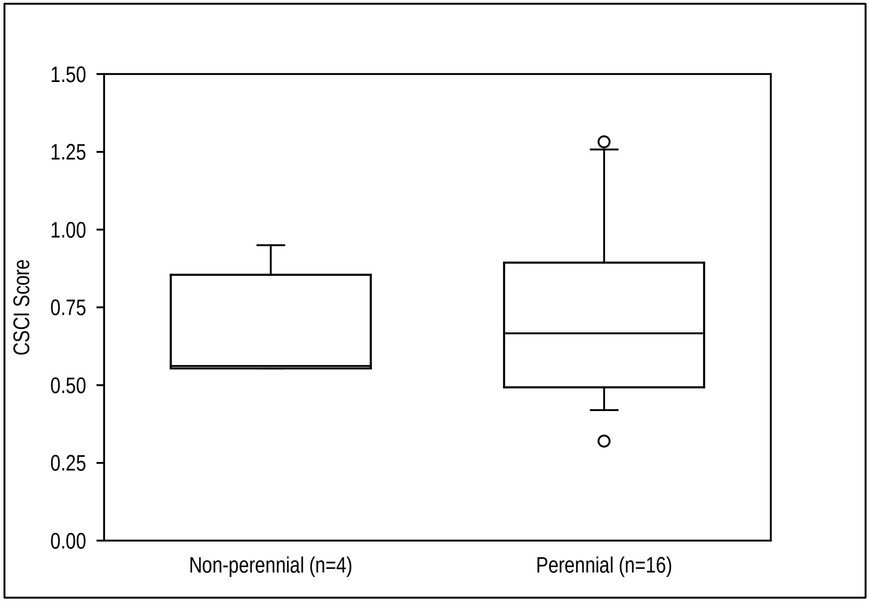

Figure 5.2. Box plots showing distribution of CSCI scores for perennial (n=16) and non-perennial (n=4) sites sampled in Santa Clara County in WY2014.

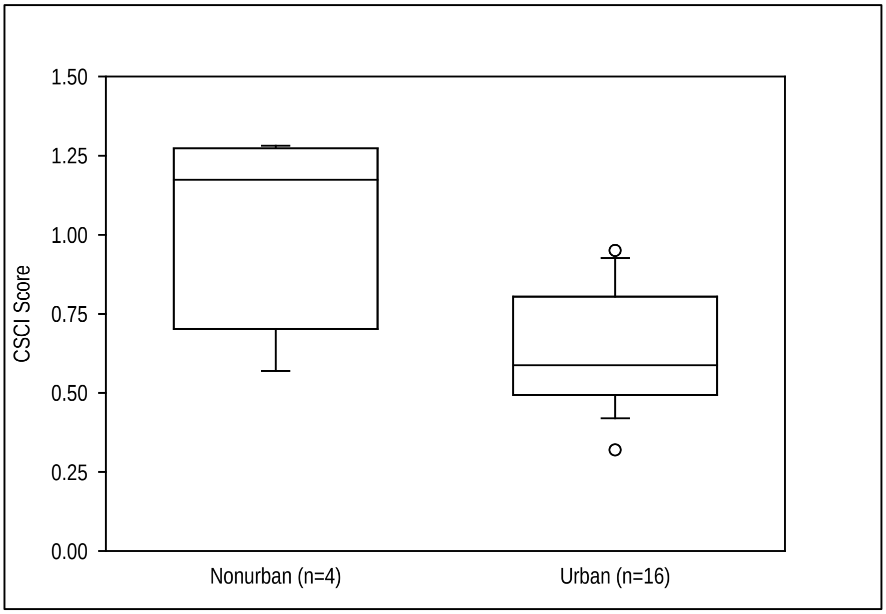

Figure 5.3. Box plots showing distribution of CSCI scores for urban (n=16) and non-urban (n=4) sites sampled in Santa Clara County in 2014.

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[18] The land use classification is based on the RMC sample frame, which was developed using a combination of urban areas (as defined by Association of Bay Area Governments) and city boundaries. For some areas, city boundaries include parks and undeveloped areas. Thus sampling locations that are classified as urban may have a wide range of impacts associated with urban development.

The amount (i.e., percent) of impervious area within the upstream watershed for each sampling location was calculated using existing land use data in GIS. Impervious coefficients for land use classes were derived from SMCWPPP (2000). Three classes of imperviousness (<3%, 3-10%, and > 10%) were used to define the range of potential stress to biological condition at each sample location. The distribution of CSCI scores for the three categories of imperviousness is shown in Figure 5.4. As expected, CSCI scores were lowest for the sites with the most imperviousness. However, there is little difference between the sites with the least imperviousness and sites in the middle class. The lack of differentiation may be due to the small sample size in WY2014, especially in the 3-10% imperviousness class.

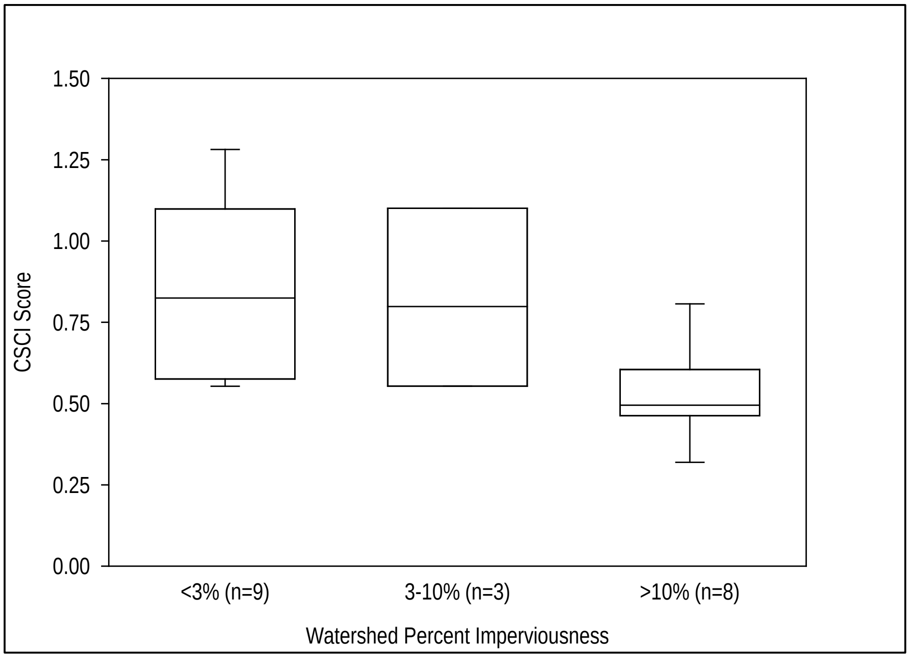


Figure 5.4. Box plots showing distribution of CSCI scores at sites sampled in Santa Clara County in WY2014 for three classifications of % watershed imperviousness.

5.2.2 Algae

Biological condition, presented as “H20” hybrid IBI (Algae IBI) scores for the 20 probabilistic sites sampled in Santa Clara County during WY2014 are listed in Table 5.3. The Algae IBI scores across all the sites ranged from 11 to 80. Algae IBI scores ranged from 66 to 80 at non-urban sites and 11 to 68 at urban sites. The highest IBI scores all occurred at non-urban sites. The Algae IBI scores were moderately correlated with CSCI scores ($r^2 = 0.316$, $p = 0.01$) (Figure 5.5). These results suggest that different stressors impact the algae assemblage as compared to the BMI assemblage.

Table 5.3. Algae IBI scores for 20 probabilistic sites sampled in Santa Clara County during WY2014.

StationCode	Creek	Land Use[1]	Modified Channel	Flow[2]	Hybrid "H20" IBI Score
205R00266	Limekiln Creek	NU	N	NP	80
205R00362	Lyndon Canyon	NU	N	P	70
205R00330	Hick's Creek	NU	N	P	68
205R01299	Arroyo Aguague	U	N	NP	68
205R00394	Austrian Gulch	NU	N	P	66
205R00851	Los Coches Creek	U	N	NP	59
205R01578	San Tomas Aquino Creek	U	N	NP	55
205R01434	Arroyo Calero	U	N	P	50
205R01539	Los Gatos Creek	U	N	P	49
205R01226	Los Gatos Creek	U	N	P	48
205R01443	Stevens Creek	U	N	P	48
205R00938	San Tomas Aquino Creek	U	N	P	44
205R01098	Guadalupe Creek	U	Y	P	44
205R01091	Saratoga Creek	U	Y	P	42
205R01306	Ross Creek	U	Y	P	32
205R00883	Adobe Creek	U	N	P	31
205R01027	Guadalupe River	U	N	P	31
205R01187	Stevens Creek	U	N	P	29
205R00915	Thompson Creek	U	N	P	21
205R00979	Lower Silver Creek	U	Y	P	11

[1] NU = non-urban, U = urban (as classified by the GIS-based probabilistic monitoring design)

[2] P = perennial, NP = non-perennial

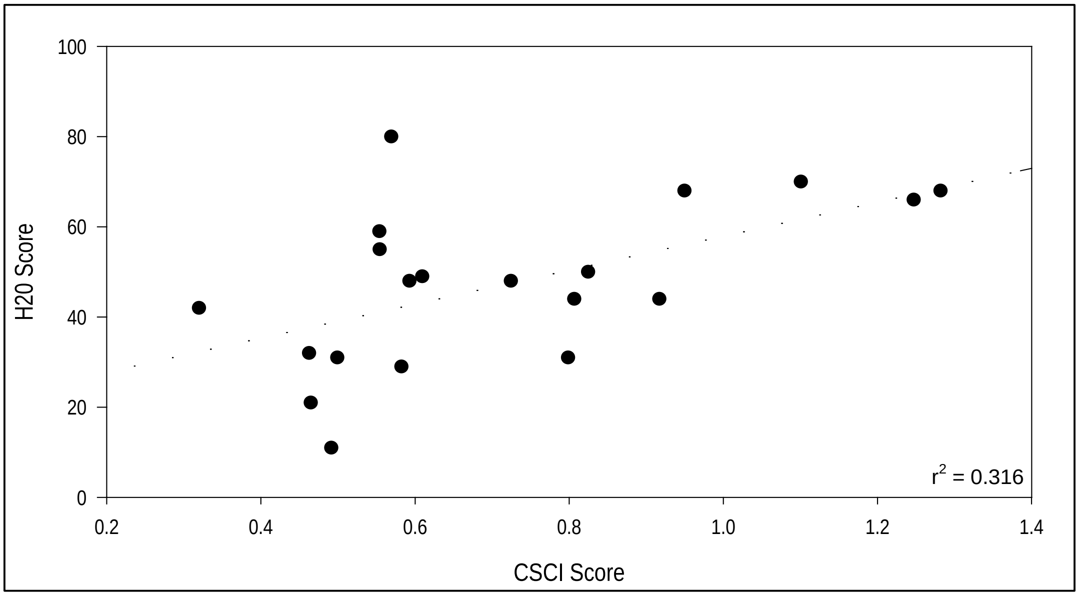


Figure 5.5. Linear regression of Algae IBI score (H2)) and CSCI score for 20 probabilistic sites in Santa Clara County sampled during WY2014 (r^2 = 0.316, p = 0.01).

In contrast to the CSCI scores where there was very little difference between non-perennial and perennial streams, the non-perennial sites generally had higher Algae IBI scores compared to the perennial sites (Figure 5.6). The Algae IBI scores had similar pattern to CSCI scores for three disturbance classes, based on percent impervious area, with limited overlap in scores between the high and low disturbance/imperviousness classes (Figure 5.7).

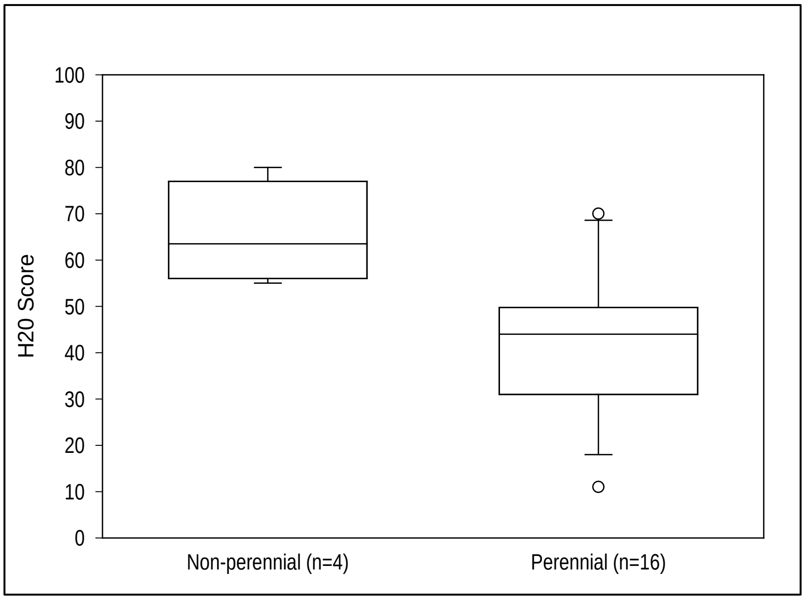


Figure 5.6. Box plots showing distribution of H20 IBI scores for perennial (n=16) and non-perennial (n=4) sites sampled in Santa Clara County in 2014.

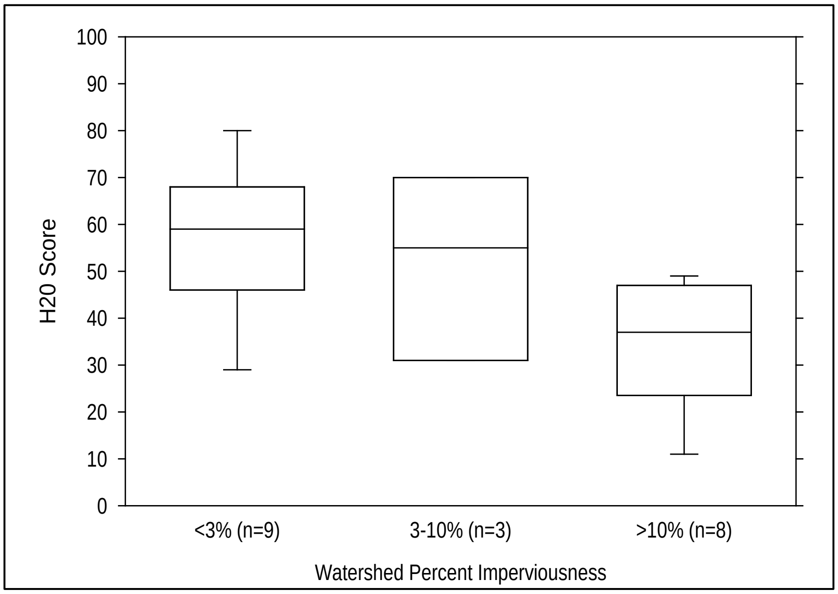


Figure 5.7. Box plots showing distribution of H20 IBI scores at sites sampled in Santa Clara County in 2014 for three classifications of % watershed imperviousness.

5.3 Physical Habitat Condition

Individual attribute and total scores for PHAB and CRAM are listed in Table 5.4. Total PHAB scores ranged from 5 to 55 and CRAM scores ranged from 41 to 88. The majority of sites with higher total PHAB scores were non-urban. Sites with highest total CRAM scores were both urban and non-urban. Total PHAB scores and total CRAM scores were correlated ((r^2 = 0.660, p.< 0.01).) (Figure 5.8). Comparison between CSCI scores and total PHAB scores for 20 probabilistic sites are shown in Figure 5.9. There was moderate correlation between PHAB score and CSCI score (r^2 = 0.398, p = 003). The Algae IBI scores and total PHAB scores were also moderately correlated (r^2 = 0.471, p < 0.001) (Figure 5.10). There was minimal correlation between CRAM scores and CSCI or Algae IBI scores. Physical habitat endpoints and urban land use characteristics for the 20 probabilistic sites are listed in Table 5.5. These stressor variables are compared to biological condition scores in Section 5.4.

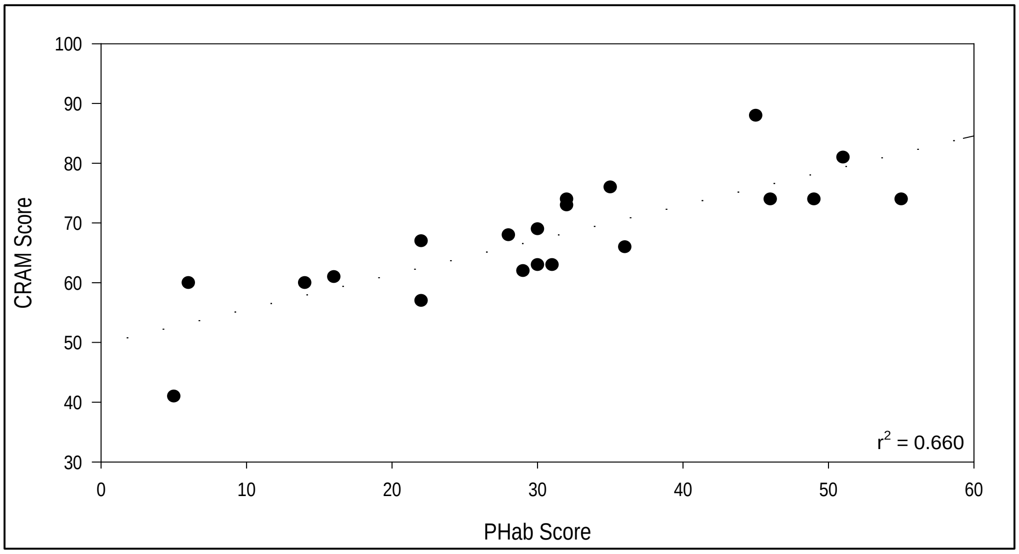


Figure 5.8. Total CRAM scores and Total PHAB scores are compared for all probabilistic sites (r^2 = 0.660, p.< 0.01).

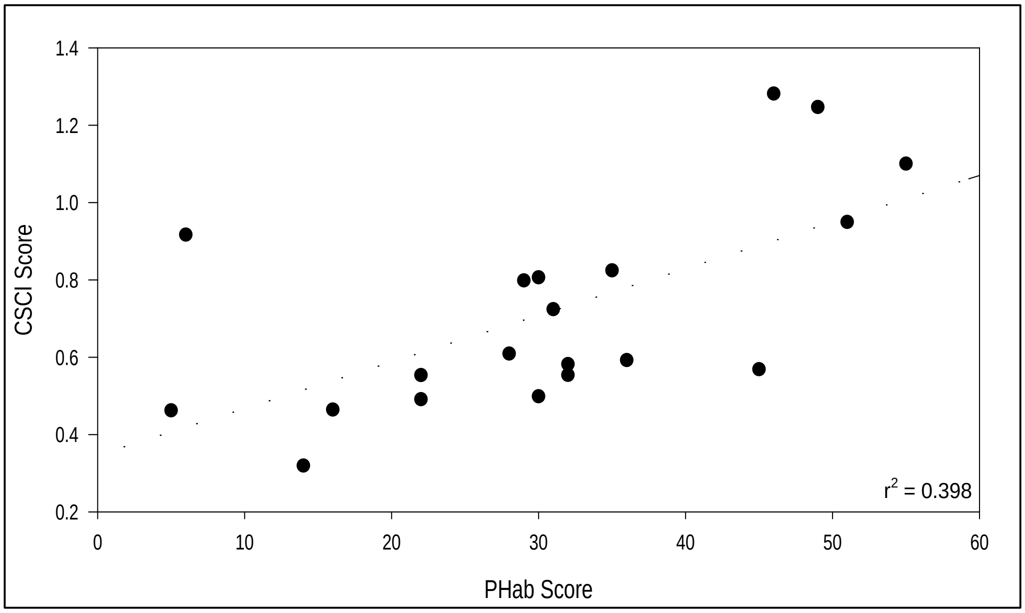


Figure 5.9. CSCI scores and Total PHAB scores are compared for all probabilistic sites ($r^2 = 0.398$, $p = 0.003$).

