CONTRA COSTA CLEAN WATER PROGRAM

March 31, 2023

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SUBJECT: Submittal of the WY2022 Urban Creeks Monitoring Report in Accordance with MRP 3.0 Provisions C.8.h.iii, C.8.h.iv, and C.19.d.iii

Dear Ms. White and Mr. Pulupa,

Attached please find the Water Year 2022 Urban Creeks Monitoring Report (UCMR) submitted on behalf of all Contra Costa Permittees per the Municipal Regional Permit (MRP) for urban stormwater issued by the San Francisco Bay Regional Water Quality Control Board (Order No. R2-2022-0018). We are submitting this report concurrently to the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB) and the Central Valley Regional Water Quality Control Board (CVRWQCB). Contra Costa Clean Water Program (CCCWP) copies the CVRWQCB on monitoring reports as stipulated in MRP Provision C.19.d.iii.

With approval and direction from duly authorized representatives of each Permittee, I am authorized to submit and certify under penalty of law that this document and all attachments were prepared under my direction of supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Regards,

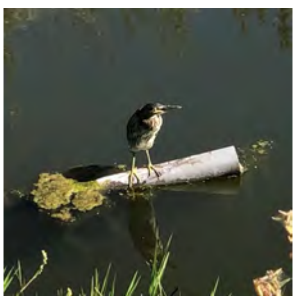
Karin Graves
Program Manager
Contra Costa Clean Water Program

cc: Zach Rokeach, SFBRWQCB
Richard Looker, SFBRWQCB
Elizabeth Lee, CVRWQCB
Contra Costa County Permittees

CONTRA COSTA CLEAN WATER PROGRAM

Urban Creeks Monitoring Report: Water Year 2022

(October 2021 – September 2022)




Submitted to the San Francisco Bay and Central Valley Regional Water Quality Control Boards in Compliance with NPDES Permit Provision C.8.h.iii

NPDES Permit No. CAS612008

March 31, 2023

A Program of Contra Costa County, its Incorporated Cities and Towns, and the Contra Costa Flood Control & Water Conservation District

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Contra Costa Clean Water Program

Urban Creeks Monitoring Report: Water Year 2022
(October 2021 – September 2022)

March 31, 2023

Prepared for

Contra Costa Clean Water Program
255 Glacier Drive
Martinez, California 94553

Contra Costa Clean Water Program Participants

- Cities of Antioch, Brentwood, Clayton, Concord, Danville (Town), El Cerrito, Hercules, Lafayette, Martinez, Moraga (Town), Oakley, Orinda, Pinole, Pittsburg, Pleasant Hill, Richmond, San Pablo, San Ramon, and Walnut Creek
- Unincorporated Contra Costa County
- Contra Costa County Flood Control & Water Conservation District

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Acronyms and Abbreviations

ACCWP	Alameda Countywide Clean Water Program
BAMSC	Bay Area Municipal Stormwater Collaborative
BASMAA	Bay Area Stormwater Management Agencies Association
CCCWP	Contra Costa Clean Water Program
CEDEN	California Environmental Data Exchange Network
CSCI	California Stream Condition Index
CVRWQCB	Central Valley Regional Water Quality Control Board
Delta	Sacramento-San Joaquin River Delta
FSURMP	Fairfield-Suisun Urban Runoff Management Program
GIS	geographic information system
IMS	Information Management System
MRP	Municipal Regional NPDES Stormwater Permit
MS4	municipal separate storm sewer system
NPDES	National Pollutant Discharge Elimination System
POC	pollutants of concern
P/S Studies	Pilot and Special Studies
QAPP	quality assurance project plan
Region 2	San Francisco Bay Regional Water Quality Control Board
Region 5	Central Valley Regional Water Quality Control Board
RMC	Regional Monitoring Coalition
RMP	Regional Monitoring Program for Water Quality in San Francisco Bay
RWL	Receiving water limitations
RWQCB	Regional Water Quality Control Board
SCVURPPP	Santa Clara Valley Urban Runoff Pollution Prevention Program
SFBRWQCB	San Francisco Bay Regional Water Quality Control Board
SMCWPPP	San Mateo Countywide Water Pollution Prevention Program
SOP	standard operating procedure(s)
SPoT	Stream Pollution Trends
STLS	Small Tributaries Loading Strategy
SWAMP	California Surface Water Ambient Monitoring Program
TMDL	Total maximum daily load
UCMR	urban creeks monitoring report

Table i. Summary of Water Year 2022 Creek Status and Pesticides/Toxicity Monitoring Stations

Site ID	Creek Name	Land Use	Latitude	Longitude	City/Town	Bioassessment PHab Chlorine Nutrients	Water Toxicity, Sediment Toxicity and Sediment Chemistry[1]	Continuous Water Temperature	Continuous Water Quality
204R01519	Rimer Creek	Region 2, Urban	37.81534	-122.11636	Moraga			X	
204R03652	W. Branch Alamo Creek	Region 2, Urban	37.80805	-121.89786	Blackhawk	X			
204SLE204	Moraga Creek	Region 2, Urban	37.83252	-122.13431	Moraga			X	
206R03479	Wildcat Creek	Region 2, Urban	37.93098	-121.28738	Richmond	X			
206R03584	Rodeo Creek	Region 2, Urban	38.00760	-122.22544	Hercules	X			
207R02635	Las Trampas Creek	Region 2, Urban	37.88925	-122.07336	Walnut Creek			X	
207R02756	San Ramon Creek	Region 2, Urban	37.77228	-121.98737	San Ramon	X			
207R03211	Reliez Creek	Region 2, Urban	37.90409	-122.09425	Lafayette	X			
207R03403	Walnut Creek	Region 2, Urban	37.90316	-122.05882	Walnut Creek				X
207R03447	E. Branch Grayson Creek	Region 2, Urban	37.94974	-122.06763	Pleasant Hill	X			
207R03639	Walnut Creek	Region 2, Urban	37.99650	-122.05472	Concord	X			
207R03659	Grizzly Creek	Region 2, Urban	37.86963	-122.09768	Lafayette	X			
207R03780	Bollinger Canyon Creek	Region 2, Urban	37.77108	-121.98964	San Ramon	X		X	
207R04819	Las Trampas Creek	Region 2, Urban	37.89248	-122.11031	Lafayette		X		
207LFC355	Lafayette Creek	Region 2, Urban	37.89214	-122.11178	Lafayette				X
544R03529	Marsh Creek	Region 5, Urban	37.99622	-121.69563	Oakley	X			

1 Dry weather sample
PHab physical habitat

Preface

In 2010, several members of the Bay Area Stormwater Management Agencies Association (BASMAA) joined to form the Regional Monitoring Coalition (RMC) to coordinate and oversee water quality monitoring required by the Municipal Regional Stormwater Permit (MRP). The RMC includes the following stormwater program participants:

- Alameda Countywide Clean Water Program
- Contra Costa Clean Water Program
- San Mateo Countywide Water Pollution Prevention Program
- Santa Clara Valley Urban Runoff Pollution Prevention Program
- Fairfield-Suisun Urban Runoff Management Program
- City of Vallejo and Vallejo Sanitation and Flood Control District

After more than 31 years of operation, including the last dozen years as a 501(c)(3) non-profit, BASMAA wound down its activities and dissolved in 2021. The State of California officially confirmed the dissolution of the non-profit organization on June 28, 2021. Information sharing and permittee advocacy functions of BASMAA have continued informally under a new moniker, Bay Area Municipal Stormwater Collaborative (BAMSC), via a steering committee and subcommittees. CCCWP continues to perform creek status monitoring and report results in accordance with RMC standards like prior years.

On May 11, 2022, the SFBRWQCB adopted the third Municipal Regional Stormwater NPDES Permit per Order No. R2-2022-0018 (MRP 3.0). This permit became effective July 1, 2022, at the start of the fourth quarter of water year 2022, superseding Order No. R2-2019-0004 (MRP 2.0).

In accordance with the BASMAA RMC multi-year work plan (Work Plan) (BASMAA 2011) and the creek status and long-term trends monitoring plan (BASMAA 2012), MRP 2.0 monitoring data were collected in accordance with the BASMAA RMC quality assurance project plan (QAPP) (BASMAA 2020) and the BASMAA RMC standard operating procedures (SOPs) (BASMAA 2016). Where applicable, monitoring data were derived using methods comparable with methods specified by the California Surface Water Ambient Monitoring Program (SWAMP) QAPP. Data presented in this report were also submitted in electronic SWAMP-comparable formats to Moss Landing Marine Laboratory for transmittal to the Regional Water Quality Control Board on behalf of the Contra Costa Clean Water Program (CCCWP) permittees and pursuant to the MRP 3.0 Provision C.8.h.ii requirements for electronic data reporting.

This Urban Creeks Monitoring Report complies with MRP 3.0 Provision C.8.h.iii for reporting of all data in water year 2022 (Oct. 1, 2021-Sept. 30, 2022). Data were collected pursuant to Provision C.8 of MRP 2.0. Data presented in this report were produced under the direction of the RMC and CCCWP using regional/probabilistic and local/targeted monitoring designs as described herein. All monitoring plans and status report appendices presented herein fulfill reporting requirements as specified in MRP 3.0 Provision C.8.h.iii.