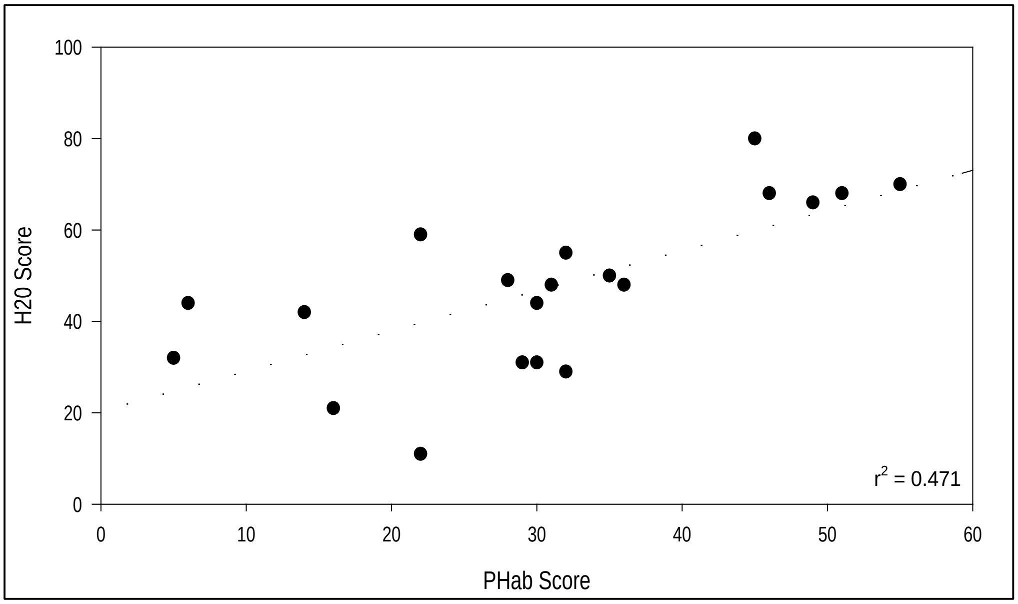


Figure 5.10. Algal IBI scores and Total PHAB scores are compared for all probabilistic sites ($r^2 = 0.471$, $p < 0.001$).

Table 5.4. PHAB and CRAM assessment scores at 20 probabilistic sites in Santa Clara County for WY2014.

Station Code	Creek Name	Land Use	PHAB				CRAM				
			Channel Alteration	Epifaunal Substrate	Sediment Deposition	Total Score	Land	Hydro	Physical	Biotic	Total Score
205R00362	Lyndon Canyon	NU	20	19	16	55	56	100	75	67	74
205R01299	Arroyo Aguague	U	20	18	13	51	100	83	75	64	81
205R00394	Austrian Gulch	NU	20	18	11	49	63	83	75	75	74
205R00330	Hick's Creek	NU	15	16	15	46	56	83	75	81	74
205R00266	Limekiln Creek	NU	16	14	15	45	90	92	88	81	88
205R01226	Los Gatos Creek	U	10	12	14	36	66	58	63	75	66
205R01434	Arroyo Calero	U	15	14	6	35	80	75	75	75	76
205R01187	Stevens Creek	U	19	12	1	32	53	75	88	75	73
205R01578	San Tomas Aquino Creek	U	10	10	12	32	63	67	88	78	74
205R01443	Stevens Creek	U	15	12	4	31	50	58	63	81	63
205R00938	San Tomas Aquino Creek	U	8	12	10	30	41	58	75	78	63
205R01027	Guadalupe River	U	10	10	10	30	38	83	88	67	69
205R00883	Adobe Creek	U	16	8	5	29	80	42	50	75	62
205R01539	Los Gatos Creek	U	10	10	8	28	55	75	75	67	68
205R00851	Los Coches Creek	U	10	7	5	22	36	92	75	64	67
205R00979	Lower Silver Creek	U	4	2	16	22	50	83	38	56	57
205R00915	Thompson Creek	U	9	4	3	16	68	50	63	64	61
205R01091	Saratoga Creek	U	9	3	2	14	63	58	50	69	60
205R01098	Guadalupe Creek	U	2	2	2	6	73	42	50	75	60
205R01306	Ross Creek	U	2	2	1	5	29	58	38	39	41

Table 5.5. Physical habitat condition scores and endpoints calculated from habitat measurements conducted during bioassessments in WY2014.

Station Code	Creek Name	Land Use	% Algae Cover	% Canopy Cover	% Sands & Fines	HDI Score	% Urban	% Impervious
205R00266	Limekiln Creek	NU	17.1	97.3	2.9	0.8	2.9%	1.5%
205R00330	Hick's Creek	NU	21.4	89.4	1.0	0.6	0.0%	1.0%
205R00362	Lyndon Canyon	NU	15.0	99.3	6.7	0.1	2.6%	3.4%
205R00394	Austrian Gulch	NU	15.3	98.5	9.5	0.7	0.0%	1.0%
205R00851	Los Coches Creek	U	22.2	94.9	61.0	1.7	14.8%	1.6%
205R00883	Adobe Creek	U	25.6	97.3	30.5	1.6	33.8%	7.9%
205R00915	Thompson Creek	U	24.0	73.0	25.7	2.0	32.9%	15.7%
205R00938	San Tomas Aquino Creek	U	18.9	94.4	30.8	1.8	52.8%	10.6%
205R00979	Lower Silver Creek	U	32.2	17.9	6.7	2.2	50.3%	23.8%
205R01027	Guadalupe River	U	20.2	66.6	45.7	1.5	46.1%	24.4%
205R01091	Saratoga Creek	U	38.8	29.0	33.3	2.2	48.9%	25.2%
205R01098	Guadalupe Creek	U	22.0	92.0	20.0	1.3	0.1%	1.0%
205R01187	Stevens Creek	U	20.0	96.5	37.1	0.7	3.7%	1.7%
205R01226	Los Gatos Creek	U	32.9	70.3	34.3	2.6	24.5%	12.3%
205R01299	Arroyo Aguague	U	24.6	85.7	5.7	0.2	0.7%	1.3%
205R01306	Ross Creek	U	39.8	5.9	21.9	2.0	81.4%	30.9%
205R01434	Arroyo Calero	U	25.8	93.7	30.5	0.9	11.6%	2.7%
205R01443	Stevens Creek	U	29.1	98.8	40.0	2.0	6.0%	2.4%
205R01539	Los Gatos Creek	U	26.0	89.7	17.1	2.2	31.2%	16.7%
205R01578	San Tomas Aquino Creek	U	24.3	94.4	16.3	1.5	27.0%	5.3%

5.4 Stressor/WQO Assessment

This section addresses the core management question ***"Are water quality objects, both numeric and narrative, being met in local receiving waters, including creeks, rivers, and tributaries?"*** or more specifically, ***"What are the major stressors to aquatic life in Santa Clara County?"*** Potential stressors to aquatic life (such as PHAB measures, percent impervious, and water quality) were compared to biological condition scores to evaluate their importance as major stressors to aquatic life. In addition, each monitoring category required by MRP Provision C.8.c, Table 8.1 is associated with a specification for "Results that Trigger a Monitoring Project in Provision C.8.d.i" (Stressor/Source Identification). The definitions of these "Results that Trigger…", as shown in Table 8.1, are considered to represent "trigger criteria", meaning that the relevant monitoring results should be forwarded for consideration as potential Stressor/Source Identification Projects per Provision C.8.d.i. The trigger criteria/thresholds are listed in Table 4.4 of this report. The physical, chemical, and toxicity monitoring data collected during WY2014 were evaluated against the trigger criteria. When the data analysis indicated that the associated trigger criteria were met, those sites and results were identified as potentially warranting further investigation.

5.4.1 Potential Stressors to Biological Condition

Physical habitat, general water quality, and water chemistry (e.g., nutrients) data were evaluated as potential stressors to biological condition. These data were collected synoptically with biological data during bioassessments at probabilistic sites during WY2014. Using the Sigma Plot statistical software platform, the variables were tested for normality using the Shapiro-Wilk Test. Several environmental parameters were not normally distributed. Correlations between biological assessment tools and environmental variables were evaluated using the Spearman rank method. Coefficients values greater than ±0.7 indicate a strong relationship between variables. If the p-value is ≤0.05, the correlation is considered statistically significant.

Statistically significant variables with the highest correlations are indicated as shaded cells in Table 5.6. There are slightly more significant variables explaining Algae IBI scores (epifaunal substrate score, CRAM score, unionized ammonia, and Total Kjeldahl Nitrogen) compared to CSCI scores (epifaunal substrate score, percent impervious, and chloride). Epifuanal substratre was the only environmental variable that had strong relationship with both biological assessment scores.

Table 5.6. Spearman Rank Correlations for biological condition scores (CSCI and algae H20 IBI) and environmental variables. Coefficients greater than ± 0.7 are indicated as shaded cells.

Independent Variables	Shapiro-Wilk		CSCI		H20	
	Normal Distribution	p-value	Spearman Rank Correlation	p-value	Spearman Rank Correlation	p-value
Biological Assessment Tool						
CSCI	Yes	0.08			0.58	0.01
Algae H20 IBI	Yes	0.89	0.58	0.01		
Potential Stressor						
HDI Score	Yes	0.34	-0.63	< 0.01	-0.55	0.01
Algae Cover	Yes	0.18	-0.48	0.03	-0.39	0.09
Canopy Cover	No	< 0.01	0.54	0.01	0.47	0.04
Sands & Fines	Yes	0.48	-0.40	0.08	-0.48	0.03
Channel Alteration (PHAB)	Yes	0.11	0.58	0.01	0.56	0.01
Epifaunal Substrate (PHAB)	Yes	0.16	0.72	< 0.01	0.72	< 0.01
Sediment Deposition (PHAB)	Yes	0.06	0.46	0.04	0.53	0.02
CRAM Total Score	Yes	0.42	0.52	0.02	0.76	< 0.01
Biotic Structure (CRAM)	No	< 0.01	0.44	0.05	0.35	0.13
Buffer and Landscape (CRAM)	Yes	0.91	0.34	0.11	0.30	0.19
Hydrology (CRAM)	Yes	0.23	0.19	0.41	0.59	0.01
Physical Structure (CRAM)	No	0.02	0.21	0.36	0.46	0.04
% Impervious Watershed Area	No	< 0.01	-0.72	< 0.01	-0.61	< 0.01
Chloride	No	< 0.01	-0.75	< 0.01	-0.60	< 0.01
Unionized Ammonia	No	< 0.01	-0.56	0.01	-0.80	< 0.01
Nitrate as N	No	< 0.01	-0.20	0.40	-0.61	< 0.01
Nitrogen, Total Kjeldahl	Yes	0.862	-0.46	0.04	-0.75	< 0.01
Suspended Sediment Concentration	No	< 0.01	-0.51	0.02	-0.66	< 0.01
Specific Conductivity	Yes	0.551	-0.26	0.26	-0.19	0.42
Temperature	Yes	0.474	-0.45	0.04	-0.55	0.01

5.4.2 Nutrients and Conventional Analytes

Descriptive statistics for nutrient and conventional analyte concentrations measured in samples collected synoptically during bioassessments are listed in Table 5.7. Chlorophyll α and ash free dry mass were measured in µg/L and mg/L, respectively, and were converted to volume per area units using a module developed by EOA. Trigger thresholds for chloride, unionized ammonia, and nitrate are shown in Table 5.7 for reference. No samples exceeded the thresholds.

Table 5.7. Descriptive statists for water chemistry results in Santa Clara County during WY2014.

Nutrients and Conventional Analytes	Units	N	**N ≥ RL**	Min	Max	Mean[1]	Median[1]	Trigger	
								Threshold	Exceedance
Alkalinity (as $CaCO_3$)	*(mg/L)*	20	20	141	453	264.3	237	--	--
Ash Free Dry Mass	*(g/m^2)*	20	19	3.6	1387	277	118	--	--
Chloride	*(mg/L)*	20	20	5.3	340	65.2	41.5	230/250[2]	5%
Chlorophyll α	*(mg/m^2)*	20	18	14	155.8	57	47.8	--	--
Dissolved Organic Carbon	*(mg/L)*	20	20	0.57	4.1	2.15	1.7	--	--
Ammonia (as N)	*(mg/L)*	20	2	< 0.04	0.19	0.05	0.02	--	--
Unionized Ammonia (as N)[3]	*(µg/L)*	20	2	<0.03	3.23	0.85	0.45	25	0%
Nitrate (as N)	*(mg/L)*	20	13	< 0.01	2.9	0.54	0.11	10	0%
Nitrite (as N)	*(mg/L)*	20	1	< 0.005	0.05	0.006	0	--	--
Total Kjeldahl Nitrogen (as N)	*(mg/L)*	20	19	< 0.07	0.97	0.44	0.46	--	--
OrthoPhosphate (as P)	*(mg/L)*	20	17	< 0.006	0.2	0.06	0.03	--	--
Phosphorus (as P)	*(mg/L)*	20	18	< 0.007	0.2	0.07	0.05	--	--
Suspended Sediment Concentration	*(mg/L)*	20	4	< 2	16	3.39	1	--	--
Silica (as SiO_2)	*(mg/L)*	20	20	11	38	19.85	19	--	--

[1] Mean and median concentrations calculated using ½ the method detection limit (MDL) for samples below the detection limit (ND).

[2] The nitrate and 250 mg/L chloride thresholds apply to Title 22 drinking waters and sites with MUN beneficial use only.

[3] Unionized ammonia estimated from ammonia, pH, temperature, and specific conductance per Emerson et al., 1975.

5.4.3 Chlorine

Field testing for free chlorine and total chlorine residual was conducted at all probabilistic sites concurrent with spring bioassessment sampling and at a subset of the sites concurrent with dry season toxicity sampling. Chlorine concentrations and comparisons to the MRP Table 8.1 trigger threshold are listed in Table 5.8. The MRP trigger criterion for chlorine states, “After immediate resampling, concentrations remain >0.08 mg/L”. If a repeat chlorine measurement was not conducted, the original measurement was evaluated. Twenty-three measurements were collected in WY2014; 13% exceeded the threshold for free chlorine, and 22% exceeded the threshold for total chlorine residual. Lower Silver Creek (205R00979) exceeded the threshold for both free and total chlorine on both measurement dates. All four sites that exceeded chlorine thresholds were highly urban sites.

Table 5.8. SCVURPPP chlorine testing results compared to MRP trigger criteria for WY2014. Samples were taken twice at some sites when results exceeded 0.08 mg/L trigger. Values above the trigger are indicated by shaded cells.

Station Code	Date	Creek	Free Chlorine (mg/L)[1, 2]	Total Chlorine Residual (mg/L)[1, 2]	Exceeds Trigger? [3] (0.08 mg/L)
205R00266	4/23/2014	Limekiln Creek	0.04	0.05	No
205R00330	5/16/2014	Hick's Creek	< 0.02	0.02	No
205R00362	5/22/2014	Lyndon Canyon	< 0.02	< 0.02	No
205R00394	5/12/2014	Austrian Gulch	< 0.02	0.02	No
205R00851	4/21/2014	Los Coches Creek	< 0.02[4]	< 0.02[4]	No
205R00883	5/13/2014	Adobe Creek	0.04	0.06	No
205R00883	6/4/2014	Adobe Creek	0.03	0.03	No
205R00915	4/24/2014	Thompson Creek	< 0.02	0.03	No
205R00938	4/30/2014	San Tomas Aquino Creek	0.02	0.03	No
205R00938	6/4/2014	San Tomas Aquino Creek	0.02	0.03	No
205R00979	4/24/2014	Lower Silver Creek	0.09 / 0.09	0.12 / 0.12	Yes
205R00979	6/4/2014	Lower Silver Creek	0.18[5]	0.13[5]	Yes
205R01027	5/5/2014	Guadalupe River	0.03	0.03	No
205R01091	5/5/2014	Saratoga Creek	0.03 / 0.04	0.08 / 0.09	Yes
205R01098	5/16/2014	Guadalupe Creek	0.04	0.05	No
205R01187	5/14/2014	Stevens Creek	0.10 / 0.09	0.13 / 0.13	Yes
205R01226	5/20/2014	Los Gatos Creek	0.02	0.02	No
205R01299	5/15/2014	Arroyo Aguague	0.05 / <0.02	0.04	No
205R01306	4/23/2014	Ross Creek	0.08	0.09[5]	Yes
205R01434	5/21/2014	Arroyo Calero	0.02	0.02	No
205R01443	5/14/2014	Stevens Creek	< 0.02	0.15 / 0.03	No
205R01539	5/20/2014	Los Gatos Creek	0.02	0.02	No
205R01578	4/22/2014	San Tomas Aquino Creek	< 0.02[4]	< 0.02[4]	No
Number of samples exceeding 0.08 mg/L:			3	5	--
Percentage of samples exceeding 0.08 mg/L:			13%	22%	--

[1] The method detection limit for the test kits is 0.02 mg/L.

[2] Original and repeat samples are reported where conducted. The first value is the original sample, and the second value is the duplicate sample.

[3] The trigger applies to both free and total chlorine measurements.

[4] Questionable results – diluted test reagent.

[5] Immediate resampling was not conducted at these sites.

5.4.4 Water and Sediment Toxicity

Water toxicity samples were collected from a subset of urban probabilistic sites twice per year, during storm events and summer dry conditions. Samples were tested for toxic effects using four species: an algae (*Selenastrum capricornutum*), two aquatic invertebrates (*Ceriodaphnia dubia* and *Hyalella azteca*), and one fish species (*Pimephales promelas* or fathead minnow). Both acute and chronic endpoints (survival and reproduction/growth) were analyzed for *Ceriodaphnia dubia* and fathead minnow. *Selenastrum capricornutum* are tested only for the chronic (growth) endpoint and *Hyalella azteca* are tested only for the acute (survival) endpoint.

Table 5.9 provides a summary of toxicity testing results for water samples. One water sample was found to be toxic to *Hyalella Azteca* – the wet season sample from Lower Silver Creek. This sample did not meet the trigger criteria of being less than 50 percent of the control (see Table 5.11). Three samples were found to be chronically toxic to *Ceriodaphnia dubia* (San Tomas Aquino in both the wet and dry season, and Adobe Creek in the dry season); however, these results did not meet the trigger criteria (see Table 5.12).

Table 5.9. Summary of SCVURPPP water toxicity results for WY2014.

SCVURPPP Water Samples			Test Initiation Date	Toxicity relative to the Lab Control treatment?					
Sample Station	Creek	Sample Date		*Selenastrum capricornutum*	*Ceriodaphnia dubia*		*Hyalella azteca*	Fathead Minnow	
				Growth	Survival	Reproduction	Survival	Survival	Growth
205R00883	Adobe Creek	2/26/14	2/27/14	No	No	No	No	No	No
205R00938	San Tomas Aquino Creek	2/26/14	2/27/14	No	No	Yes	No	No	No
205R00979	Lower Silver Creek	2/26/14	2/27/14	No	No	No	Yes	No	No
205R00883	Adobe Creek	6/4/14	6/5/14	No	No	Yes	No	No	No
205R00938	San Tomas Aquino Creek	6/4/14	6/5/14	No	No	Yes	No	No	No
205R00979	Lower Silver Creek	6/4/14	6/5/14	No	No	No	No	No	No

During the dry season, sediment samples were collected at the same sites and tested for sediment toxicity and an extensive suite of sediment chemistry constituents. Sediment toxicity testing was performed with just one species, *Hyalella azteca*, a common benthic invertebrate. Both acute and chronic endpoints (survival and growth) were analyzed. Table 5.10 provides a summary of toxicity testing results for sediment samples. One sediment sample collected at site in Adobe Creek was determined to be acutely toxic. No chronic endpoint results indicated chronic toxicity at any site.

Table 5.10. Summary of SCVURPPP dry season sediment toxicity results for WY2014.

Dry Season Sediment Samples			Date of Analysis	Toxicity relative to the Lab Control treatment?	
				Hyalella azteca	
Sample Station	Creek	Collection Date		Survival	Growth
205R00883	Adobe Creek	6/4/14	6/9/14	Yes	No
205R00938	San Tomas Aquino Creek	6/4/14	6/9/14	No	No
205R00979	Lower Silver Creek	6/4/14	6/9/14	No	No

Table 5.11 provides detailed results for the *Hyalella azteca* water and sediment tests that were found to be toxic relative to the laboratory control (via statistical comparison at p=0.5), along with comparisons to the relevant trigger criteria from MRP Tables 8.1 and H-1 (included in Table 4.4 of this report). The toxic sediment sample (205R00883) met the MRP Table H-1 trigger criteria of being more than 20% less than the control.

Table 5.11. Comparison between laboratory control and SCVURPPP water and sediment receiving sample toxicity results (*Hyalella azteca*) in the context of MRP trigger criteria.

Test Initiation Date	Sample Type	Treatment/ Sample ID	Creek	10-Day Mean % Survival	Comparison to MRP Table 8.1 Trigger Criteria
2/27/14	Water	Lab Control	N/A	90	N/A
		205R00979	Lower Silver Creek	**64 ***	Not < 50% of Control
6/9/14	Sediment	Lab Control	N/A	95	N/A
		205R00883	Adobe Creek	**86.3 ***	Not < 20% of Control

N/A – not applicable

* The response at this test treatment was significantly less than the Lab Control at p<0.05.

Table 5.12 provides detailed results for the *Ceriodaphnia dubia* tests with statistically different results from laboratory controls, along with comparisons to the relevant trigger criteria from MRP Table 8.1. No sample was less than the association MRP threshold of less than 50% of the control values for either survival or growth.

Table 5.12. Comparison between laboratory control and SCVURPPP receiving water sample toxicity results for *Ceriodaphnia dubia* in the context of MRP trigger criteria.

Test Initiation Date	Treatment / Sample ID	Creek	Mean % Survival	Comparison to MRP Table 8.1 Trigger Criteria; Identification of PRM effects and PRM Method Re-tests
2/27/14	Lab Control	N/A	31.3	N/A
	205R00938	San Tomas Aquino Creek	23.1	Not < 50% of Control
6/5/14	Lab Control	N/A	26.2	N/A
	205R00883	Adobe Creek	**19.6***	Not < 50% of Control
	205R00938	San Tomas Aquino Creek	**14.3***,[a]	Not < 50% of Control

* The response at this test treatment was significantly less than the Lab Control at p < 0.05.

[a] The test response in one of the replicates at this test treatment was determined to be a statistical outlier; the results reported above are for the analysis of the data excluding the outlier. As per EPA guidelines, analysis of the data including the outlier was also performed and is included as a supplemental appendix to the laboratory report.

5.4.5 Sediment Chemistry

Sediment chemistry results are evaluated as potential stressors based on TEC quotients, PEC quotients, and TU equivalents, according to criteria in Table H-1 of the MRP which are summarized in Section 4.3.3 of this report.

Table 5.13 lists TEC quotients for all non-pyrethroid sediment chemistry constituents, calculated as the measured concentration divided by the more sensitive TEC value, per MacDonald et al. (2000). This table also provides a count of the number of constituents that exceed TEC values for each site, as evidenced by a TEC quotient greater than or equal to 1.0. The number of TEC quotients exceeded per site ranges from three to four, out of 27 constituents included in MacDonald et al. (2000). All three sites exceeded the relevant trigger criterion from MRP Table H-1, which is interpreted to stipulate three or more constituents with TEC quotients greater than or equal to 1.0.

Table 5.14 provides PEC quotients for all non-pyrethroid sediment chemistry constituents, and calculated mean values of the PEC quotients for each site. No sites meet the MRP Table H-1 action criteria with a mean PEC greater than 0.5.

Table 5.15 provides a summary of the calculated TU equivalents for the pyrethroids for which there are published LC50 values in the literature, as well as a sum of TU equivalents for each site. Because organic carbon mitigates the toxicity of pyrethroid pesticides in sediments, the LC50 values were derived on the basis of TOC-normalized pyrethroid concentrations. Therefore, the pyrethroid 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 pyrethroid. The individual TU equivalents were summed to produce a total pyrethroid TU equivalent value for each site. Two of the three sites meet the MRP Table H-1 action criterion with TU sums greater than or equal to 1.0.

Some of the calculated numbers for TEC quotients, PEC quotients, and pyrethroid TU equivalents may be artificially elevated due to the method used to account for filling in non-detect data. Concentrations equal to one-half of the respective laboratory method detection limits were substituted for non-detect data so these statistics could be computed. High levels of naturally-occurring chromium and nickel in geologic formations (i.e., serpentinite) and soils can contribute to TEC and PEC quotients, particularly for sites located higher in the watersheds where contributing watersheds contain a higher percent of natural sources.

Table 5.13. Threshold Effect Concentration (TEC) quotients for WY2014 sediment chemistry constituents. Bolded values indicate TEC quotient ≥ 1.0. Shaded cells indicate sum of TEC quotients >3.

Site ID, Creek	TEC	205R00883	205R00938	205R00979
		Adobe	San Thomas Aquino	Lower Silver
Metals (mg/kg DW)				
Arsenic	9.79	0.27	0.27	0.31
Cadmium	0.99	0.21	0.15	0.26
Chromium	43.4	**4.15**	**3.69**	0.67
Copper	31.6	**1.27**	**1.49**	0.51
Lead	35.8	0.31	0.27	0.24
Mercury	0.18	0.22	0.51	0.31
Nickel	22.7	**5.73**	**8.37**	**1.98**
Zinc	121	0.72	0.83	0.46
PAHs (µg/kg DW)				
Anthracene	57.2	0.09	0.03 [a]	0.03 [a]
Fluorene	77.4	0.02 [a]	0.05	0.02
Naphthalene	176	0.01 [a]	0.01 [a]	0.01 [a]
Phenanthrene	204	0.20	0.13	0.09
Benz(a)anthracene	108	0.15	0.05	0.09
Benzo(a)pyrene	150	0.23	0.01 [a]	0.20 [a]
Chrysene	166	0.24	0.19	0.25
Dibenz[a,h]anthracene	33.0	0.05 [a]	0.05 [a]	0.05 [a]
Fluoranthene	423	0.14	0.06	0.08
Pyrene	195	0.23	0.13	0.16
Total PAHs	1,610	0.25 [b]	0.10 [b]	0.15 [b]
Pesticides (µg/kg DW)				
Chlordane	3.24	0.20 [a]	0.21 [a]	0.20 [a]
Dieldrin	1.9	0.19 [a]	0.19 [a]	0.18 [a]
Endrin	2.22	0.17 [a]	0.17 [a]	0.17 [a]
Heptachlor Epoxide	2.47	0.13 [a]	0.13 [a]	0.13 [a]
Lindane (gamma-BHC)	2.37	0.14 [a]	0.14 [a]	0.14 [a]
Sum DDD	4.88	0.11 [b]	0.11 [b]	0.20 [b]
Sum DDE	3.16	0.36 [b]	**1.28** [b]	**1.53** [b]
Sum DDT	4.16	0.08 [b]	0.09 [b]	**12.79** [b]
Total DDTs	5.28	0.38 [b]	0.93 [b]	**11.17** [b]
Number of constituents with TEC quotient >= 1.0	-	3	4	4

a - Concentraion was below the method detection limit (MDL). TEC quotient calculated using 1/2 MDL.
b - Total calculated using 1/2 MDLs.

Table 5.14. Probable Effect Concentration (PEC) quotients for WY2014 sediment chemistry constituents. Bolded values indicate individual PEC quotients > 1.0; mean PEC quotients did not exceed 0.5.

Site ID, Creek	PEC	205R00883	205R00938	205R00979
		Adobe	San Thomas Aquino	Lower Silver
Metals (mg/kg DW)				
Arsenic	33.0	0.08	0.08	0.09
Cadmium	4.98	0.04	0.03	0.05
Chromium	111	**1.62**	**1.44**	0.26
Copper	149	0.27	0.32	0.11
Lead	128	0.09	0.08	0.07
Mercury	1.06	0.04	0.09	0.05
Nickel	48.6	**2.67**	**3.91**	0.93
Zinc	459	0.19	0.22	0.12
PAHs (µg/kg DW)				
Anthracene	845	0.01	0.00 [a]	0.00 [a]
Fluorene	536	0.00 [a]	0.01	0.00
Naphthalene	561	0.00 [a]	0.00 [a]	0.00 [a]
Phenanthrene	1170	0.03	0.02	0.02
Benz(a)anthracene	1050	0.02	0.01	0.01
Benzo(a)pyrene	1450	0.02	0.00 [a]	0.02 [a]
Chrysene	1290	0.03	0.02	0.03
Fluoranthene	2230	0.03 [a]	0.01 [a]	0.01 [a]
Pyrene	1520	0.03	0.02	0.02
Total PAHs	22,800	0.02 [b]	0.01 [b]	0.01 [b]
Pesticides (µg/kg DW)				
Chlordane	17.6	0.04 [a]	0.04 [a]	0.04 [a]
Dieldrin	61.8	0.01 [a]	0.01 [a]	0.01 [a]
Endrin	207.0	0.00 [a]	0.00 [a]	0.00 [a]
Heptachlor Epoxide	16	0.02 [a]	0.02 [a]	0.02 [a]
Lindane (gamma-BHC)	4.99	0.07 [a]	0.07 [a]	0.07 [a]
Sum DDD	28	0.02 [b]	0.02 [b]	0.03 [b]
Sum DDE	31.3	0.04 [b]	0.13 [b]	0.15 [b]
Sum DDT	62.9	0.01 [b]	0.01 [b]	0.85 [b]
Total DDTs	572	0.00 [b]	0.01 [b]	0.10 [b]
Mean PEC Quotient	-	0.20	0.24	0.11

a - concentration was below the method detection limit (MDL). PEC quotient calculated using 1/2 MDL.
b - Total calculated using 1/2 MDLs.

Table 5.15. Calculated pyrethroid toxic unit (TU) equivalents for WY2014 pyrethroid concentrations. Bolded cells indicate exceedance of LC50. Shaded cells indicate sum of TUs >1.

Pyrethroid	Unit	LC50	205R00883	205R00938	205R00979
			Adobe	San Thomas Aquino	Lower Silver
Bifenthrin	µg/g dw	0.52	0.33	**2.88**	**3.27**
Cyfluthrin	µg/g dw	1.08	0.04 [a]	0.62	0.44
Cypermethrin	µg/g dw	0.38	0.12 [a]	0.13 [a]	**1.26** [a]
Deltamethrin	µg/g dw	0.79	0.09 [a]	0.09 [a]	0.09 [a]
Esfenvalerate	µg/g dw	1.54	0.03 [a]	0.03 [a]	0.03 [a]
Lambda-Cyhalothrin	µg/g dw	0.45	0.12 [a]	0.13 [a]	0.12 [a]
Permethrin	µg/g dw	10.83	0.03 [b]	0.12 [b]	0.16 [b]
Sum of Toxic Unit Equivalents per Site	-	-	0.76	4.00	5.36

a - concentration was below the method detection limit (MDL). PEC quotient calculated using 1/2 MDL.

b - Total calculated using 1/2 MDLs.

5.4.6 Temperature

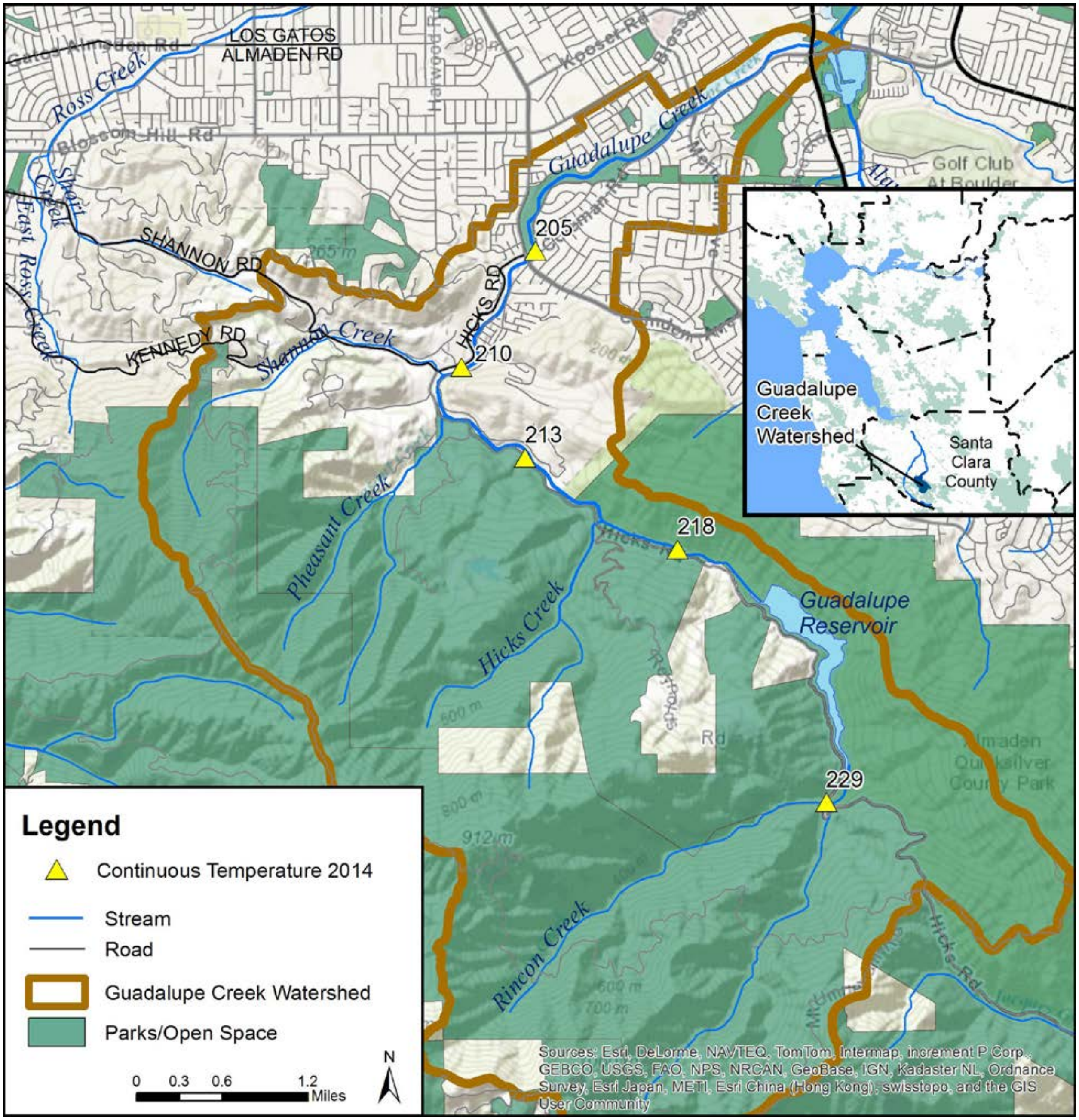
Summary statistics for water temperature data collected at five sites in Guadalupe Creek and five sites in Stevens Creek during WY2014 are shown in Table 5.16 and Table 5.17, respectively. Station locations are mapped in Figures 5.11 and 5.12. Hourly temperature data was collected between April and September, with the exceptions of sites 205GUA229 and 205STE095, which were retrieved in June and July, respectively, due to dry channel conditions.

Table 5.16. Descriptive statistics for continuous water temperature measured in Guadalupe Creek at five sites during WY2014.

	Site	205GUA229	205GUA218	205GUA213	205GUA210	205GUA205
	Start Date	4/29/2014	4/29/2014	4/29/2014	4/29/2014	4/29/2014
	End Date	6/14/2014	9/29/2014	9/29/2014	9/29/2014	9/29/2014
Temperature (°C)	Minimum	10.1	11.0	10.7	10.0	11.6
	Median	13.7	18.9	17.5	17.6	18.2
	Mean	13.8	18.2	16.8	17.3	17.8
	Maximum	18.4	23.3	20.4	22.9	21.8
	Max 7-day Mean	16.0	21.0	18.7	20.1	20.4
	N	1233	3809	3809	3810	3810

Table 5.17. Descriptive statistics for continuous water temperature measured in Stevens Creek at five sites during WY2014.

	Site	205STE105	205STE95	205STE70	205STE65	205STE64
	Start Date	4/29/2014	4/29/2014	4/29/2014	4/29/2014	4/29/2014
	End Date	9/28/2014	7/13/14	9/29/2014	9/29/2014	9/29/2014
Temperature (°C)	Minimum	9.4	9.5	11.3	11.2	12.5
	Median	14.7	15.4	18.7	17.5	18.1
	Mean	14.6	15.3	18.0	17.1	18.0
	Maximum	19.5	21.2	23.0	21.2	24.3
	Max 7-day Mean	17.0	17.5	21.2	19.9	20.2
	N	3790	1940	3810	3810	3810



Sources: Esri, DeLorme, NAVTEQ, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, and the GIS User Community

Figure 5.11. Continuous temperature stations in Guadalupe Creek.

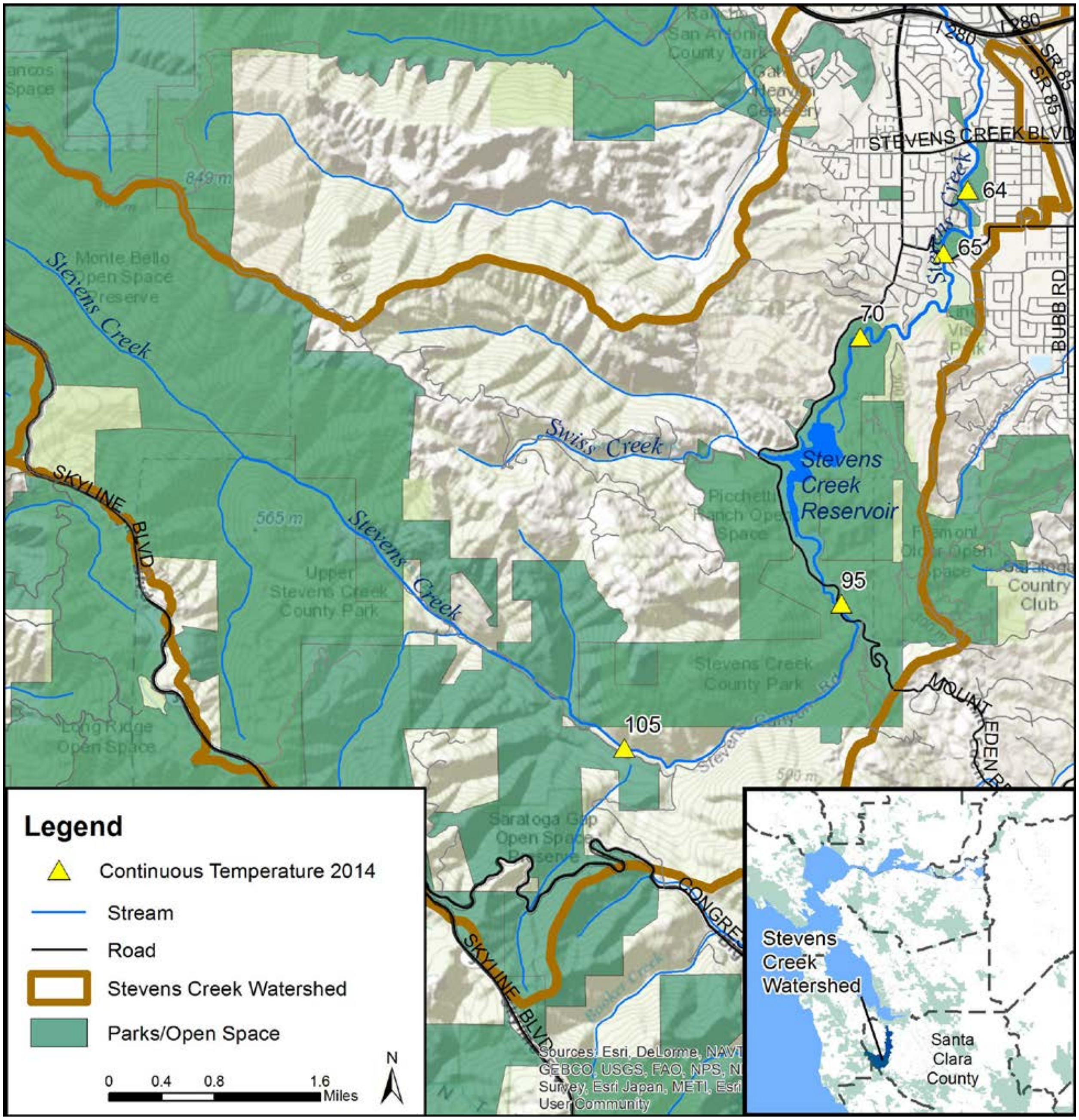


Figure 5.12. Continuous temperature stations in Stevens Creek.