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1 Introduction

This Urban Creeks Monitoring Report (UCMR) was prepared by the Contra Costa Clean Water Program (CCCWP) on behalf of its 21 member agencies (19 cities/towns, County of Contra Costa, and Contra Costa County Flood Control and Water Conservation District). CCCWP gathers and reports monitoring data to help its program members comply with the Municipal Regional Stormwater National Pollutant Discharge Elimination System (NPDES) Permit (MRP). This UCMR and its appendices present monitoring data through statistical and graphical analysis and summarizes results to understand creek health in Contra Costa County.

This report, including appendices and attachments, fulfills the requirements of MRP 3.0 Provision C.8.h.iii for interpreting and reporting monitoring data collected during water year 2022 (Oct. 1, 2021-Sept. 30, 2022). All monitoring data presented in this report were submitted electronically to the RWQCB by CCCWP (Attachment A). Data collected from receiving waters may be obtained via the California Environmental Data Exchange Network (CEDEN) website.[1] This site contains information related to data retrieval from the CEDEN Query Tool, the California State Open Data Portal, and the Tableau Public Visualization Tool.

On May 11, 2022, the SFBRWQCB adopted the third Municipal Regional Stormwater NPDES Permit per Order No. R2-2022-0018 (MRP 3.0). This permit became effective July 1, 2022, at the start of the fourth quarter of water year 2022. Monitoring plans and status reports submitted with this UCMR fulfill requirements of MRP 3.0 Provision C.8.h.iii.

1.1 Regulatory Context

Contra Costa County lies within the jurisdictions of both the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB) (Region 2) and the Central Valley Regional Water Quality Control Board (CVRWQCB) (Region 5). Municipal stormwater discharges in Contra Costa County previously were regulated by the requirements of two NPDES stormwater permits: the MRP in Region 2 (Order No. R2-2015-0049[2]), and the East Contra Costa County Municipal NPDES Permit (Central Valley Permit) in Region 5 (Order No. R5-2010-0102[3]).

Prior to the reissuance of MRP 2.0 in 2015, the requirements of the two permits were effectively identical. With the reissued MRP, there were some differences between MRP 2.0 and the Central Valley Permit, although in most respects monitoring and reporting requirements remained similar. For this report, creek status monitoring and reporting requirements specified in the reissued MRP 2.0 are considered the prevailing requirements. Sites in the Central Valley Region have been monitored as part of the creek status monitoring required by both permits. Per agreement between the Central Valley and San Francisco Regional Water Quality Control Boards on Feb. 13, 2019, the SFBRWQCB adopted Order

[1] Information on how this data may be obtained is available at http://www.ceden.org/find_data_page.shtml.

2 The SFBRWQCB adopted the reissued Municipal Regional Stormwater NPDES Permit (Order No. R2-2015-0049) to 76 cities, counties and flood control districts (i.e., permittees) in the Bay Area on Nov. 19, 2015 (SFBRWQCB 2015), effective Jan. 1, 2016. The BASMAA programs supporting MRP regional projects include all MRP permittees, plus the eastern Contra Costa County cities of Antioch, Brentwood, and Oakley, which have voluntarily elected to participate in the RMC. The RMC regional monitoring design was expanded to include the eastern portion of Contra Costa County, which is within the Central Valley Region (Region 5), to assist CCCWP in fulfilling parallel Provisions in the Central Valley Permit.

3 The CVRWQCB issued the East Contra Costa County Municipal NPDES Permit (Order No. R5-2010-0102) on Sept. 23, 2010 (CVRWQCB 2010). This Order was superseded by Order No. R2-2019-0004, incorporating the eastern portion of Contra Costa County within the requirements of the MRP (Order No. R2-2015-0049) on Feb. 13, 2019.

No. R2-2019-0004, to include the eastern portion of Contra Costa County under the jurisdiction of the MRP, rendering the Central Valley Permit obsolete for the purposes of MRP 2.0 parameters presented in this report.

On July 1, 2022, with the issuance of MRP 3.0, Contra Costa County cities and agencies located in the CVRWQCB's geographic jurisdiction continue to be included as Permittees in the SFBRWQCB permit and subject to C.8 monitoring and reporting requirements. Requirements of MRP 3.0 also include CVRWQCB total maximum daily load (TMDL) and control program, as specified in MRP 3.0 Provision C.19.

1.2 Regional Monitoring Coalition (RMC) Overview

In 2010, CCCWP joined with several other members of the Bay Area Stormwater Management Agencies Association (BASMAA) to participate in a regional collaborative effort to coordinate water quality monitoring required by the MRP 1.0. The resulting regional monitoring collaborative is called the Regional Monitoring Coalition (RMC). Details of the respective RMC stormwater program participants and their co-permittees are presented in Table 1.

Table 1. Regional Monitoring Coalition 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
Alameda Countywide Clean Water Program (ACCWP)	Cities of Alameda, Albany, Berkeley, Dublin, Emeryville, Fremont, Hayward, Livermore, Newark, Oakland, Piedmont, Pleasanton, San Leandro, and Union City; Alameda County; Alameda County Flood Control and Water Conservation District; and Zone 7 Water Agency
Contra Costa Clean Water Program (CCCWP)	Cities/Towns 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 Countywide Water Pollution Prevention Program (SMCWPPP)	Cities and towns 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

In June 2010, the permittees notified the RWQCB in writing of their agreement to participate in the RMC to collaboratively address creek status and related monitoring requirements in MRP Provision C.8. The goals of the RMC are to:

- Assist permittees in complying with the requirements of MRP Provision C.8 (Water Quality Monitoring).
- Develop and implement regionally consistent creek monitoring approaches and designs in the Bay Area through the improved coordination among RMC participants and other agencies, such as the Regional Water Quality Control Board (RWQCB), that share common goals.

- Stabilize the costs of creek monitoring by reducing duplication of effort (e.g., development of quality assurance project plans).

In February 2011, the RMC developed a multi-year work plan (RMC Work Plan; BASMAA 2011) to provide a framework for implementing regional monitoring and assessment activities required under MRP Provision C.8. The RMC Work Plan summarized RMC-related projects planned for implementation between fiscal years 2009-2010 and 2014-2015. Projects were collectively developed by RMC representatives to the BASMAA Monitoring and Pollutants of Concern Committee and were conceptually agreed to by the BASMAA Board of Directors.

Based on the requirements described in Provision C.8 of the original MRP (SFBRWQCB 2009), a total of 27 regional projects were identified in the RMC Work Plan. Regionally implemented activities to provide standardization and coordination for the RMC Work Plan were conducted under the auspices of BASMAA. Scopes, budgets, and contracting implementation mechanisms for BASMAA regional projects follow BASMAA's Operational Policies and Procedures, approved by the BASMAA Board of Directors. MRP permittees, through their stormwater program representatives on the Board of Directors and its subcommittees, collaboratively authorized and participated in BASMAA regional projects or tasks. Regional project costs were shared by either all BASMAA members or among those Phase I municipal stormwater programs that are subject to the MRP. CCCWP and other RMC participants coordinate their monitoring activities through meetings and communications of the RMC workgroups and the BAMSC Monitoring and Pollutants of Concern Committee.

1.3 Report Organization

This report is organized by the sub-provisions of MRP 3.0 Provision C.8, incorporating applicable sub-provisions of MRP 2.0 as follows:

1. Compliance Options (MRP 3.0 Provision C.8.a), Monitoring Protocols and Data Quality (MRP 3.0 Provision C.8.b), San Francisco Estuary Receiving Water Monitoring (MRP 3.0 Provision C.8.c)
2. Low Impact Development (LID) Monitoring Status Report (MRP 3.0 Provision C.8.d)
3. Trash Monitoring Progress Report (MRP 3.0 C.8.e)
4. Creek Status Monitoring (MRP 2.0 C.8.d) and Pesticides and Toxicity Monitoring (MRP 3.0 Provision C.8.g) (Appendices 3 and 4)
5. Pollutants of Concern Monitoring (MRP 3.0 C.8.f and MRP 3.0 C.19.d) (Appendices 5-8)

Figure 1 maps the locations of CCCWP monitoring stations associated with MRP 2.0 Provision C.8 compliance in water year 2022, including creek status, pesticides and toxicity, and pollutants of concern (POC) monitoring studies.

Monitoring results, plans and status reports discussed herein were performed in accordance with the requirements of both MRP 2.0 and 3.0. Key technical findings, detailed methods and results associated with these reports are summarized and provided in the respective appendices, as referenced within the applicable sections of the main body of this report.