The monitoring results from Guadalupe Creek suggest that the reservoir has some influence on the water temperature measured in the creek (Table 5.16). The lowest median temperature (13.7 °C) was measured at the site approximately 0.5 mile upstream of the Guadalupe Reservoir (205GUA229) and the highest median temperature (18.9 °C) was measured at the site approximately 0.5 mile downstream of the reservoir (205GUA218). However, temperature was only collected at the upper site until June 14th due to dry channel conditions. As a result, the median temperatures at the upper site should only be compared to the lower site for the monitoring period prior to June. For this time period, the median temperatures for sites above reservoir and below reservoir were 13.7 °C and 15.2 °C, respectively.

Water temperatures for the sites just upstream and downstream Guadalupe Reservoir are plotted in Figure 5.13. The daily maximum and minimum air temperatures, collected from a local weather station, are also shown on the figure. Stream flow data (not shown) measured below the dam was consistently less than 1 cfs throughout the monitoring period. Water temperature downstream of the dam is likely influenced by increased air temperatures through the dry season, as well as increased water temperatures within the reservoir. Due to extreme drought conditions during WY2014, the water levels in Guadalupe Reservoir were much lower than normal, which likely resulted in elevated temperatures in water released below the dam.

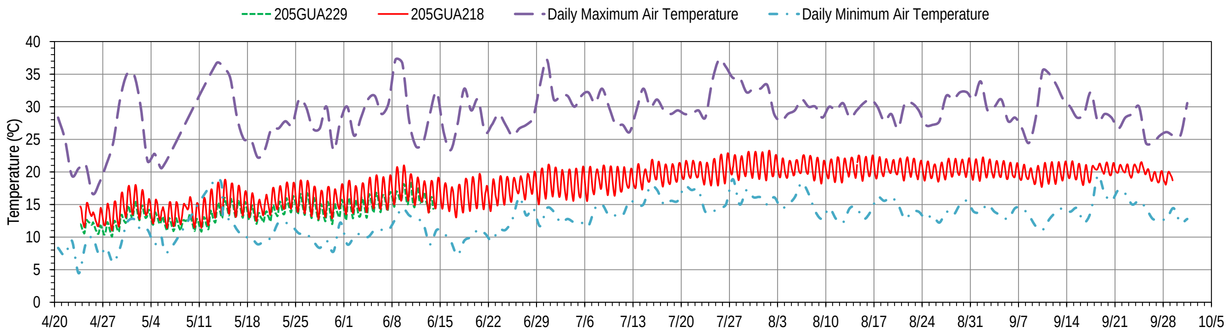


Figure 5.13. Water temperature collected directly upstream and downstream of Guadalupe Creek during WY 2014. Minimum and maximum air temperature data, collected from local weather station, are also shown.

The temperature pattern in Stevens Creek was similar to Guadalupe Creek with the highest median temperatures measured at the site directly downstream of the reservoir (18.7 °C) and the lowest median temperature (14.7 °C) occurring at the upper elevation site (Table 5.17). Note the upper elevation site was approximately three miles upstream of the reservoir. The temperature collected at these two sites occurred over the same period (April through September). Similar to Guadalupe Creek, drying conditions upstream of the Stevens Creek Reservoir occurred by July and water levels in the reservoir became extremely low.

Box plots illustrating the distribution of water temperature data for 2014 at five sites in Guadalupe Creek and five sites in Stevens Creek, are shown in Figures 5.14 and 5.15, respectively. The acute temperature threshold (24.0 °C) is shown on both figures. Temperatures were below the acute threshold at all sites in both watersheds, with the exception of a small percentage of the data collected at the Backberry Farm site in Stevens Creek (STE064).

Box plots illustrating the distribution of water temperature data, calculated as the 7-day mean, for five sites in Guadalupe Creek and five sites in Stevens Creek are shown in Figures 5.16 and 5.17, respectively. The chronic (maximum 7-day mean) temperature (MWAT) threshold (19.0 °C) is shown in both figures. Trigger analysis of temperature data using the MWAT threshold is included in Table 5.25. A trigger is defined when the MWAT exceeds the threshold for more than 20% of records at a single site.

Triggers for temperature were exceeded in Guadalupe Creek at the site directly downstream of the reservoir (GUA218) and the lowest elevation site downstream of Coleman Avenue (GUA205) with 49% and 28%, respectively, of the measurements exceeding the MWAT threshold (Table 5.18). A similar pattern was observed in Stevens Creek, with triggers exceeded at the site below the dam (STE070) and lowest elevation site at Blackberry Farm, with 54% and 30%, respectively, of the measurements exceeding the MWAT threshold.

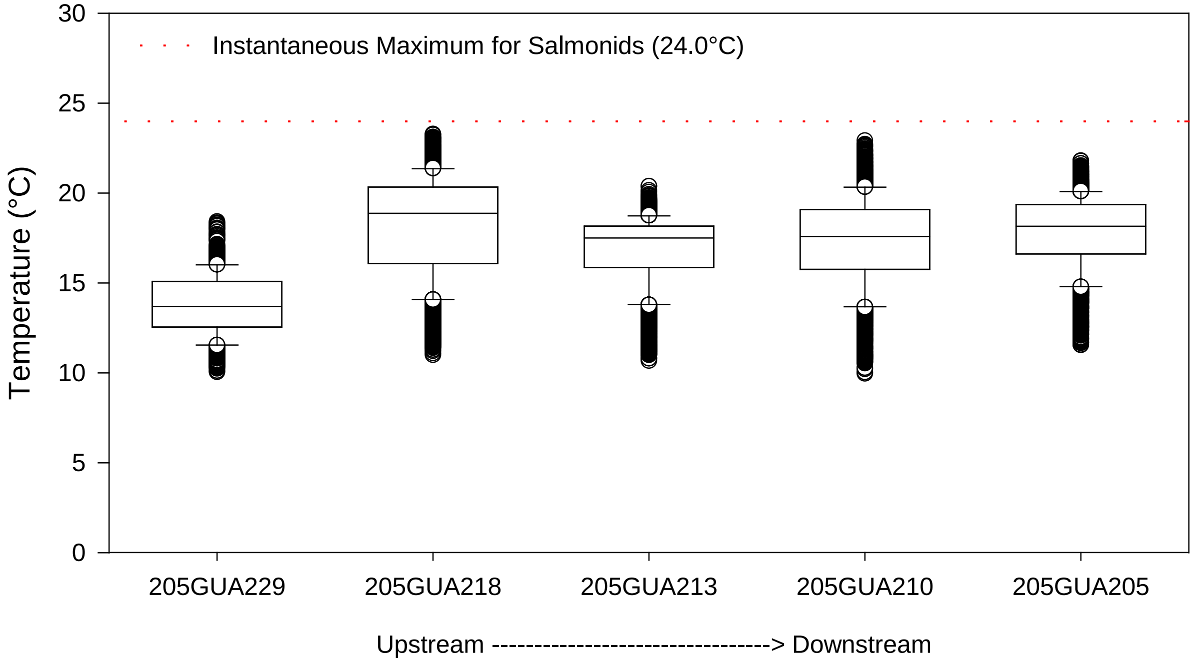


Figure 5.14. Box plots of water temperature data collected at five stream locations in Guadalupe Creek, Santa Clara County, from April through September 2014.

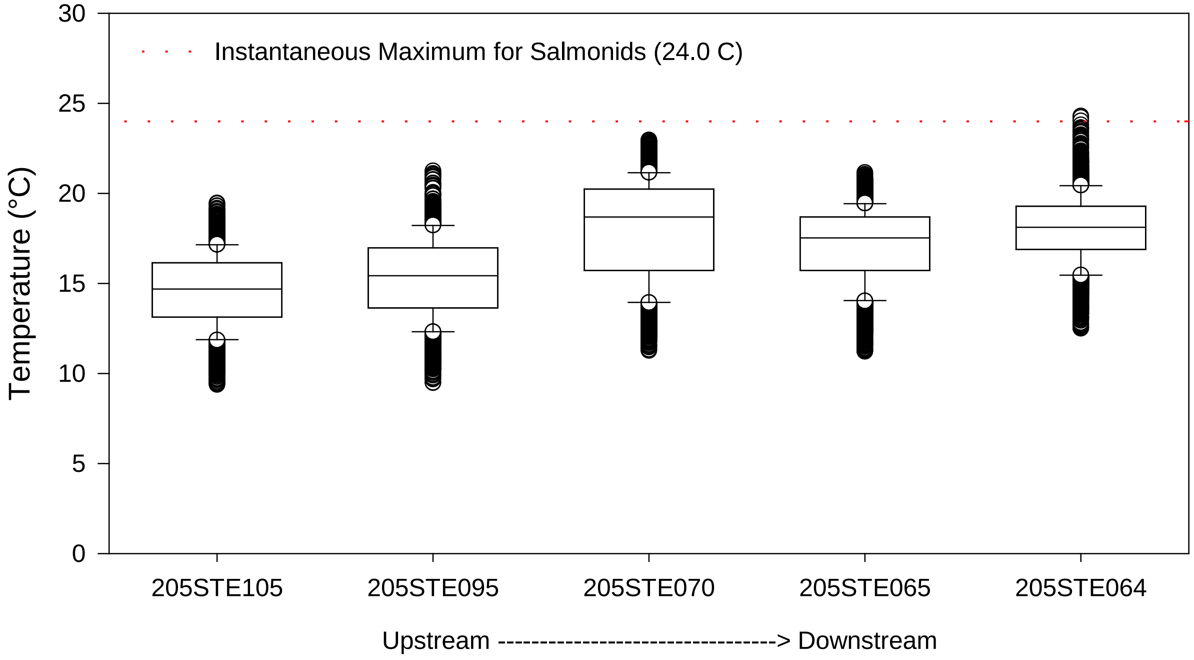


Figure 5.15. Box plots of water temperature data collected at five stream locations in Stevens, Santa Clara County, from April through September 2014.

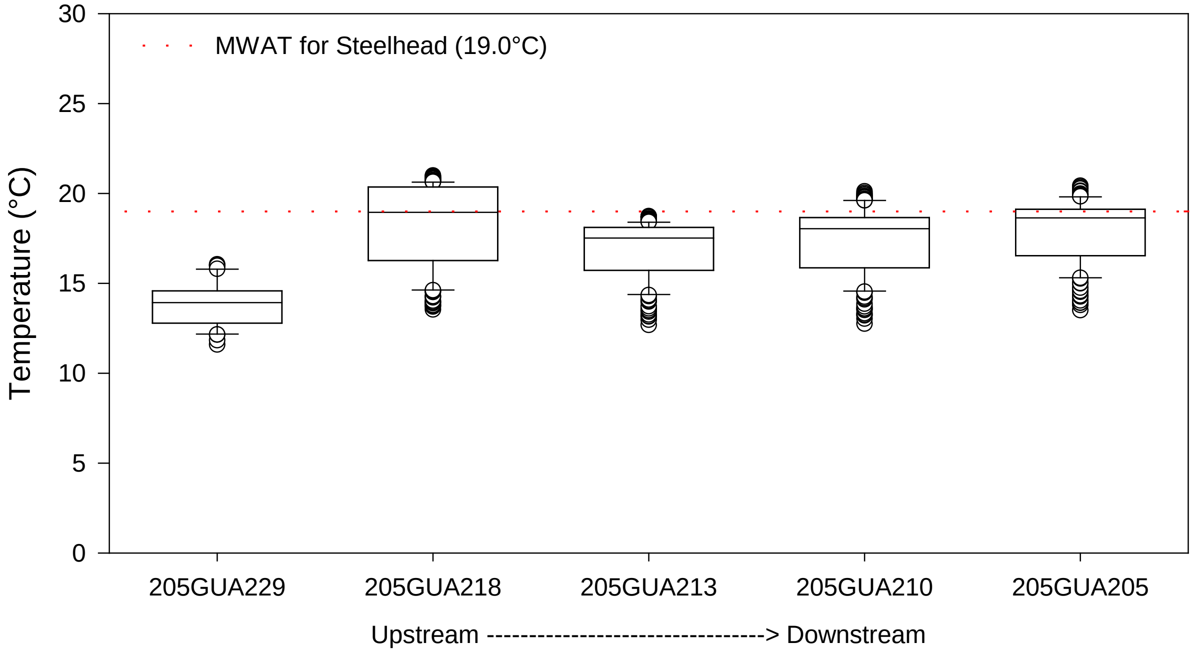


Figure 5.16. Box plots of water temperature data, calculated as the 7-day mean, collected at five stream locations in Guadalupe Creek, Santa Clara County, from April through September 2014.

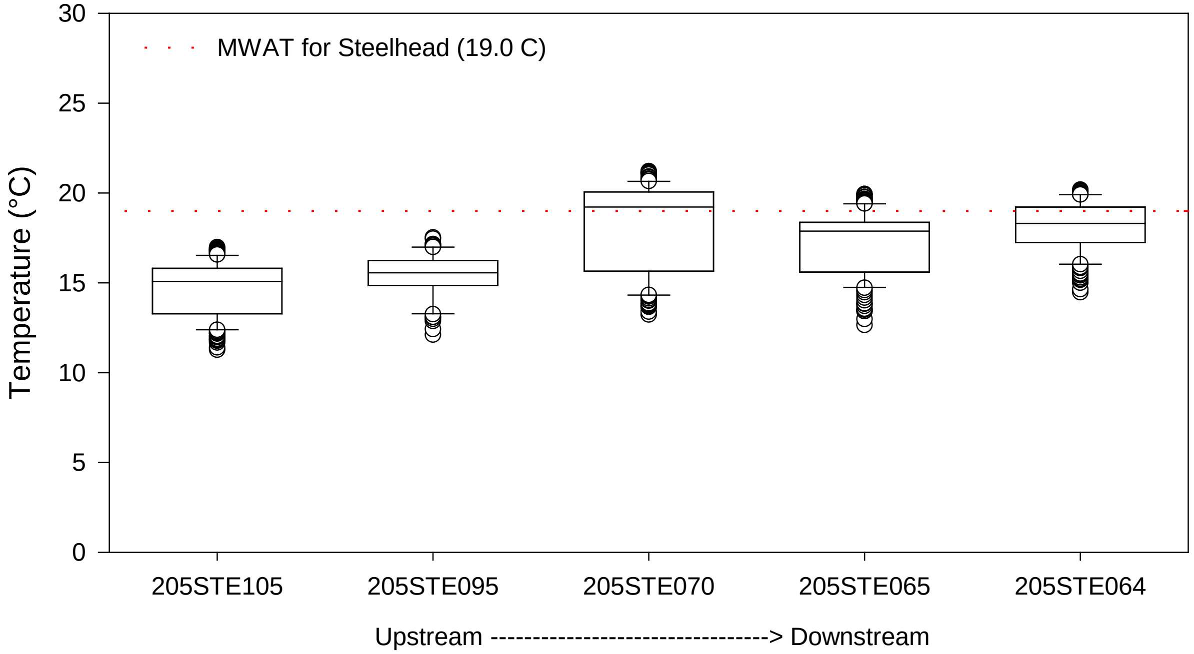


Figure 5.17. Box plots of water temperature data, calculated as the 7-day mean, collected at five stream locations in Stevens Creek, Santa Clara County, from April through September 2014.

Table 5.18. Percent of water temperature data measured between April – September, 2014 that exceeded MWAT maximum threshold value (19 °C) at the ten temperature sites monitored in Guadalupe Creek and Stevens in Santa Clara County.

Site ID	Creek	Site Name	Percentage results MWAT > 19˚	Trigger (>20%) Exceeded?
205GUA229	Guadalupe Creek	Confluence with Rincon Creek	0%	No
205GUA218		Downstream of the Horse Stable	49%	Yes
205GUA213		At the Fish Ladder	0%	No
205GUA210		At Shannon Oaks	17%	No
205GUA205		At Camden and Coleman	30%	Yes
205STE105	Stevens Creek	Upstream of the reservoir	0%	No
205STE95		At Sycamore Group area	0%	No
205STE70		At the SCVWD gage	54%	Yes
205STE65		At McClellan Ranch	14%	No
205STE64		At Blackberry Farm	28%	Yes

The reach in Stevens Creek between Blackberry Farm and Stevens Creek Reservoir was identified as having the best quality steelhead spawning and juvenile rearing habitat within the Stevens Creek watershed (Stillwater 2004). The limiting factors analysis study evaluated water temperature data collected by the SCVWD during WY2000 and determined that temperatures downstream of the dam were relatively warm, but within the range to support a steelhead population. Across eight monitoring sites below Stevens Creek dam, the daily average temperatures ranged between 11.7 to 21.7 °C (note: raw temperature data was not available to calculate daily averages for any one site). The study concluded that WY2000 was considered an “average” year climatologically suggesting that the stream temperature data was representative of typical conditions below Stevens Creek Reservoir.

The three lowest elevation monitoring sites in Steven Creek are located within the reach that potentially supports steelhead populations. Two of the three sites in this reach had temperatures that exceeded MWAT (19 °C) for steelhead. Water temperatures measured during this study are expected to be higher than what might occur during a more typical year due to antecedent drought conditions causing very low water levels in the Stevens Creek Reservoir and minimal baseflows during the dry season. Additional temperature monitoring during wetter years would provide a useful comparison to data collected during WY2014.

Similar to Stevens Creek, Guadalupe Creek potentially supports steelhead rearing and spawning habitat downstream of the Guadalupe Creek Reservoir. Existing information was not available to evaluate the distribution or abundance of steelhead in Guadalupe Creek, nor to compare temperatures from previous years to temperatures measured during WY2014.

5.5 General Water Quality

Summary statistics for general water quality measurements collected at the three sites in Stevens Creek during two sampling events in WY2014 are listed in Table 5.19. Sampling Event 1 was conducted in May-June and Event 2 was conducted during August 2014. Plots of the data collected during both events in WY2014 are shown in Figure 5.18 and Figure 5.19. Station locations are mapped in Figure 5.12.

5.5.1 Temperature

Box plots showing the distribution of 7-day average water temperature data collected at three sites in Stevens Creek during 2014 are shown in Figure 5.20. The chronic (maximum 7-day mean) temperature (MWAT) threshold (19.0 °C) is shown in the figure. Trigger analysis of temperature data using the MWAT threshold is included in Table 5.20. The MWAT threshold was exceeded at site 205STE071 (100% of the data) and site 205STE065 (40% of the data) during the August event.

Table 5.19. Descriptive statistics for daily and monthly continuous water temperature, dissolved oxygen, conductivity, and pH measured at three sites in Stevens Creek during two sampling events in 2014.