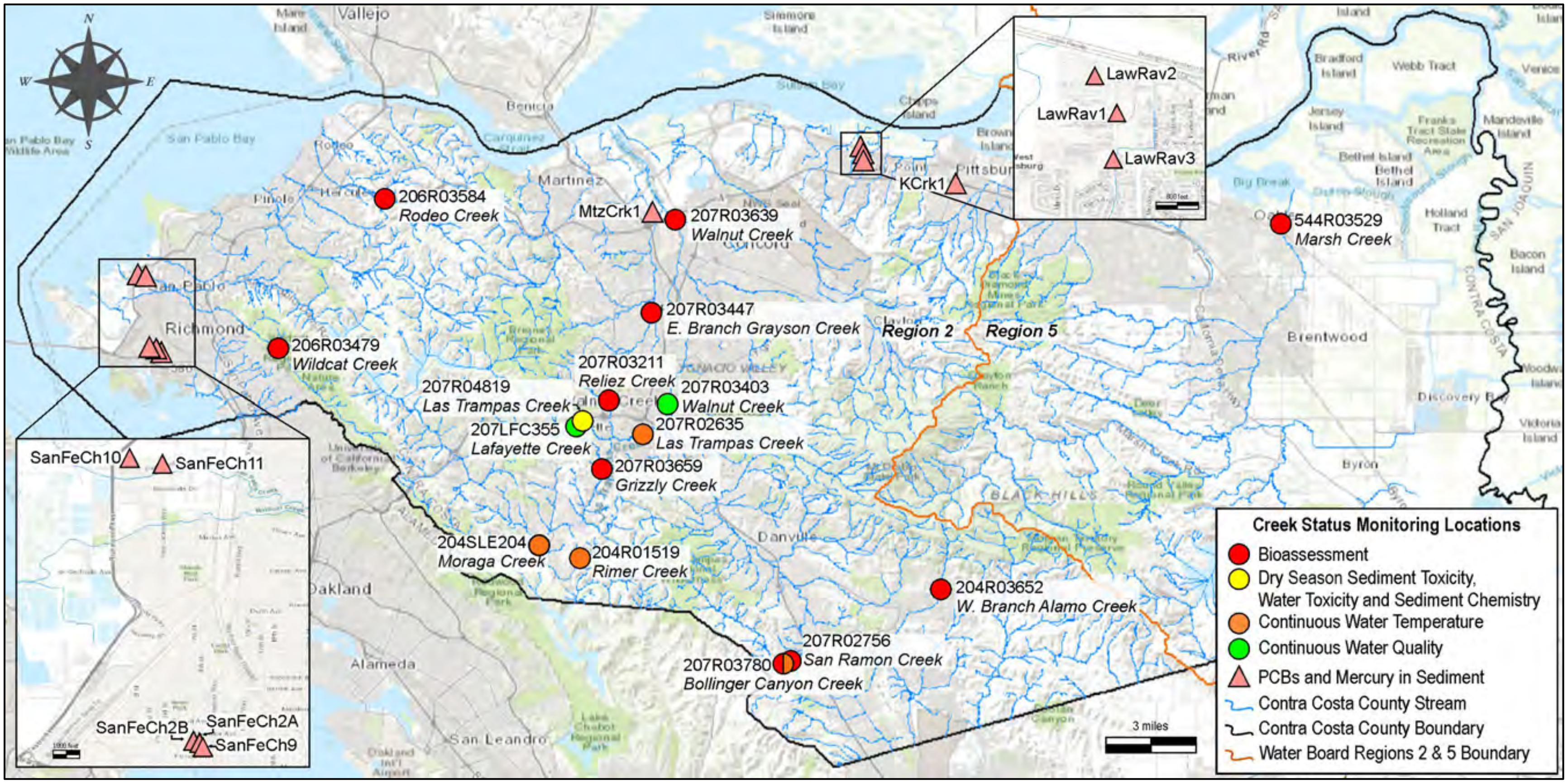

Figure 1. Creek Status and Pollutants of Concern Monitoring Stations in Water Year 2022

1.4 Compliance Options (MRP 3.0 C.8.a)

Provision C.8.a (Compliance Options) of MRP 3.0 allows the Permittees to comply with monitoring requirements by contributing to their countywide stormwater program, through regional collaboration or by using data collected by a third party. The primary means for regional collaboration on creek status monitoring is the RMC, which coordinates member programs on monitoring needs, including:

- Shared standard operating procedures
- Shared quality assurance project plans (QAPPs)
- Site selection and number of sites per program
- Timing of sampling events
- Data quality assurance and quality control procedures
- Database management

The main benefit of the RMC to the CCCWP Permittees is assurance that the final results meet RWQCB expectations for data content and quality. The MRP defines the type, amount, and frequency of monitoring; however, many details of execution require operator judgements (e.g., how to best screen LID and Trash monitoring sites, select and configure sampling equipment, or identify acceptable data quality objectives). Discussion at the RMC provides a single point of communication and common documentation to align the details across programs and allow the RWQCB to comment on approach. The RMC is likely cost-neutral, in that the staff time and consultant support necessary to collaborate is offset by the cost efficiencies achieved by sharing methods and documents.

CCCWP works with third-party water quality monitoring partners to benefit local, regional, and statewide monitoring efforts. Provision C.8.a.iii allows permittees to work with third-party organizations such as the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB), Central Valley Regional Water Quality Control Board (CVRWQCB), State Water Resources Control Board, or California Department of Pesticide Regulation to fulfill monitoring requirements if data meets water quality objectives described in Provision C.8.b. Monitoring locations in Contra Costa County are sampled in a manner to be comparable to the protocols of the state's Surface Water Ambient Monitoring Program (SWAMP) and assessed for pesticide pollution and toxicity through the Stream Pollution Trends (SPoT) Program (Phillips et al. 2016). SPoT monitors status and trends in sediment toxicity and sediment contaminant concentrations in selected large rivers throughout California and relates contaminant concentrations and toxicity test results to watershed land uses.

In addition, CCCWP supports efforts by local creek groups to monitor San Pablo, Wildcat, Walnut, and Marsh Creek Watersheds.

1.5 Monitoring Protocols and Data Quality (MRP 3.0 C.8.b)

Provision C.8.b of the MRP requires water quality data collected by the Permittees to comply with and be of a quality consistent with the State of California's SWAMP standards, set forth in the SWAMP QAPP and standard operating procedures (SOPs). RMC protocols and procedures were developed to assist permittees with meeting SWAMP data quality standards and to develop data management systems which allow for easy access to water quality monitoring data by Permittees.

1.5.1 Standard Operating and Data Quality Assurance Procedures

For creek status monitoring, the RMC adapted existing SOPs and the QAPP developed by SWAMP to document the field procedures necessary to produce SWAMP-comparable, high-quality data among RMC participants[4]. The RMC creek status monitoring program SOP and QAPPs were updated to accommodate MRP 2.0 requirements in March 2016 (Version 3) (BASMAA 2016) and January 2020 (Version 4) (BASMAA 2020), respectively.

For POC monitoring, a sampling analysis plan (ADH and AMS 2020a) and QAPP (ADH and AMS 2020b) were developed in 2016 and finalized in 2020 to guide the monitoring efforts for each POC task.

1.5.2 Information Management System Development/Adaptation

Permittees are required to report annually on water quality data collected in compliance with the MRP. To facilitate data management and transmittal, the RMC participants developed an Information Management System (IMS) to provide SWAMP-compatible storage and import/export of data for all RMC programs, with data formatted in a manner suitable for uploading to CEDEN.

BASMAA subsequently supplemented the IMS to accommodate management of POC data collected by the RMC programs. The expanded IMS provides standardized data storage formats which allow RMC participants to share data among themselves and to submit data electronically to the SFBRWQCB and CVRWQCB.

1.6 San Francisco Estuary Receiving Water Monitoring (C.8.c)

CCCWP contributes to the Regional Monitoring Program for Water Quality in San Francisco Bay (RMP), specifically the Status & Trends Monitoring Program (S&T Program) and the Pilot and Special Studies (P/S Studies). These efforts provide useful tools for CCCWP. Brief descriptions of the S&T Program and P/S Studies are provided below.

As described in MRP 3.0 Provision C.8.c, Permittees are required to conduct or cause to be conducted receiving water monitoring in the Bay. Permittees comply with this provision by making financial contributions through the CCCWP to the RMP. Additionally, Permittees actively participate in RMP committees and work groups through Permittee and/or stormwater program representatives.

The Sacramento-San Joaquin River Delta (Delta) RMP serves a similar function in fulfilling receiving water monitoring requirements for dischargers located within the jurisdiction of the CVRWQCB. Some CCCWP Permittees (the cities of Brentwood, Antioch, and Oakley, and portions of unincorporated Contra Costa County and the Contra Costa County Flood Control District) are located within the CVRWQCB's jurisdiction; however, by agreement with the SFRWQCB and the CVRWQCB, those Permittees also meet receiving water monitoring requirements through funding of the San Francisco Bay RMP. This is consistent with the historic approach of managing the entire countywide program as a single, integrated program.

The RMP is a long-term, discharger-funded monitoring program directed by a steering committee and represented by regulatory agencies and the regulated community. In addition to regulators and the regulated community, the RMP Technical Committee includes participation by a local, non-

[4] Further details on SWAMP comparability are available at https://www.waterboards.ca.gov/water_issues/programs/quality_assurance/comparability.html

governmental organization that specializes in water quality in the Bay. The goal of the RMP is to assess water quality in San Francisco Bay. The regulated community includes Permittees, publicly owned treatment works, dredgers, and industrial dischargers.

The RMP is intended to answer the following core management questions:

1. *Are chemical concentrations in the estuary potentially at levels of concern and are associated impacts likely?*
2. *What are the concentrations and masses of contaminants in the estuary and its segments?*
3. *What are the sources, pathways, loadings, and processes leading to contaminant-related impacts in the estuary?*
4. *Have the concentrations, masses, and associated impacts of contaminants in the estuary increased or decreased?*
5. *What are the projected concentrations, masses, and associated impacts of contaminants in the estuary?*

The RMP budget is generally broken into two major program elements: status and trends monitoring and Pilot/Special Studies. The RMP publishes reports and study results on their website at www.sfei.org/rmp.