Parameter	Data Type	205STE105		205STE071		205STE065	
		June	August	June	August	June	August
Temp (° C)	Min	10.31	13.5	13.5	20.2	13.1	16.8
	Median	13.9	16.5	15.9	22.1	15.8	18.8
	Mean	13.8	16.4	16.0	22.2	15.9	18.8
	Max	18.4	19.6	19.2	24.6	19.4	20.3
	Max 7-day Mean	14.6	17.1	16.5	22.5	16.8	19.3
Dissolved Oxygen (mg/l)	Min	7.6	6.3	4.4	5.5	5.0	4.8
	Median	9.0	7.9	6.1	6.4	7.2	7.3
	Mean	9.0	7.9	6.0	6.4	7.2	7.3
	Max	9.8	9.3	6.7	7.1	9.9	8.7
	7-day Avg. Min	8.1	6.8	5.1	5.7	5.8	5.7
pH	Min	7.9	7.9	7.6	7.9	8.1	7.9
	Median	8.0	8.0	7.6	7.9	8.3	8.2
	Mean	8.0	8.0	7.6	7.9	8.3	8.2
	Max	8.1	8.2	7.7	8.0	8.4	8.3
Specific Conductance (uS/cm)	Min	602	619	770	736	751	746
	Median	608	627	777	759	761	753
	Mean	608	626	777	756	760	752
	Max	616	631	782	767	764	752
Total number data points (n)		1235	1424	1240	1425	1443	1427

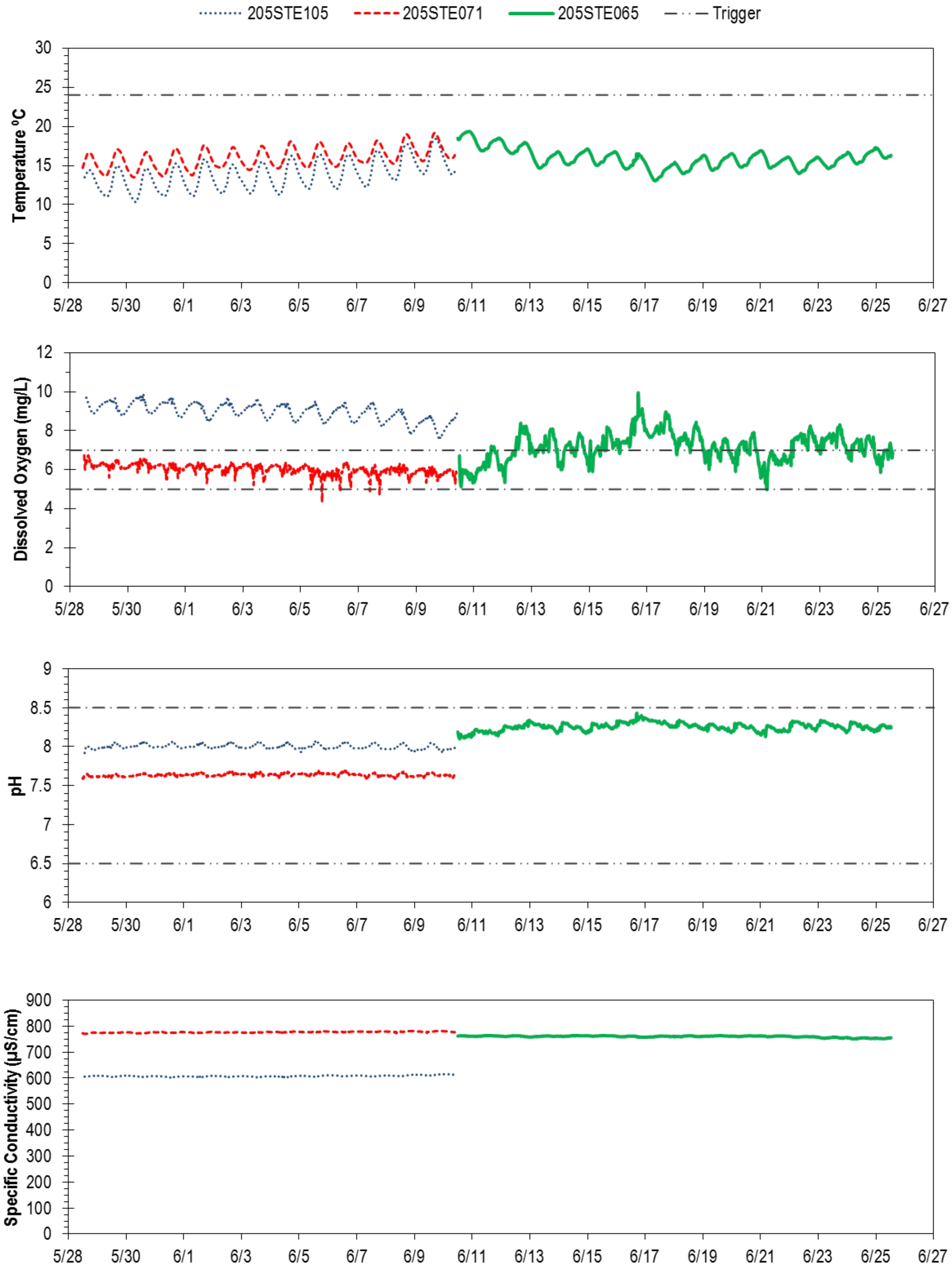


Figure 5.18. Continuous water quality data (temperature, dissolved oxygen, pH and specific conductance) collected using sondes at three sites in Stevens Creek during sampling Event 1 in 2014.

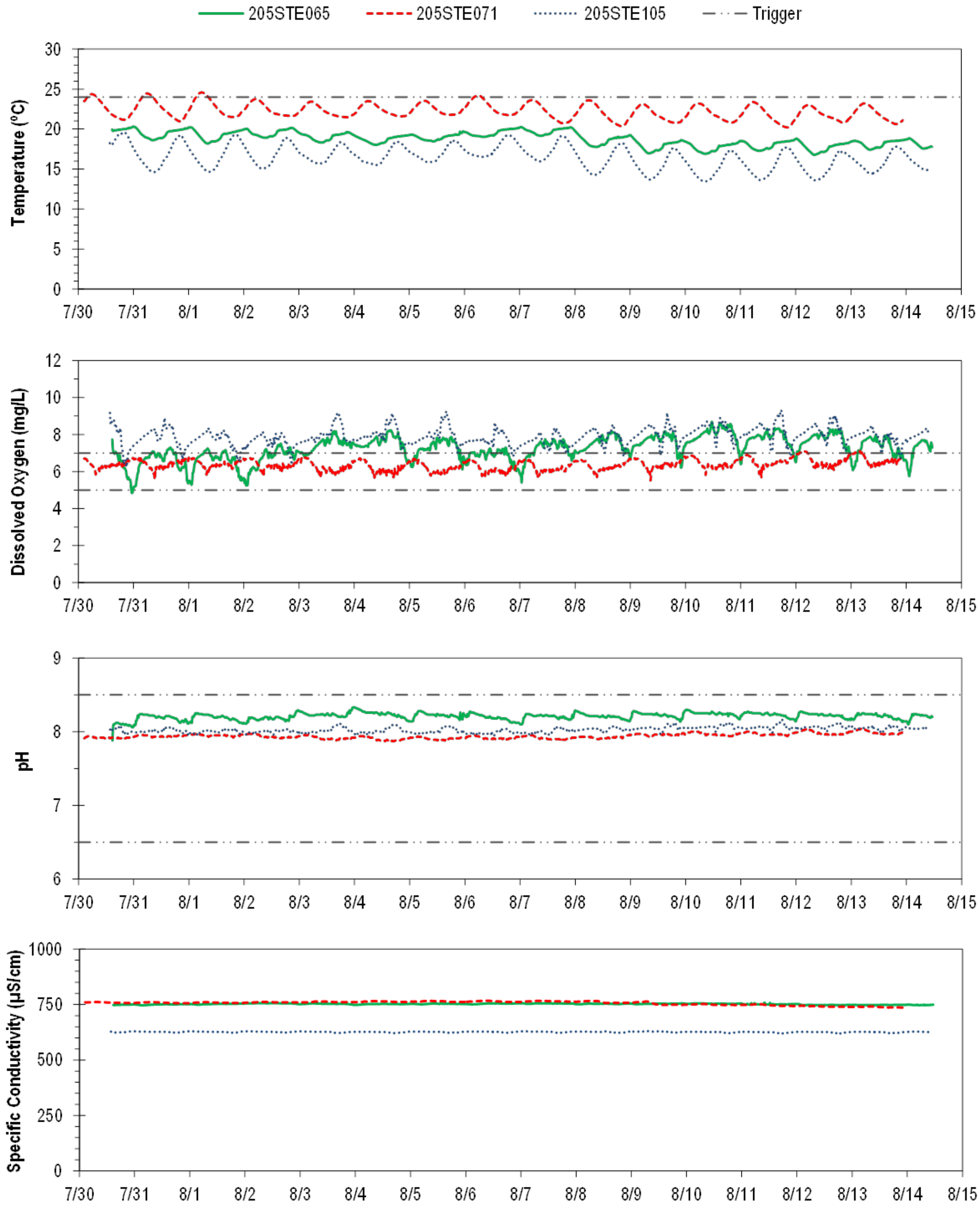


Figure 5.19. Continuous water quality data (temperature, dissolved oxygen, pH and specific conductance) collected using sondes at three sites in Stevens Creek during sampling Event 2 in 2014.

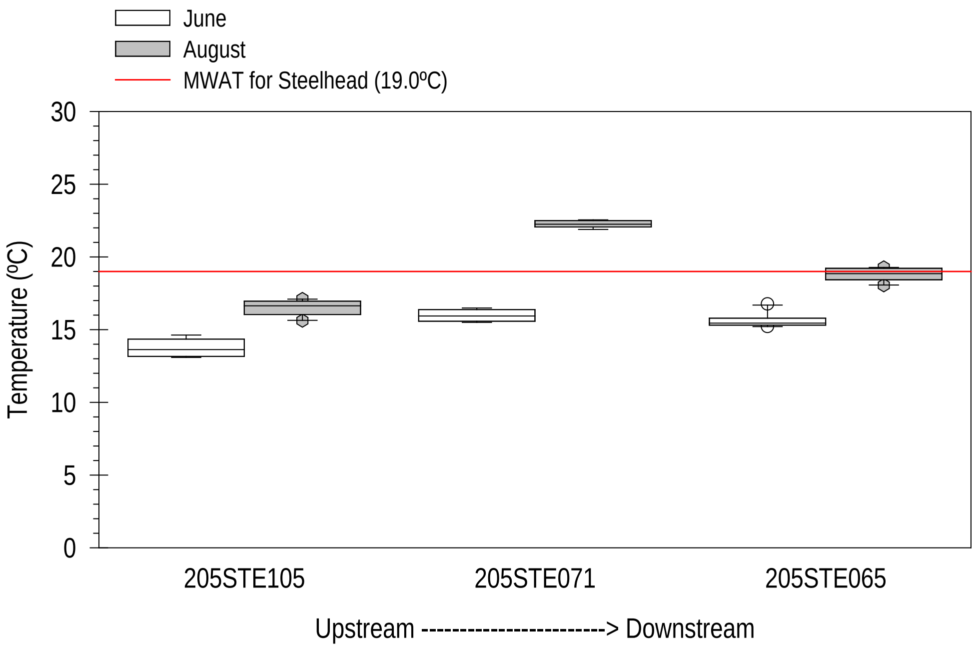


Figure 5.20. Box plots of 7-day average water temperature data at three stream locations in Stevens Creek, Santa Clara County, during two sampling events in 2014

Table 5.20. Percent of water temperature data measured at three sites in Stevens Creek, Santa Clara County for both events that exceed trigger values identified in Table 4.4.

Site ID	Creek Name	Site	Monitoring Event	*Percent results MWAT > 19 °C*	Trigger (>20%) Exceeded?
205STE105	Stevens Creek	Above Reservoir	June	0%	No
			August	0%	No
205STE071		Below Dam	June	0%	No
			August	100%	Yes
205STE065		McClellan Ranch	June	0%	No
			August	40%	Yes

5.5.2 Dissolved Oxygen

Box plots showing the distribution of dissolved oxygen data measured at three sites in Stevens Creek during WY2014 are shown in Figure 5.21. The dissolved oxygen WQOs for WARM and COLD Freshwater Habitat are included in the figure. A trigger analysis of dissolved oxygen data using both WQOs is included in Table 5.21. The WQO for COLD (7.0 mg/L) was not met in 98% to 100% of the measurements taken at the site below the dam (STE071) and in 32% to 40% of the measurements taken at McClellan Ranch (STE065) during the WY2014 sampling events (Table 5.28). The WQO for WARM (5.0 mg/L) was infrequently exceeded at the two sites below the dam; however the number of measurements was well below the 20% criteria for trigger.

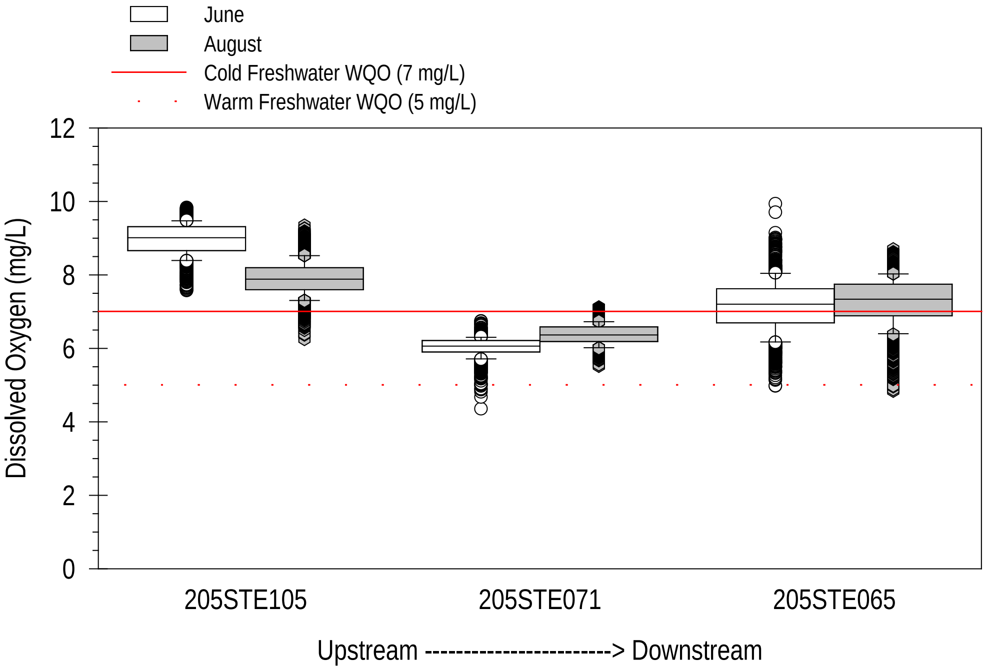


Figure 5.21. Box plots of dissolved oxygen data collected at three stream locations in Stevens Creek, Santa Clara County, during two sampling events in 2014.

Table 5.21. Percent of dissolved oxygen data measured at three sites in Stevens Creek for both events that exceed triggers.

Site ID	Creek Name	Site	Monitoring Event	*Percent Results DO < 5.0 mg/L*	*Percent Results DO < 7.0 mg/L*	Trigger (>20%) Exceeded?
205STE105	Stevens Creek	Above Reservoir	June	0%	0%	No
			August	0%	3%	No
205STE071		Below Dam	June	0.5	100%	Yes (Cold)
			August	0%	98%	Yes (Cold)
205STE065		McClellan Ranch	June	0.1%	40%	Yes (Cold)
			August	0.3%	32%	Yes (Cold)

5.5.3 pH

Box plots showing the distribution of pH measurements taken during the two sampling events in 2014 at three sites in Stevens Creek are shown in Figure 5.22. pH measurements never exceeded WQOs and thus, did not result in any triggers at any of the sites.

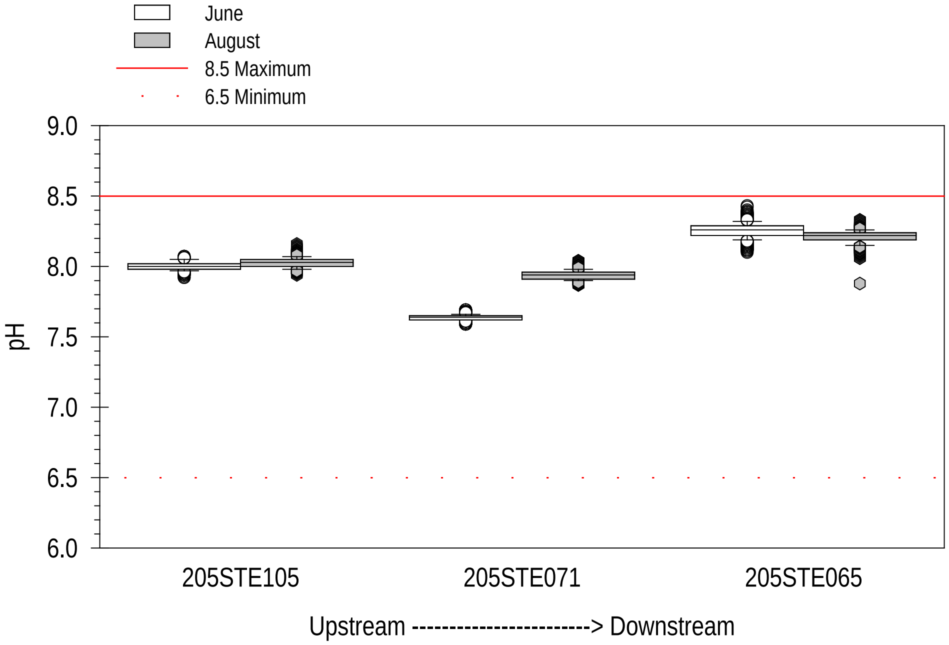


Figure 5.22. Box plots of pH measured at three stream locations in Stevens Creek, Santa Clara County, during two sampling events in 2014.

5.5.4 Specific Conductivity

Box plots showing the distribution of specific conductivity measurements taken during the two sampling events in 2014 at three sites in Stevens Creek are shown in Figure 5.23. There are no water quality objectives or thresholds for this parameter, so an evaluation of trigger exceedence was not conducted. There was little temporal variability in specific conductivity at the three sites during both two-week deployments and very little difference between the two events at each site. However, there is a clear spatial trend with lower values recorded upstream of the reservoir at 205STE105 during both the June and August events. This trend suggests that the reservoir releases are higher in conductivity than other sources. Of the two sites downstream of the dam, the site directly below the dam (205STE071) has slightly higher values suggesting that additional inputs to the creek further downstream dilute reservoir releases.

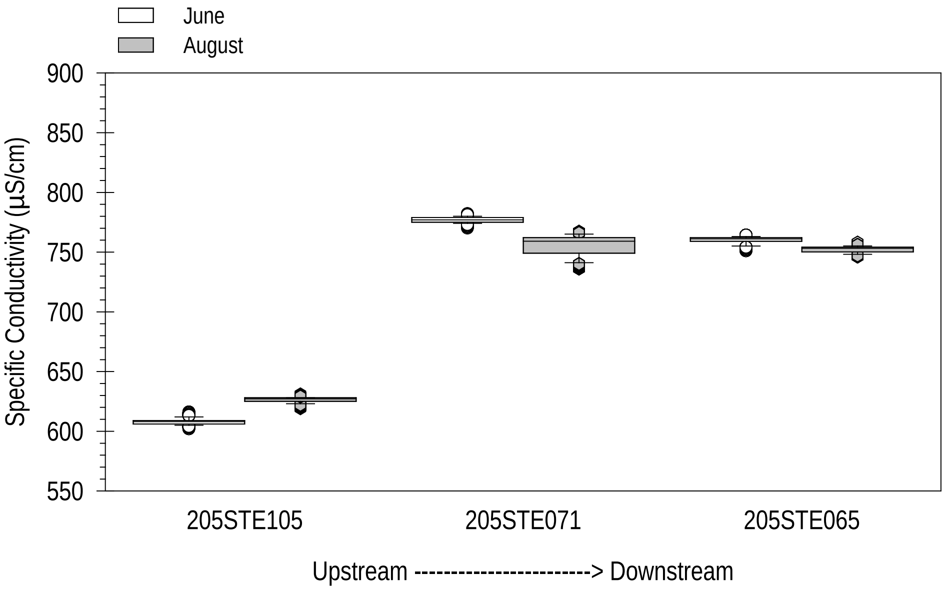


Figure 5.23. Box plots of specific conductivity measured at three stream locations in Stevens Creek, Santa Clara County, during two sampling events in 2014.

5.6 Pathogen Indicators

Pathogen indicator densities measured in water samples in WY2014 are listed in Table 5.22.

Table 5.22. Fecal coliform and *E. coli* levels measured in Santa Clara County during WY2014.

Site ID	Creek Name	Site Name	*Fecal Coliform (MPN/100ml)*	*E. Coli (MPN/100ml)*	Sample Date
		Trigger Threshold (REC-1/REC-2)	*400/4,000*	*410*	
205GUA050	Los Gatos Creek	Lonus Street	**500**	**500**	7/8/14
205GUA225	Arroyo Calero	Singer Park	300	300	7/8/14
205SAR005	Saratoga Creek	Bowers Park	**500**	**500**	7/8/14
205STE065	Stevens Creek	McClellan Ranch	230	230	7/8/14
205STE071	Stevens Creek	Lower Stevens Creek County Park	50	50	7/8/14

All five creeks monitored for pathogen indicators are designated for both contact (REC-1) and non-contact (REC-2) recreation. Although none of the stations could be considered “bathing beaches,” monitoring locations at each creek were selected at city parks or trails that were considered to exhibit high potential for public access. The trigger threshold for fecal coliform and for *E. coli* concentrations were exceeded at the sites in Los Gatos Creek (205GUA050) and Saratoga Creek (205SAR005). Additional investigations relative to characterizing exposure would be needed to better understand the waterborne pathogen-related risk at these sites.