1.6.1 RMP Status and Trends Monitoring Program

The S&T Program is the long-term contaminant monitoring component of the RMP. The S&T Program was initiated as a pilot study in 1989 and was redesigned in 2007 based on a more rigorous statistical design aimed at enabling the detection of trends. The S&T Program is comprised of the following program elements:

- Long-term water, sediment, and bivalve monitoring
- Episodic toxicity monitoring
- Sport fishing monitoring
- U.S. Geological Survey (USGS) hydrographic and sediment transport studies
- Factors controlling suspended sediment in San Francisco Bay
- USGS monthly water quality data
- Triennial bird egg monitoring (cormorant and tern)

Additional information on the S&T Program and associated monitoring data are available for download via the RMP website at www.sfei.org/content/status-trends-monitoring.

1.6.2 RMP Pilot and Special Studies

The RMP conducts pilot and special studies on an annual basis through committees, workgroups, and strategy teams. Usually, studies are designed to investigate and develop new monitoring measures related to anthropogenic contamination or contaminant effects on biota in the estuary. Special studies address specific scientific issues that RMP committees and standing workgroups identify as priority for further study. These studies are developed through an open selection process at the workgroup level and are selected for further funding through RMP committees. Results and summaries of the most pertinent pilot and special studies can be found on the RMP web site (http://www.sfei.org/rmp).

1.6.3 Participation in Committees, Workgroups and Strategy Teams

CCCWP and/or other BAMSC representatives participate in the following RMP committees and workgroups:

- Steering Committee
- Technical Review Committee
- Sources, Pathways and Loadings Workgroup
- Emergent Contaminant Workgroup
- Nutrient Technical Workgroup
- Strategy teams (e.g., Small Tributaries, PCBs)

Committee and workgroup representation are provided by CCCWP, other stormwater program staff, and/or individuals designated by RMC participants. Representation includes participation in meetings, review of technical reports and work products, co-authoring or review of articles included in the RMP's annual publication, *Pulse of the Estuary*, and general program direction to RMP staff. Representatives of the RMP also provide timely summaries and updates to and receive input from BAMSC stormwater program representatives (on behalf of the Permittees) during workgroup meetings to ensure the Permittees' interests are represented.

2 Low Impact Development (LID) Monitoring (MRP 3.0 C.8.d)

MRP 3 Provision C.8.d requires Permittees to conduct LID monitoring that is intended to answer the following two management questions:

- What are the pollutant removal and hydrologic benefits, such as addressing impacts associated with hydromodification, of different types of LID facilities, systems, components, and design variations, at different spatial scales (e.g., single control vs. watershed or catchment scale), and how do they change over time?
- What are the minimum levels of O&M necessary to avoid deteriorated LID facilities, systems, and components that reduce pollutant removal and hydrologic performance?

In WY 2022, Permittees have been identifying LID monitoring locations, convening a LID technical advisory group (TAG), and developing a LID Monitoring Plan which, per Provision C.8.d.vi, must be submitted for Executive Officer approval by May 1, 2023. Permittees will begin implementation of the LID Monitoring Plan by Oct. 1, 2023. A summary of actions Permittees have taken on LID monitoring in WY 2022 is provided in Appendix 1.

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3 Trash Monitoring (MRP 3.0 C.8.e)

MRP 3.0 Provision C.8.e requires Permittees to conduct trash monitoring that is intended to: 1) verify whether Permittees' trash control actions to-date have effectively prevented trash from their jurisdictions from discharging to receiving waters, and 2) evaluate whether discharges of trash from areas of Permittees' jurisdictions where full trash capture equivalency (full trash capture devices or other actions verified with on-land visual trash assessments, as referenced in Provision C.10.b.iii) has been achieved are causing and/or contributing to adverse trash impacts in receiving waters.

Trash monitoring shall address the following management and monitoring questions:

- Have Permittees' trash management actions effectively prevented trash from their jurisdictions from discharging to receiving waters?
- Are discharges of trash from areas within Trash Management Areas controlled to a low trash generation level causing and/or contributing to adverse trash impacts in receiving waters?

In WY 2022, Permittees have been identifying trash outfall monitoring locations, convening a Trash TAG, and developing a Trash Monitoring Plan which, per Provision C.8.e.v, must be submitted by July 31, 2023 and is subject to Executive Officer approval. Permittees will begin trash outfall monitoring starting October 1, 2023 and in-stream monitoring on October 1, 2024 (Provision C.8.e.iii). A summary of actions Permittees have taken on trash monitoring in WY 2022 is provided in Appendix 2.