6.0 CONCLUSIONS

The following conclusions from the MRP Creek Status Monitoring conducted during WY2014 in Santa Clara County are based on the management questions presented in Section 1.0:

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 Table 4.4. A summary of trigger exceedances observed for each site is presented in Table 6.1. Sites where triggers are exceeded may indicate potential impacts to aquatic life or other beneficial uses and are considered for future evaluation of stressor source identification projects.

The second management question is addressed primarily through calculation of indices of biological integrity (IBI) using benthic macroinvertebrate and algae data collected at probabilistic sites. Biological condition scores were compared to physical habitat and water quality data collected synoptically with bioassessments to evaluate whether any correlations exist that may explain the variation in IBI scores.

Biological Condition

- The California Stream Condition Index (CSCI) tool was used to assess the biological condition for benthic macroinvertebrate data collected at probabilistic sites. Of the 20 sites monitored in WY2014, five sites rated as likely intact condition (CSCI score $\geq$ 0.92); three sites rated as possibly intact condition (CSCI score 0.79 – 0.92); one site rated as likely altered condition (CSCI score 0.63 – 0.78) and eleven sites rated as very likely altered condition ($\leq$ 0.63).
- An Algae IBI, based on combination of soft algae and diatom metrics (referred to as "H20"), was used to evaluate benthic algae data collected synoptically with BMIs at probabilistic sites. No condition categories have been developed for "H20" Algae IBI scores. The Algae IBI results should be considered preliminary until additional research shows that these tools perform well for data collected in Santa Clara County.
- Algae IBI scores were not well correlated with CSCI scores ($R^2 = 0.31$), indicating responses of algae to stressors differ compared to BMIs.
- There was very little difference in CSCI scores between perennial (n=16) and non-perennial (n=4) sites. In contrast, Algae IBI scores were generally lower at perennial sites compared to non-perennial sites. Both CSCI scores and Algae IBI scores had good response to different levels of urbanization (calculated as percent impervious area).
- Environmental variables that had significant correlation to CSCI scores include epifaunal substrate score, percent impervious and chloride. Environmental variables that had significant correlation to Algae IBI scores included epifaunal substrate, CRAM score, Unionized Ammonia and Total Kjeldahl Nitrogen).

Nutrients and Conventional Analytes

- Nutrients (nitrogen and phosphorus), algal biomass indicators, and other conventional analytes were measured in samples collected concurrently with bioassessments which are conducted in the spring season. Trigger thresholds for chloride, unionized ammonia, and nitrate were not exceeded.
- Free chlorine and/or total chlorine residual triggers were exceeded at four highly urban probabilistic sites. These results are common under urban land use conditions.

Water Toxicity

- Water toxicity samples were collected from three sites during two sample events (winter storm event and summer). Although two samples from both sampling events were toxic relative to the Lab Control treatment, no water toxicity samples exceeded MRP trigger thresholds.

Sediment Toxicity

- Sediment toxicity and chemistry samples were collected concurrently with the summer water toxicity samples. None of the sites exceeded the MRP trigger for sediment toxicity. All three sites exceeded the trigger threshold for sediment chemistry as a result of pyrethroid pesticide concentrations. Two sites also exceeded the highly conservative TEC trigger.

Spatial and Temporal Variability of Water Quality Conditions

- Median water temperatures continuously measured in Guadalupe Creek (n=5) and Stevens Creek (n=5) were generally highest at sites downstream of the reservoirs and lowest at sites upstream of the reservoirs. Dry channel conditions occurred upstream of the reservoirs in Guadalupe Creek and Stevens Creek beginning in the months of June and July, respectively.
- Continuous general water quality monitoring was conducted at three sites in Stevens Creek during two two-week periods (June and August. Median dissolved oxygen concentrations were lowest (range 6.0 – 6.4 mg/L) for both sampling events at site 205STE071, located just downstream Stevens Creek Reservoir. Median dissolved oxygen concentrations were relatively consistent at all three sites between spring and late summer sample events.

Potential Impacts to Aquatic Life

- There were no exceedances of the Maximum Weekly Average Temperature (MWAT) threshold at any of the sites upstream of either Guadalupe Creek (n=1) or Stevens Creek (n=2) Reservoirs, suggesting that water temperatures support rearing habitat for resident rainbow trout in these reaches. However, the intermittent flow and dry channel conditions above both reservoirs during the summer and fall season of 2014 would significantly limit the amount of potential habitat available to trout.
- Three of the four sites below Guadalupe Creek Reservoir exceeded the MWAT threshold trigger between 17% and 49% of the time during WY2014. The monitoring location below the fish ladder (site 205GUA105) never exceeded the threshold, suggesting areas downstream of the dam provide habitat with temperatures that are more suitable for steelhead. The three sites below Stevens Creek Reservoir exceeded the MWAT threshold trigger between 14% and 54% of the time during WY2014.
- Cool water releases below dams provide adequate summer rearing conditions in relatively low elevation habitats that historically were too warm to support steelhead or were seasonally dry. The extended drought type conditions during WY2014 have resulted in dramatically low water levels in both Guadalupe and Stevens Creek Reservoirs, resulting in lower than normal baseflows and releases and higher than normal water temperatures downstream of the dam.
- The WQO for DO in waters designated as having cold freshwater habitat (COLD) beneficial uses (i.e., 7.0 mg/L) was not met in 98% - 100% of measurements taken at the site below the dam (205STE071) and was not met in 32% - 40% of measurements taken at McClellan Ranch (205STE065) during both sampling events in 2014. The WQO for WARM (5.0 mg/L) was periodically exceeded, but the total number of exceedences were not above the 20% criteria to cause a trigger.
- Values for pH measured at three Stevens Creek sites during WY2014 were within WQOs.

Potential Impacts to Water Contact Recreation

- Pathogen indicator densities were measured at five of the probabilistic sites during WY2014. Threshold triggers for fecal coliform and *E. coli* were exceeded at one site in Los Gatos Creek (205GUA050) and one site in Saratoga Creek (205SAR005).

It is important to recognize that pathogen indicator thresholds are based on human recreation at beaches receiving bacteriological contamination from human wastewater, and may not be applicable to conditions found in urban creeks. As a result, the comparison of pathogen indicator results to water quality objectives and criteria for full body contact recreation, may not be appropriate and should be interpreted cautiously.

Table 6.1. Summary of SCVURPPP Trigger Threshold Exceedance Analysis, WY2014. “No” indicates samples were collected but did not exceed the MRP trigger; “Yes” indicates an exceedance of the MRP trigger.

Station Number	Creek	Bioassessment	Nutrients”	Chlorine	Water Toxicity	Sediment Toxicity	Sediment Chemistry	Temperature	Continuous WQ	Pathogen Indicators
205R00266	Limekiln Creek	Yes	No	No	--	--	--	--	--	--
205R00330	Hick's Creek	No	No	No	--	--	--	--	--	--
205R00362	Lyndon Canyon	No	No	No	--	--	--	--	--	--
205R00394	Austrian Gulch	No	No	No	--	--	--	--	--	--
205R00851	Los Coches Creek	Yes	No	No	--	--	--	--	--	--
205R00883	Adobe Creek	No	No	No	No	No	Yes	--	--	--
205R00915	Thompson Creek	Yes	No	No	--	--	--	--	--	--
205R00938	San Tomas Aquino Creek	No	No	No	No	No	Yes	--	--	--
205R00979	Lower Silver Creek	Yes	No	Yes	No	No	Yes	--	--	--
205R01027	Guadalupe River	Yes	No	No	--	--	--	--	--	--
205R01091	Saratoga Creek	Yes	No	Yes	--	--	--	--	--	Yes
205R01098	Guadalupe Creek	No	No	No	--	--	--	--	--	--
205R01187	Stevens Creek	Yes	No	Yes	--	--	--	--	--	No
205R01226	Los Gatos Creek	Yes	No	No	--	--	--	--	--	--
205R01299	Arroyo Aguague	No	No	No	--	--	--	--	--	--
205R01306	Ross Creek	Yes	No	Yes	--	--	--	--	--	--
205R01434	Arroyo Calero	No	No	No	--	--	--	--	--	No
205R01443	Stevens Creek	Yes	No	No	--	--	--	--	--	No
205R01539	Los Gatos Creek	Yes	No	No	--	--	--	--	--	Yes
205R01578	San Tomas Aquino Creek	Yes	No	No	--	--	--	--	--	--
205STE064	Stevens Creek	--	--	--	--	--	--	Yes	--	--
205STE065	Stevens Creek	--	--	--	--	--	--	No	Yes	--
205STE071	Stevens Creek	--	--	--	--	--	--	Yes	Yes	--
205STE095	Stevens Creek	--	--	--	--	--	--	No	--	--
205STE105	Stevens Creek	--	--	--	--	--	--	No	No	--
205GUA205	Guadalupe Creek	--	--	--	--	--	--	Yes	--	--
205GUA210	Guadalupe Creek	--	--	--	--	--	--	No	--	--
205GUA213	Guadalupe Creek	--	--	--	--	--	--	No	--	--
205GUA218	Guadalupe Creek	--	--	--	--	--	--	Yes	--	--
205GUA229	Guadalupe Creek	--	--	--	--	--	--	No	--	--

Management Implications

The Program's Creek Status Monitoring program (consistent with MRP Provision C.8.c) focuses on assessing the water quality condition of urban creeks in the Santa Clara Valley and identifying stressors and sources of impacts observed. Although the sample size from WY2014 (overall n=20; urban n=16) is not sufficient to develop statistically representative conclusions regarding the overall condition of all creeks, it is clear that most urban portions have likely or very likely altered populations of aquatic life indicators (e.g., aquatic macroinvertebrates). These conditions are likely the result of long-term changes in stream hydrology, channel geomorphology and in-stream habitat complexity, and other modifications to the watershed and riparian areas associated with urban development that has occurred over the past 50 plus years in the contributing watersheds. Additionally, water quality conditions associated with pyrethroid pesticides present in creek sediments at concentrations known to adversely affect sensitive aquatic organisms (i.e., LC50s), and episodic or site specific increases temperature and decreased dissolved oxygen (particularly in lower creek reaches) are not optimal for aquatic life in local creeks.

The Program and its Co-permittees are actively implementing many stormwater management programs to address these and other 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 MRP provision C.3, 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 develop (LID) methods, such as rainwater harvesting and use, infiltration and biotreatment are now required as part of development and redevelopment projects. These LID measures are expected to reduce the impacts of urban runoff and associated impervious surfaces on stream health.
- In compliance with MRP provision C.9, 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, the adoption of formal State pesticide registration procedures, and sustainable landscaping requirements for new and redevelopment projects. Through these efforts, it is estimated that the amount of pyrethroids observed in urban stormwater runoff will decrease by 80-90% over time, and in turn significantly reduce the magnitude and extent of toxicity in local creeks.
- Trash loadings to local creeks are also being reduced through implementation of new control measures in compliance with MRP provision C.10 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.
- In compliance with MRP 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) 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.
- Additionally, in compliance with MRP provision C.13, copper in stormwater runoff is reduced through implementation of controls such as architectural and site design requirements, street sweeping, and participation in statewide efforts to significantly reduce the level of copper vehicle brake pads.

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 (e.g., SCVWD's 2010 Flood Protection and Stream Stewardship Master Plan). 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 overtime. 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 “grey” infrastructure and disconnect impervious areas constructed over the course of the past 50 plus years will take time to implement. Consequently, it may take several decades to observe the outcomes of these important, large-scale improvements to our watersheds in our local creeks. Long-term creek status monitoring programs designed to detect these changes over time are therefore beneficial to our collective understanding of the condition and health of our local waterways.

7.0 REFERENCES

Atkinson, K. 2011. Evaluating Water Temperature and Turbidity Effects on Steelhead Life History Tactics in Alameda Creek Watershed. Technical Memorandum. Alameda Creek Fisheries Restoration Workgroup.

Bay Area Stormwater Management Agency Association (BASMAA) Regional Monitoring Coalition. 2012. RMC Creek Status and Long-Term Trends Monitoring Plan.

Bay Area Stormwater Management Agency Association (BASMAA) Regional Monitoring Coalition. 2014a. Creek Status Monitoring Program Quality Assurance Project Plan, Final Draft Version 2. Prepared for BASMAA by EOA, Inc. on behalf of the Santa Clara Urban Runoff Pollution Prevention Program and the San Mateo Countywide Water Pollution Prevention Program, Applied Marine Sciences on behalf of the Alameda Countywide Clean Water Program, and Armand Ruby Consulting on behalf of the Contra Costa Clean Water Program. 80 pp plus appendices.

Bay Area Stormwater Management Agency Association (BASMAA) Regional Monitoring Coalition. 2014b. Creek Status Monitoring Program Standard Operating Procedures Version 2. Prepared for BASMAA by EOA, Inc. on behalf of the Santa Clara Urban Runoff Pollution Prevention Program and the San Mateo Countywide Water Pollution Prevention Program, Applied Marine Sciences on behalf of the Alameda Countywide Clean Water Program, and Armand Ruby Consulting on behalf of the Contra Costa Clean Water Program. 203 pp.

Bay Area Stormwater Management Agency Association (BASMAA) Regional Monitoring Coalition. 2013. Urban Creeks Monitoring Report Water Years 2012. Submitted pursuant to Provision C.8.g.iii of Order R2-2009-0074 on behalf of all Permittees.

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water; Washington, D.C.

Beller E.E., Grossinger R.M., Nicholson M., and Salomon M.N. 2012. Upper Penitencia Creek Historical Ecology Assessment. A report of SFEI's Historical Ecology Program, SFEI Publication #664, San Francisco Estuary Institute, Richmond, CA.

Buchan, L. A. J., R. A. Leidy, and M. K. Hayden. 1999. Aquatic resource characterization of Western Mt. Hamilton Stream fisheries. Prepared by Eisenberg, Olivieri & Associates in association with United States Environmental Protection Agency, for The Nature Conservancy, Sunnyvale, California.

Center for Watershed Protection. 2005. Urban Subwatershed Restoration Manual Series, No. 10 Unified Stream Assessment: A User's Manual. Version 2.0. Center for Watershed Protection. Ellicot City, Maryland. February 2005.

Collins, J.N., E.D. Stein, M. Sutula, R. Clark, A.E. Fetscher, L. Grenier, C. Grosso, and A. Wiskind. 2008. California Rapid Assessment Method (CRAM) for Wetlands, v. 5.0.2. 157 pp.

Fetscher, A.E, L. Busse, and P.R. Ode. 2009. Standard Operating Procedures for Collecting Stream Algae Samples and Associated Physical Habitat and Chemical Data for Ambient Bioassessments in California. California State Water Resources Control Board Surface Water Ambient Monitoring Program (SWAMP) Bioassessment SOP 002. (Updated May 2010)

Fetscher, A.E., R. Stancheva, J.P. Kociolek, R.G. Sheath, E. Stein, R.D. Mazo and P. Ode. 2013a. Development and comparison of stream indices of biotic integrity using diatoms vs. non-diatom algae vs. a combination. Journal of Applied Phycology. Volume 25 no. 4. August 2013.

Fetscher, A.E., M.A. Sutula, L.B. Busse and E.D. Stein. 2013b. Condition of California Perennial, Wadeable Streams Based on Algal Indicators. Final Technical Report 2007-11. Prepared by Southern California Coastal Water Research Project and San Diego Regional Water Quality Control Board. Prepared for California State Water Board.

Grossinger, RM, Askevold R, Striplen CJ, Brewster E, Pearce S, Larned K, McKee LJ, Collins JN. 2006. Coyote Creek Watershed Historical Ecology Study: Historical Conditions and Landscape Change in the Eastern Santa Clara Valley, California. San Francisco Estuary Institute. Contribution No. 426. January 2006.

Herbst, D.B., and E.L. Silldorff. 2009. Development of a benthic macroinvertebrate index of biological integrity (IBI) for stream assessments in the Eastern Sierra Nevada of California. Sierra Nevada Aquatic Research Lab. Mammoth Lakes, CA Hill et al. 2000

Karr and Chu 1999. Restoring Life in Running Waters: Better Biological Monitoring. Island Press, Covelo, California.

Leidy, R.A., G.S. Becker, B.N. Harvey. 2005. Historical distribution and current status of steelhead/rainbow trout *(Oncorhynchus mykiss)* in streams of the San Francisco Estuary, California. Center for Ecosystem Management and Restoration, Oakland, CA.

MacDonald, D.D., C.G. Ingersoll, T.A. Berger. 2000. Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems. Arch. Environ. Contam. Toxicol. 39, 20-31.

Mattern, D. and .J.M. Sowers. 2003. Baseline Development for Hydrograph Modification Program. Prepared by Mattern & Assoc. and William Lettis & Associates. Prepared for the Santa Clara Valley Water District. December 23, 2003.

Mazor, R.D., A. Rehn, P.R. Ode, M. Engeln, K. Schiff, E. Stein, D. Gillett, D. Herbst, C.P. Hawkins. In review.. Bioassessment in complex environments: Designing an index for consistent meaning in different settings

Moyle, P. B. 2000. Inland Fishes of California. 2nd. edition. University of California Press, Berkeley, California.

Moyle, P.B., J.A. Israel, and S.E. Purdy. 2008. Salmon, Steelhead and Trout in California: Status of an Emblematic Fauna. A report commissioned by Cal Trout 2008.

Myrick, C. A. and J.J. Cech, Jr. 2001. Bay-Delta Modeling Forum. Technical publication 01-1. Temperature effects on Chinook salmon and steelhead: a review focusing on California's Central Valley populations. Available at: http://www.pacificorp.com/File/File43061.pdf.

Ode, P.R., A. Rehn, and J. May. 2005. Quantitative Tool for Assessing the Integrity of Southern Coastal California Streams, Environmental Management Vol. 35, No. 4, pp. 493-504.

Ode, P.R. 2007. Standard Operating Procedures for Collection Macroinvertebrate Samples and Associated Physical and Chemical Data for Ambient Bioassessments in California. California State Water Resources Control Board Surface Water Ambient Monitoring Program (SWAMP) Bioassessment SOP 001.

Ode, P.R., T.M. Kincaid, T. Fleming and A.C. Rehn. 2011. Ecological Condition Assessments of California's Perennial Wadeable Streams: Highlights from the Surface Water Ambient Monitoring Program's Perennial Streams Assessment (PSA) (2000-2007). A Collaboration between the State Water Resources Control Board's Non-Point Source Pollution Control Program (NPS Program), Surface Water Ambient Monitoring Program (SWAMP), California Department of Fish and Game Aquatic Bioassessment Laboratory, and the U.S. Environmental Protection Agency.

Rehn, A.C., P.R. Ode, and J.T. May. 2005. Development of a benthic index of biotic integrity (B-IBI) for wadeable streams in northern coastal California and its application to regional 305(b) assessment. Report to the State Water Resources Control Board. California Department of Fish. Rancho Cordova, CA.

Rehn, A.C., J.T. May and P.R. Ode. 2008. An Index of Biotic Integrity (IBI) for Perennial Streams in California's Central Valley. Report to the State Water Resources Control Board. California Department of Fish. Rancho Cordova, CA.

Railsback, S.F. and K.A. Rose. 1999. Bioenergetics modeling of stream trout growth: temperature and food consumption effects. *Trans. Am. Fish. Soc*. 128:241-256.

San Francisco Regional Water Quality Control Board (SFRWQCB). 2009. Municipal Regional Stormwater NPDES Permit. Order R2-2009-0074, NPDES Permit No. CAS612008. 125 pp plus appendices.

San Francisco Regional Water Quality Control Board (SFRWQCB). 2012. The Reference Site Study and the Urban Gradient Study Conducted in Selected San Francisco Bay Region Watersheds in 2008-2010 (Years 8 to 10). Surface Water Ambient Monitoring Program, San Francisco Bay Regional Water Quality Control Board, Oakland, CA.

San Francisco Regional Water Quality Control Board (SFRWQCB). 2013. Water Quality Control Plan. (Basin Plan). http://www.waterboards.ca.gov/sanfranciscobay/basin_planning.shtml.

San Mateo Countywide Water Pollution Prevention Program. 2000. Characterization of Imperviousness and Creek Channel Modifications for Six Watersheds in San Mateo County. Prepared by EOA, Inc. August 30, 2000.

Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP). 2003. Watershed monitoring and assessment summary report, submitted in fulfillment of NPDES permit provision C.10 (b), Sunnyvale, California.

Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP). 2007. Watershed Assessment and Sediment Impact Analysis; Saratoga Creek, Santa Clara County. Prepared by EOA, Inc. for SCVURPPP. Draft Report July 17, 2007.

Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP). 2013. Local Urban Creeks Status Monitoring Report, Water Year 2012 (October 2011 – September 2012. March 15, 2013.

Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP). 2014. Part A of the Integrated Monitoring Report.

Santa Clara Valley Water District. 2006. Coyote Creek: Montague Ex. To Interstate 280 Baseline Fisheries Habitat Study. Prepared by Entrix, Inc. November 16, 2006.

Santa Clara Valley Water District. 2008. Mid-Coyote Flood Protection Project Baseline Fisheries Report Year 2 2008.

Santa Clara Valley Water District. 2011. Stream Ecosystem Condition Profile: Coyote Creek Watershed. San Jose, CA. 103 pp plus appendices.

Smith, J.J. and H.W. Li. 1983. Energetic factors influencing foraging tactics of juvenile steelhead trout, *Salmo gairdneri*. Pp. 173-180 in D.L.G. Noakes et al. (eds.), *Predators and Prey in Fishes*. Dr. W. Junk Publishers, The Hague.

Smith, J. 2001. Potential Fisheries in Selected Santa Clara County Streams. Data provided to the Santa Clara Valley Water District.

Solek, C.W., E.D. Stein, and M. Sutula. 2011. Demonstration of an integrated watershed assessment using a three-tiered assessment framework. Wetlands Ecol Manage (2011)19:459-474.

Stevens, D.L.Jr., and A.R. Olsen. 2004. Spatially Balanced Sampling of Natural Resources. Journal of the American Statistical Association 99(465):262-278.

Stillwater Sciences. 2006. Upper Penitencia Creek Limiting Factors Analysis, Final Report. Prepared for Santa Clara Valley Urban Runoff Pollution Prevention Program (Program Managers, EOA, Inc.). 72 pp plus figures and appendices.

Sullivan, K., Martin, D.J., Cardwell, R.D., Toll, J.E., and S. Duke. 2000. An analysis of the effects of temperature on salmonids of the Pacific Northwest with implications for selecting temperature criteria. Sustainable Ecosystems Institute, Portland, OR. December 2000.

Sogard, Susan M., Merz, Joseph E., Satterthwaite, William H., Beakes, Michael P., Swank, David R., Collins, Erin M., Titus, Robert G. and Mangel, Marc (2012): Contrasts in Habitat Characteristics and Life History Patterns of Oncorhynchus mykiss in California's Central Coast and Central Valley, Transactions of the American Fisheries Society, 141:3, 747-760.

USEPA. 1977. Temperature criteria for freshwater fish: protocol and procedures. Ecological Research Series., U.S. Environmental Protection Agency, EPA-600/3-77-061. 130 pp. [Also cited as Brungs and Jones. 1977]

USEPA. 2000. U.S. Environmental Protection Agency Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California. 40 CFR Part 131. Federal Register: May 18, 2000 (Volume 65, Number 97), Pages 31681-31719

USEPA. 2009. U.S. Environmental Protection Agency Office of Water, National Recommended Water Quality Criteria <http://water.epa.gov/scitech/swguidance/standards/current/index.cfm>http://water.epa.gov/scitech/swguidance/standards/current/index.cfm

USEPA. 2012. Recreational Water Quality Criteria. Office of Water 820-F-12-058.

ATTACHMENTS

Attachment A
Site Evaluation Details

Attachment A. Summary of site evaluation results between WY 2012 -2014.

Station Code	Stratum	Agency Code	Year Evaluated	Target Status Code	Target Status Detail
204R00013	SC_R2_Nonurb	SCVURPPP	2012	TNS	TNS_PD
204R00018	SC_R2_Nonurb	SCVURPPP	2012	TNS	TNS_PD
204R00029	SC_R2_Nonurb	SCVURPPP	2012	TNS	TNS_PD
204R00045	SC_R2_Nonurb	SCVURPPP	2012	TNS	TNS_PD
204R00061	SC_R2_Nonurb	SCVURPPP	2012	TNS	TNS_PD
204R00077	SC_R2_Nonurb	SCVURPPP	2012	NT	NT_NLSF
204R00082	SC_R2_Nonurb	SCVURPPP	2013	TNS	TNS_DIST
204R00083	SC_R2_Nonurb	SWAMP	2013	NT	NT_NLSF
204R00093	SC_R2_Nonurb	SCVURPPP	2013	NT	NT_NLSF
204R00109	SC_R2_Nonurb	SWAMP	2013	TNS	TNS_DIST
204R00121	SC_R2_Nonurb	SCVURPPP	2013	NT	NT_NLSF
204R00125	SC_R2_Nonurb	SCVURPPP	2013	TNS	TNS_PD
204R00130	SC_R2_Nonurb	SCVURPPP	2013	TNS	TNS_PD
204R00141	SC_R2_Nonurb	SCVURPPP	2013	NT	NT_NLSF
204R00149	SC_R2_Nonurb	SCVURPPP	2013	NT	NT_NLSF
204R00157	SC_R2_Nonurb	SCVURPPP	2013	NT	NT_NLSF
204R00173	SC_R2_Nonurb	SCVURPPP	2013	TNS	TNS_PD
204R00185	SC_R2_Nonurb	SCVURPPP	2013	NT	NT_NLSF
204R00189	SC_R2_Nonurb	SCVURPPP	2013	T	Target
204R00194	SC_R2_Nonurb	SCVURPPP	2013	TNS	TNS_DIST
204R00198	SC_R2_Nonurb	SCVURPPP	2013	NT	NT_NLSF
204R00205	SC_R2_Nonurb	SCVURPPP	2013	NT	NT_NLSF
204R00221	SC_R2_Nonurb	SWAMP	2014	T	Target
204R00237	SC_R2_Nonurb	SCVURPPP	2014	TNS	TNS_DIST
204R00249	SC_R2_Nonurb	SCVURPPP	2014	TNS	TNS_PD
204R00253	SC_R2_Nonurb	SCVURPPP	2014	U	U_AU
204R00274	SC_R2_Nonurb	SWAMP	2014	NT	NT_NLSF
204R00285	SC_R2_Nonurb	SCVURPPP	2014	NT	NT_NLSF
204R00301	SC_R2_Nonurb	SCVURPPP	2014	TNS	TNS_PD
204R00317	SC_R2_Nonurb	SCVURPPP	2014	TNS	TNS_DIST
204R00333	SC_R2_Nonurb	SCVURPPP	2014	NT	NT_NLSF
204R00338	SC_R2_Nonurb	SCVURPPP	2014	U	U_AU
204R00339	SC_R2_Nonurb	SWAMP	2014	NT	NT_NLSF
204R00365	SC_R2_Nonurb	SWAMP	2014	T	Target
204R00377	SC_R2_Nonurb	SCVURPPP	2014	TNS	TNS_DIST
205R00001	SC_R2_Nonurb	SCVURPPP	2012	TNS	TNS_PD
205R00002	SC_R2_Nonurb	SCVURPPP	2012	NT	NT_NLSF
205R00003	SC_R2_Urb	SCVURPPP	2012	NT	NT_NW

Station Code	Stratum	Agency Code	Year Evaluated	Target Status Code	Target Status Detail
205R00005	SC_R2_Nonurb	SCVURPPP	2012	NT	NT_NLSF
205R00007	SC_R2_Nonurb	SCVURPPP	2012	NT	NT_NLSF
205R00010	SC_R2_Nonurb	SCVURPPP	2012	TNS	TNS_PD
205R00017	SC_R2_Nonurb	SWAMP	2012	TNS	TNS_DIST
205R00019	SC_R2_Urb	SCVURPPP	2012	NT	NT_NC
205R00021	SC_R2_Nonurb	SCVURPPP	2012	T	Target
205R00026	SC_R2_Urb	SCVURPPP	2012	T	Target
205R00033	SC_R2_Nonurb	SCVURPPP	2012	TNS	TNS_PD
205R00035	SC_R2_Urb	SCVURPPP	2012	T	Target
205R00037	SC_R2_Urb	SCVURPPP	2012	NT	NT_NC
205R00042	SC_R2_Urb	SCVURPPP	2012	T	Target
205R00049	SC_R2_Nonurb	SWAMP	2012	NT	NT_NLSF
205R00051	SC_R2_Urb	SCVURPPP	2012	TNS	TNS_PD
205R00058	SC_R2_Nonurb	SCVURPPP	2012	T	Target
205R00065	SC_R2_Nonurb	SCVURPPP	2012	TNS	TNS_DIST
205R00066	SC_R2_Nonurb	SWAMP	2012	T	Target
205R00067	SC_R2_Urb	SCVURPPP	2012	T	Target
205R00069	SC_R2_Nonurb	SCVURPPP	2012	NT	NT_NLSF
205R00071	SC_R2_Urb	SCVURPPP	2012	NT	NT_NLSF
205R00074	SC_R2_Nonurb	SCVURPPP	2012	TNS	TNS_PD
205R00081	SC_R2_Nonurb	SWAMP	2012	NT	NT_NLSF
205R00085	SC_R2_Nonurb	SCVURPPP	2013	NT	NT_NLSF
205R00090	SC_R2_Urb	SCVURPPP	2012	T	Target
205R00097	SC_R2_Nonurb	SWAMP	2014	T	Target
205R00099	SC_R2_Urb	SCVURPPP	2012	T	Target
205R00101	SC_R2_Nonurb	SCVURPPP	2013	NT	NT_NLSF
205R00106	SC_R2_Nonurb	SCVURPPP	2013	NT	NT_NLSF
205R00113	SC_R2_Nonurb	SCVURPPP	2013	NT	NT_NLSF
205R00115	SC_R2_Urb	SCVURPPP	2012	T	Target
205R00118	SC_R2_Nonurb	SWAMP	2013	TNS	TNS_DIST
205R00122	SC_R2_Nonurb	SCVURPPP	2013	TNS	TNS_PD
205R00129	SC_R2_Nonurb	SCVURPPP	2013	TNS	TNS_PD
205R00131	SC_R2_Urb	SCVURPPP	2012	T	Target
205R00133	SC_R2_Nonurb	SCVURPPP	2013	TNS	TNS_PD
205R00138	SC_R2_Nonurb	SWAMP	2013	TNS	TNS_DIST
205R00145	SC_R2_Nonurb	SCVURPPP	2013	TNS	TNS_PD
205R00147	SC_R2_Nonurb	SCVURPPP	2013	NT	NT_NLSF
205R00154	SC_R2_Urb	SCVURPPP	2012	T	Target
205R00161	SC_R2_Nonurb	SWAMP	2014	NT	NT_NLSF

Station Code	Stratum	Agency Code	Year Evaluated	Target Status Code	Target Status Detail
205R00163	SC_R2_Nonurb	SCVURPPP	2013	TNS	TNS_PD
205R00170	SC_R2_Nonurb	SCVURPPP	2013	T	Target
205R00177	SC_R2_Nonurb	SWAMP	2013	NT	NT_NLSF
205R00179	SC_R2_Urb	SCVURPPP	2012	TNS	TNS_PD
205R00182	SC_R2_Nonurb	SCVURPPP	2013	T	Target
205R00186	SC_R2_Nonurb	SCVURPPP	2013	TNS	TNS_IA
205R00193	SC_R2_Nonurb	SCVURPPP	2013	NT	NT_NLSF
205R00195	SC_R2_Urb	SCVURPPP	2012	NT	NT_NLSF
205R00197	SC_R2_Nonurb	SCVURPPP	2013	NT	NT_NLSF
205R00202	SC_R2_Urb	SCVURPPP	2012	NT	NT_NLSF
205R00209	SC_R2_Nonurb	SWAMP	2013	NT	NT_NLSF
205R00211	SC_R2_Nonurb	SCVURPPP	2014	NT	NT_NLSF
205R00213	SC_R2_Nonurb	SCVURPPP	2014	NT	NT_NLSF
205R00218	SC_R2_Urb	SCVURPPP	2012	T	Target
205R00225	SC_R2_Nonurb	SWAMP	2014	NT	NT_NLSF
205R00227	SC_R2_Urb	SCVURPPP	2012	T	Target
205R00234	SC_R2_Urb	SCVURPPP	2012	T	Target
205R00241	SC_R2_Urb	SCVURPPP	2012	T	Target
205R00246	SC_R2_Nonurb	SCVURPPP	2014	NT	NT_NLSF
205R00257	SC_R2_Nonurb	SCVURPPP	2014	TNS	TNS_DIST
205R00258	SC_R2_Nonurb	SCVURPPP	2014	U	U_AU
205R00259	SC_R2_Urb	SCVURPPP	2012	T	Target
205R00261	SC_R2_Nonurb	SCVURPPP	2014	U	U_AU
205R00263	SC_R2_Urb	SCVURPPP	2012	TNS	TNS_PD
205R00266	SC_R2_Nonurb	SCVURPPP	2014	T	Target
205R00269	SC_R2_Nonurb	SCVURPPP	2014	NT	NT_NLSF
205R00273	SC_R2_Nonurb	SCVURPPP	2014	TNS	TNS_DIST
205R00275	SC_R2_Nonurb	SWAMP	2013	T	Target
205R00277	SC_R2_Nonurb	SCVURPPP	2014	U	U_AU
205R00282	SC_R2_Urb	SCVURPPP	2012	T	Target
205R00289	SC_R2_Nonurb	SWAMP	2013	T	Target
205R00291	SC_R2_Urb	SCVURPPP	2012	T	Target
205R00293	SC_R2_Urb	SCVURPPP	2012	TNS	TNS_PD
205R00298	SC_R2_Urb	SCVURPPP	2012	NT	NT_NC
205R00305	SC_R2_Nonurb	SCVURPPP	2014	U	U_AU
205R00314	SC_R2_Nonurb	SCVURPPP	2014	TNS	TNS_PD
205R00321	SC_R2_Nonurb	SCVURPPP	2014	TNS	TNS_DIST
205R00322	SC_R2_Nonurb	SWAMP	2014	T	Target
205R00323	SC_R2_Urb	SCVURPPP	2012	NT	NT_NLSF

Station Code	Stratum	Agency Code	Year Evaluated	Target Status Code	Target Status Detail
205R00325	SC_R2_Nonurb	SCVURPPP	2014	NT	NT_NLSF
205R00330	SC_R2_Nonurb	SCVURPPP	2014	T	Target
205R00337	SC_R2_Nonurb	SWAMP	2013	T	Target
205R00341	SC_R2_Nonurb	SCVURPPP	2014	NT	NT_NLSF
205R00346	SC_R2_Urb	SCVURPPP	2012	T	Target
205R00349	SC_R2_Nonurb	SWAMP	2014	NT	NT_NLSF
205R00353	SC_R2_Nonurb	SWAMP	2014	NT	NT_NLSF
205R00355	SC_R2_Urb	SCVURPPP	2012	T	Target
205R00357	SC_R2_Nonurb	SCVURPPP	2014	NT	NT_NW
205R00362	SC_R2_Nonurb	SCVURPPP	2014	T	Target
205R00369	SC_R2_Urb	SCVURPPP	2012	TNS	TNS_PD
205R00371	SC_R2_Urb	SCVURPPP	2012	NT	NT_NC
205R00374	SC_R2_Urb	SCVURPPP	2013	T	Target
205R00387	SC_R2_Urb	SCVURPPP	2013	T	Target
205R00394	SC_R2_Nonurb	SCVURPPP	2014	T	Target
205R00401	SC_R2_Nonurb	SWAMP	2014	T	Target
205R00403	SC_R2_Urb	SCVURPPP	2012	NT	NT_NLSF
205R00419	SC_R2_Urb	SCVURPPP	2013	T	Target
205R00435	SC_R2_Urb	SCVURPPP	2013	TNS	TNS_PD
205R00451	SC_R2_Urb	SCVURPPP	2013	T	Target
205R00458	SC_R2_Urb	SCVURPPP	2013	NT	NT_NLSF
205R00467	SC_R2_Urb	SCVURPPP	2013	TNS	TNS_TD
205R00474	SC_R2_Urb	SCVURPPP	2013	T	Target
205R00483	SC_R2_Urb	SCVURPPP	2013	NT	NT_NLSF
205R00490	SC_R2_Urb	SCVURPPP	2013	NT	NT_NLSF
205R00497	SC_R2_Urb	SCVURPPP	2013	NT	NT_NLSF
205R00499	SC_R2_Urb	SCVURPPP	2013	TNS	TNS_PD
205R00514	SC_R2_Urb	SCVURPPP	2013	NT	NT_NLSF
205R00515	SC_R2_Urb	SCVURPPP	2013	NT	NT_NC
205R00519	SC_R2_Urb	SCVURPPP	2013	NT	NT_NLSF
205R00538	SC_R2_Urb	SCVURPPP	2013	T	Target
205R00547	SC_R2_Urb	SCVURPPP	2013	T	Target
205R00554	SC_R2_Urb	SCVURPPP	2013	T	Target
205R00563	SC_R2_Urb	SCVURPPP	2013	TNS	TNS_PD
205R00586	SC_R2_Urb	SCVURPPP	2013	T	Target
205R00602	SC_R2_Urb	SCVURPPP	2013	T	Target
205R00611	SC_R2_Urb	SCVURPPP	2013	NT	NT_NLSF
205R00613	SC_R2_Urb	SCVURPPP	2013	NT	NT_NC
205R00627	SC_R2_Urb	SCVURPPP	2013	T	Target

Station Code	Stratum	Agency Code	Year Evaluated	Target Status Code	Target Status Detail
205R00630	SC_R2_Urb	SCVURPPP	2013	NT	NT_NC
205R00643	SC_R2_Urb	SCVURPPP	2013	NT	NT_NW
205R00659	SC_R2_Urb	SCVURPPP	2013	NT	NT_NW
205R00666	SC_R2_Urb	SCVURPPP	2013	T	Target
205R00682	SC_R2_Urb	SCVURPPP	2013	NT	NT_NLSF
205R00691	SC_R2_Urb	SCVURPPP	2013	NT	NT_NC
205R00707	SC_R2_Urb	SCVURPPP	2013	T	Target
205R00714	SC_R2_Urb	SCVURPPP	2013	T	Target
205R00723	SC_R2_Urb	SCVURPPP	2013	NT	NT_NLSF
205R00725	SC_R2_Urb	SCVURPPP	2013	NT	NT_AGDITCH
205R00730	SC_R2_Urb	SCVURPPP	2013	NT	NT_AGDITCH
205R00739	SC_R2_Urb	SCVURPPP	2013	T	Target
205R00753	SC_R2_Urb	SCVURPPP	2013	NT	NT_NLSF
205R00771	SC_R2_Urb	SCVURPPP	2013	T	Target
205R00775	SC_R2_Urb	SCVURPPP	2013	NT	NT_NLSF
205R00787	SC_R2_Urb	SCVURPPP	2013	T	Target
205R00794	SC_R2_Urb	SCVURPPP	2014	NT	NT_NW
205R00803	SC_R2_Urb	SCVURPPP	2014	NT	NT_NLSF
205R00819	SC_R2_Urb	SCVURPPP	2014	NT	NT_NLSF
205R00835	SC_R2_Urb	SCVURPPP	2014	NT	NT_NC
205R00851	SC_R2_Urb	SCVURPPP	2014	T	Target
205R00858	SC_R2_Urb	SCVURPPP	2014	NT	NT_NC
205R00867	SC_R2_Urb	SCVURPPP	2014	TNS	TNS_PD
205R00881	SC_R2_Urb	SCVURPPP	2014	NT	NT_NC
205R00883	SC_R2_Urb	SCVURPPP	2014	T	Target
205R00886	SC_R2_Urb	SCVURPPP	2014	NT	NT_NLSF
205R00899	SC_R2_Urb	SCVURPPP	2014	NT	NT_NC
205R00901	SC_R2_Urb	SCVURPPP	2014	U	U_AU
205R00906	SC_R2_Urb	SCVURPPP	2014	NT	NT_NW
205R00915	SC_R2_Urb	SCVURPPP	2014	T	Target
205R00922	SC_R2_Urb	SCVURPPP	2014	NT	NT_NLSF
205R00931	SC_R2_Urb	SCVURPPP	2014	NT	NT_NLSF
205R00938	SC_R2_Urb	SCVURPPP	2014	T	Target
205R00947	SC_R2_Urb	SCVURPPP	2014	NT	NT_NLSF
205R00970	SC_R2_Urb	SCVURPPP	2014	TNS	TNS_IA
205R00979	SC_R2_Urb	SCVURPPP	2014	T	Target
205R00995	SC_R2_Urb	SCVURPPP	2014	NT	NT_NLSF
205R01027	SC_R2_Urb	SCVURPPP	2014	T	Target
205R01050	SC_R2_Urb	SCVURPPP	2014	NT	NT_NLSF

Station Code	Stratum	Agency Code	Year Evaluated	Target Status Code	Target Status Detail
205R01059	SC_R2_Urb	SCVURPPP	2014	U	U_AU
205R01061	SC_R2_Urb	SCVURPPP	2014	NT	NT_NLSF
205R01066	SC_R2_Urb	SCVURPPP	2014	NT	NT_NLSF
205R01091	SC_R2_Urb	SCVURPPP	2014	T	Target
205R01095	SC_R2_Urb	SCVURPPP	2014	U	U_AU
205R01098	SC_R2_Urb	SCVURPPP	2014	T	Target
205R01114	SC_R2_Urb	SCVURPPP	2014	U	U_AU
205R01123	SC_R2_Urb	SCVURPPP	2014	NT	NT_NLSF
205R01125	SC_R2_Urb	SCVURPPP	2014	NT	NT_NC
205R01137	SC_R2_Urb	SCVURPPP	2014	NT	NT_NLSF
205R01139	SC_R2_Urb	SCVURPPP	2014	NT	NT_T
205R01155	SC_R2_Urb	SCVURPPP	2014	NT	NT_T
205R01178	SC_R2_Urb	SCVURPPP	2014	NT	NT_NLSF
205R01187	SC_R2_Urb	SCVURPPP	2014	T	Target
205R01203	SC_R2_Urb	SCVURPPP	2014	NT	NT_NLSF
205R01219	SC_R2_Urb	SCVURPPP	2014	NT	NT_NLSF
205R01221	SC_R2_Urb	SCVURPPP	2014	NT	NT_NLSF
205R01226	SC_R2_Urb	SCVURPPP	2014	T	Target
205R01242	SC_R2_Urb	SCVURPPP	2014	NT	NT_NC
205R01251	SC_R2_Urb	SCVURPPP	2014	TNS	TNS_PD
205R01258	SC_R2_Urb	SCVURPPP	2014	NT	NT_NLSF
205R01265	SC_R2_Urb	SCVURPPP	2014	NT	NT_NC
205R01283	SC_R2_Urb	SCVURPPP	2014	NT	NT_NW
205R01287	SC_R2_Urb	SCVURPPP	2014	NT	NT_NLSF
205R01299	SC_R2_Urb	SCVURPPP	2014	T	Target
205R01306	SC_R2_Urb	SCVURPPP	2014	T	Target
205R01315	SC_R2_Urb	SCVURPPP	2014	U	U_AU
205R01347	SC_R2_Urb	SCVURPPP	2014	NT	NT_T
205R01370	SC_R2_Urb	SCVURPPP	2014	U	U_AU
205R01379	SC_R2_Urb	SCVURPPP	2014	U	U_AU
205R01395	SC_R2_Urb	SCVURPPP	2014	U	U_AU
205R01398	SC_R2_Urb	SCVURPPP	2014	U	U_AU
205R01411	SC_R2_Urb	SCVURPPP	2014	U	U_AU
205R01434	SC_R2_Urb	SCVURPPP	2014	T	Target
205R01443	SC_R2_Urb	SCVURPPP	2014	T	Target
205R01450	SC_R2_Urb	SCVURPPP	2014	NT	NT_NLSF
205R01475	SC_R2_Urb	SCVURPPP	2014	NT	NT_NC
205R01482	SC_R2_Urb	SCVURPPP	2014	NT	NT_NC
205R01491	SC_R2_Urb	SCVURPPP	2014	NT	NT_NLSF

Station Code	Stratum	Agency Code	Year Evaluated	Target Status Code	Target Status Detail
205R01493	SC_R2_Urb	SCVURPPP	2014	NT	NT_NLSF
205R01498	SC_R2_Urb	SCVURPPP	2014	NT	NT_NC
205R01507	SC_R2_Urb	SCVURPPP	2014	U	U_AU
205R01514	SC_R2_Urb	SCVURPPP	2014	TNS	TNS_PD
205R01521	SC_R2_Urb	SCVURPPP	2014	NT	NT_NLSF
205R01526	SC_R2_Urb	SCVURPPP	2014	NT	NT_NC
205R01539	SC_R2_Urb	SCVURPPP	2014	T	Target
205R01562	SC_R2_Urb	SCVURPPP	2014	U	U_AU
205R01571	SC_R2_Urb	SCVURPPP	2014	U	U_AU
205R01578	SC_R2_Urb	SCVURPPP	2014	T	Target
205R01603	SC_R2_Urb	SCVURPPP	2014	U	U_AU
205R01610	SC_R2_Urb	SCVURPPP	2014	U	U_AU
205R01626	SC_R2_Urb	SCVURPPP	2014	U	U_AU
205R01635	SC_R2_Urb	SCVURPPP	2014	U	U_AU
205R01637	SC_R2_Urb	SCVURPPP	2014	U	U_AU
205R01649	SC_R2_Urb	SCVURPPP	2014	U	U_AU
205R01651	SC_R2_Urb	SCVURPPP	2014	U	U_AU
205R01654	SC_R2_Urb	SCVURPPP	2014	NT	NT_NLSF

Code	Description
TNS: target not sampleable	
TNS_PD	Access permanently denied OR no owner response, so access effectively denied
TNS_NR	No response from owners
TNS_TD	Access temporarily denied or temporarily inaccessible for other reasons
TNS_TNW	Temporarily no water due to water management activities
TNS_IA	Terrain is steep and unsafe for crews, and/or channel is too choked with vegetation to sample
TNS_DIST	Physically inaccessible - cannot hike round trip and sample in one day, and/or no good roads to access.
NT: non-target	
NT_W	Wetland
NT_NLSF	No/low spring flow
NT_H	Human hazards; unsafe for field crews
NT_NW	Non-wadable
NT_NC	Not a stream channel
NT_AGDITCH	Agricultural ditch; not natural, historic receiving water
NT_P	Pipeline
NT_T	Tidally influenced
NT_RI	Reservoir or impoundment

Attachment B
QA/QC Details

Water and Sediment Chemistry Field Duplicates

Included in this attachment are the results of water and chemistry field duplicate samples taken by SCVURPPP in 2014. The following tables are included:

- Table B-1. 2014 Water Chemistry Field Duplicate Site 205R00394
- Table B-2. 2014 Water Chemistry Field Duplicate Site 205R01187
- Table B-3. 2014 Sediment Chemistry Field Duplicate Results and QA Results SMCWPPP Site 202R01308

In accordance with the RMC QAPP, if the native concentration of either sample is less than the reporting limit, the RPD is not applicable.

Table B-1. 2014 Water Chemistry Field Duplicate Site 205R00394 (data in highlighted rows exceed monitoring quality objectives in RMC QAPP).

Sample Date	SampleID	Analyte Name	FractionName	Unit	Result	DUP Result	RPD	Exceeds MQO (>25%)
12/May/2014	205R00394-W	Alkalinity as CaCO3	Total	mg/L	196	190	3%	No
12/May/2014	205R00394-W	Ammonia as N	Total	mg/L	< 0.04	< 0.04	N/A	No
12/May/2014	205R00394-W	Bicarbonate	None	mg/L	195	188	4%	No
12/May/2014	205R00394-W	Carbonate	None	mg/L	1.5	2	-29%	Yes
12/May/2014	205R00394-W	Chloride	None	mg/L	5.3	5.3	0%	No
12/May/2014	205R00394-W	Dissolved Organic Carbon	None	mg/L	0.62	0.62	0%	No
12/May/2014	205R00394-W	Hydroxide	None	mg/L	< 1.2	< 1.2	N/A	No
12/May/2014	205R00394-W	Nitrate as N	None	mg/L	< 0.01	< 0.01	N/A	No
12/May/2014	205R00394-W	Nitrite as N	None	mg/L	< 0.005	< 0.005	N/A	No
12/May/2014	205R00394-W	Nitrogen, Total Kjeldahl	None	mg/L	0.22	0.35	-46%	Yes
12/May/2014	205R00394-W	Ortho Phosphate as P	Dissolved	mg/L	0.01	0.01	0%	No
12/May/2014	205R00394-W	Phosphorus as P	Total	mg/L	0.007	0.01	-35%	Yes
12/May/2014	205R00394-W	Silica as SiO2	Total	mg/L	20	20	0%	No
12/May/2014	205R00394-W	Suspended Sediment Concentration	None	mg/L	< 2	< 2	N/A	No
12/May/2014	205R00394-W	Chlorophyll a	Particulate	mg/m^2	20.3	18.1	12%	Yes
12/May/2014	205R00394-W	Ash Free Dry Mass	Fixed	g/m^2	190.6	178.0	7%	Yes

Table B-2. 2014 Water Chemistry Field Duplicate Site 205R01187 (data in highlighted rows exceed monitoring quality objectives in RMC QAPP).

Sample Date	SampleID	Analyte Name	FractionName	Unit	Result	DUP Result	RPD	Exceeds MQO (>25%)
14/May/2014	205R01187-W	Alkalinity as CaCO3	Total	mg/L	296	292	1%	No
14/May/2014	205R01187-W	Ammonia as N	Total	mg/L	0.2	0.2	24%	No
14/May/2014	205R01187-W	Bicarbonate	None	mg/L	296.0	292.0	1%	No
14/May/2014	205R01187-W	Carbonate	None	mg/L	< 1.2	< 1.2	N/A	No
14/May/2014	205R01187-W	Chloride	None	mg/L	25.0	25.0	0%	No
14/May/2014	205R01187-W	Dissolved Organic Carbon	None	mg/L	3.7	3.5	6%	No
14/May/2014	205R01187-W	Hydroxide	None	mg/L	< 1.2	< 1.2	N/A	No
14/May/2014	205R01187-W	Nitrate as N	None	mg/L	0.6	0.6	-3%	No
14/May/2014	205R01187-W	Nitrite as N	None	mg/L	0.0	0.0	0%	No
14/May/2014	205R01187-W	Nitrogen, Total Kjeldahl	None	mg/L	0.6	0.7	-20%	No
14/May/2014	205R01187-W	Ortho Phosphate as P	Dissolved	mg/L	0.0	0.0	-37%	Yes
14/May/2014	205R01187-W	Phosphorus as P	Total	mg/L	0.1	0.1	3%	No
14/May/2014	205R01187-W	Silica as SiO2	Total	mg/L	18.0	18.0	0%	No
14/May/2014	205R01187-W	Suspended Sediment Concentration	None	mg/L	16.0	16.0	0%	No
14/May/2014	205R01187-W	Chlorophyll a	Particulate	mg/m^2	32.2	57.1	-56%	Yes
14/May/2014	205R01187-W	Ash Free Dry Mass	Fixed	g/m^2	183.2	1227.8	-148%	Yes

Table B-3. 2014 Sediment Chemistry Field Duplicate Results and QA Results for SMCWPPP Site 202R01308

Method Name	Analyte Name	Unit	Sample Result	Field Duplicate Result	Relative Percent Difference	Exceeds MQO (>25%)
EPA 8270C	Acenaphthene	ng/g dw	ND	ND	N/A	No
EPA 8270C	Acenaphthylene	ng/g dw	ND	ND	N/A	No
EPA 8270C	Anthracene	ng/g dw	ND	ND	N/A	No
EPA 6020	Arsenic	mg/Kg dw	1.9	2	-5%	No
EPA 8270C	Benz(a)anthracene	ng/g dw	J3.2	J3.2	N/A	No
EPA 8270C	Benzo(a)pyrene	ng/g dw	ND	ND	N/A	No
EPA 8270C	Benzo(b)fluoranthene	ng/g dw	ND	ND	N/A	No
EPA 8270C	Benzo(e)pyrene	ng/g dw	ND	ND	N/A	No
EPA 8270C	Benzo(g,h,i)perylene	ng/g dw	ND	ND	N/A	No
EPA 8270C	Benzo(k)fluoranthene	ng/g dw	ND	ND	N/A	No
EPA 8270M_NCI	Bifenthrin	ng/g dw	0.55	0.65	-17%	No
EPA 8270C	Biphenyl	ng/g dw	ND	ND	N/A	No
EPA 6020	Cadmium	mg/Kg dw	0.25	0.28	-11%	No
EPA 8081A	Chlordane, cis-	ng/g dw	ND	ND	N/A	No
EPA 8081A	Chlordane, trans-	ng/g dw	ND	ND	N/A	No
EPA 6020	Chromium	mg/Kg dw	11	11	0%	No
EPA 8270C	Chrysene	ng/g dw	19	J17	N/A	No
EPA 6020	Copper	mg/Kg dw	6.8	7	-3%	No
EPA 8270M_NCI	Cyfluthrin, total	ng/g dw	0.26	0.23	12%	No
EPA 8270M_NCI	Cyhalothrin, Total lambda-	ng/g dw	ND	ND	N/A	No
EPA 8270M_NCI	Cypermethrin, total	ng/g dw	ND	J0.097	N/A	No
EPA 8081A	DDD(o,p')	ng/g dw	ND	ND	N/A	No
EPA 8081A	DDD(p,p')	ng/g dw	ND	ND	N/A	No
EPA 8081A	DDE(o,p')	ng/g dw	ND	ND	N/A	No
EPA 8081A	DDE(p,p')	ng/g dw	1.3	1.2	8%	No
EPA 8081A	DDT(o,p')	ng/g dw	ND	ND	N/A	No
EPA 8081A	DDT(p,p')	ng/g dw	ND	ND	N/A	No
EPA 8081A	Decachlorobiphenyl(Surrogate)	% recovery	91	77	17%	No
EPA 8270M_NCI	Deltamethrin/Tralomethrin	ng/g dw	J0.17	J0.18	N/A	No
EPA 8270C	Dibenz(a,h)anthracene	ng/g dw	ND	ND	N/A	No
EPA 8270C	Dibenzothiophene	ng/g dw	ND	ND	N/A	No
EPA 8081A	Dieldrin	ng/g dw	ND	ND	N/A	No
EPA 8270C	Dimethylnaphthalene, 2,6-	ng/g dw	J3.5	ND	N/A	N/A
EPA 8081A	Endrin	ng/g dw	ND	ND	N/A	No
EPA 8270M_NCI	Esfenvalerate/Fenvalerate, total	ng/g dw	ND	ND	N/A	No
EPA 8270M_NCI	Esfenvalerate-d6-1(Surrogate)	% recovery	102	105	-3%	No
EPA 8270M_NCI	Esfenvalerate-d6-2(Surrogate)	% recovery	105	105	0%	No
EPA 8270C	Fluoranthene	ng/g dw	11	9.8	12%	No
EPA 8270C	Fluorene	ng/g dw	J3.2	ND	N/A	N/A
EPA 8270C	Fluorobiphenyl, 2-(Surrogate)	% recovery	67	70	-4%	No

Table B-3. 2014 Sediment Chemistry Field Duplicate Results and QA Results for SMCWPPP Site 202R01308

Method Name	Analyte Name	Unit	Sample Result	Field Duplicate Result	Relative Percent Difference	Exceeds MQO (>25%)
EPA 8081A	HCH, gamma-	ng/g dw	ND	ND	N/A	No
EPA 8081A	Heptachlor Epoxide	ng/g dw	ND	ND	N/A	No
EPA 8270C	Indeno(1,2,3-c,d)pyrene	ng/g dw	ND	ND	N/A	No
EPA 6020	Lead	mg/Kg dw	4.9	4.8	2%	No
EPA 7471A	Mercury	mg/Kg dw	0.035	0.029	19%	No
EPA 8270C	Methylnaphthalene, 1-	ng/g dw	ND	ND	N/A	No
EPA 8270C	Methylnaphthalene, 2-	ng/g dw	J3.1	ND	N/A	N/A
EPA 8270C	Methylphenanthrene, 1-	ng/g dw	ND	ND	N/A	No
EPA 8270C	Naphthalene	ng/g dw	ND	ND	N/A	No
EPA 6020	Nickel	mg/Kg dw	11	12	-9%	No
EPA 8270C	Nitrobenzene-d5(Surrogate)	% recovery	71	83	-16%	No
EPA 8270M_NCI	Permethrin, cis-	ng/g dw	1.4	0.65	73%	Yes
EPA 8270M_NCI	Permethrin, trans-	ng/g dw	ND	ND	N/A	No
EPA 8270C	Perylene	ng/g dw	ND	ND	N/A	No
EPA 8270C	Phenanthrene	ng/g dw	14	12	15%	No
EPA 8270C	Pyrene	ng/g dw	13	12	8%	No
EPA 8270C	Terphenyl-d14(Surrogate)	% recovery	76	72	5%	No
EPA 8081A	Tetrachloro-m-xylene(Surrogate)	% recovery	93	79	16%	No
EPA 9060	Total Organic Carbon	%	0.96	0.96	0%	No
EPA 6020	Zinc	mg/Kg dw	58	58	0%	No
Plumb, 1981, GS	Clay, Fine <0.00098 mm	%	1.17	1.16	1%	No
Plumb, 1981, GS	Clay, Medium 0.00098 to <0.00195 mm	%	1.38	1.09	23%	No
Plumb, 1981, GS	Clay, Coarse 0.00195 to <0.0039 mm	%	0.89	1.21	-30%	Yes
Plumb, 1981, GS	Silt, V. Fine 0.0039 to <0.0078 mm	%	1.03	1.07	-4%	No
Plumb, 1981, GS	Silt, Fine 0.0078 to <0.0156 mm	%	1.52	1.6	-5%	No
Plumb, 1981, GS	Silt, Medium 0.0156 to <0.031 mm	%	2.5	2.41	4%	No
Plumb, 1981, GS	Silt, Coarse 0.031 to <0.0625 mm	%	4.12	3.76	9%	No
Plumb, 1981, GS	Sand, V. Fine 0.0625 to <0.125 mm	%	4.99	5.04	-1%	No
Plumb, 1981, GS	Sand, Fine 0.125 to <0.25 mm	%	5.75	6.17	-7%	No
Plumb, 1981, GS	Sand, Medium 0.25 to <0.5 mm	%	30.99	31.37	-1%	No
Plumb, 1981, GS	Sand, Coarse 0.5 to <1.0 mm	%	42.3	42.04	1%	No
Plumb, 1981, GS	Sand, V. Coarse 1.0 to <2.0 mm	%	3.01	2.82	7%	No
Plumb, 1981, GS	Granule, 2.0 to <4.0 mm	%	0.34	0.26	27%	Yes
Plumb, 1981, GS	Pebble, Small 4 to <8 mm	%	ND	ND	N/A	No
Plumb, 1981, GS	Pebble, Medium 8 to <16 mm	%	ND	ND	N/A	No
Plumb, 1981, GS	Pebble, Large 16 to <32 mm	%	ND	ND	N/A	No
Plumb, 1981, GS	Pebble, V. Large 32 to <64 mm	%	ND	ND	N/A	No

Notes: Highlighted rows exceed MQO (>25%).
ND: non-detect value less than the Method Detection Limit (MDL)
J: measurement was less than the Reporting Limit (RL) but above MDL
NA: Relative Percent Difference (RPD) could not be calculated