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4 Creek Status Monitoring (MRP 2.0 C.8.d / MRP 3.0 C.8.g)

Regional/probabilistic, local/targeted, and pesticides and toxicity creek monitoring in water year 2022 were conducted in compliance with Provision C.8.d of MRP 2.0 and C.8.g of MRP 3.0, respectively. Monitoring management questions, strategy, and regional collaboration for these provisions are presented below. Section 4.1 describes the approach to regional/probabilistic creek status monitoring, while Section 4.2 describes the approach to local/targeted creek status monitoring, and Section 4.3 presents the approach to pesticide and toxicity monitoring.

Creek status monitoring was conducted to assess the chemical, physical, and biological impacts of urban runoff on receiving waters, with the goal of addressing 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 waters supportive of or likely supportive of beneficial uses?

Creek status monitoring parameters, methods, occurrences, duration, and minimum number of sampling sites for each stormwater program are described in MRP 2.0 Provision C.8.d . Coordinated through the RMC, creek status monitoring began in October 2011 and continued annually in non-tidally influenced, flowing water bodies (i.e., creeks, streams, and rivers) until June 30, 2022. With the expiry of MRP 2.0 on June 30, 2022, creek status monitoring concluded, as it is not a monitoring requirement of MRP 3.0, which went into effect July 1, 2022.

The RMC's strategy for creek status monitoring is described in the Creek Status and Long-Term Trends Monitoring Plan (BASMAA 2011). The monitoring methods follow the protocols described in the updated BASMAA RMC QAPP (Version 4) (BASMAA 2020) and SOPs for creek status and pesticides and toxicity monitoring (Version 3) (BASMAA 2016). The purpose of these documents is to provide RMC participants with a common basis for application of consistent monitoring protocols across jurisdictional boundaries. These protocols form part of the RMC's quality assurance program to help ensure validity of resulting data and comparability with SWAMP protocols.

Creek status monitoring parameters required by MRP Provision C.8.d are divided into two types: those conducted under a regional/probabilistic design, and those conducted under a local/targeted design (Table 2). The combination of these monitoring designs allows each RMC-participating program to assess the status of beneficial uses in local creeks within its program (jurisdictional) area, while also contributing data to answer management questions at the regional scale (e.g., differences between aquatic life conditions in urban and non-urban creeks).

The RMC monitoring strategy for complying with MRP 2.0 requirements included continuing a regional ambient/probabilistic monitoring component and a component based on local/targeted monitoring as was done under MRP 1.0. The analyses of results from the two creek status monitoring components conducted in water year 2022 are presented in Appendix 3 and Appendix 4, respectively, and a summary of the monitoring stations is shown in Table i.

Creek status monitoring data for each water year are submitted annually by CCCWP to SFBRWQCB and CVRWQCB by March 31 of the following year.

Table 2. Creek Status Monitoring Elements per MRP 2.0 Provision C.8.d. and MRP 3.0 C.8.g., Monitored as Either Regional/Probabilistic or Local/Targeted Parameters

Biological Response and Stressor Indicators	Monitoring Design	
	Regional (Probabilistic)	Local (Targeted)
Bioassessment, physical habitat assessment, CSCI	X	X[1]
Nutrients (and other water chemistry associated with bioassessment)	X	X[1]
Chlorine	X	X[2]
Water toxicity (wet and dry weather)	NA	NA
Water chemistry (pesticides, wet weather)	NA	NA
Sediment toxicity (dry weather)	NA	NA
Sediment chemistry (dry weather)	NA	NA
Continuous water quality (sondes data: temperature, dissolved oxygen, pH, specific conductance)		X
Continuous water temperature (data loggers)		X
Pathogen indicators (bacteria)		X

1 Provision C.8.d.i.(6) allows for up to 20% of sample locations to be selected under a targeted monitoring design. This design change was made under MRP Order No. R2-2015-0049.
2 Provision C.8.d.ii.(2) provides options for probabilistic or targeted site selection. In water year 2022, chlorine was measured at probabilistic sites.
CSCI California Stream Condition Index
NA Monitoring parameter not specific to either monitoring design

4.1 Regional/Probabilistic Monitoring

The regional/probabilistic creek status monitoring report (Appendix 3) documents the results of monitoring performed by CCCWP during water year 2022 under the regional/probabilistic monitoring design developed by the RMC. During each water year of MRP 1.0 and MRP 2.0, 10 sites were monitored by CCCWP for bioassessment, physical habitat, and related water chemistry parameters. To date, 110 sites have been sampled since the inception of the program in water year 2012.

RMC probabilistic monitoring sites were drawn from a sample frame consisting of a creek network geographic information system (GIS) data set within the RMC boundary[5] (BASMAA 2011). This draw included stream segments from all perennial and non-perennial creeks and rivers running through urban and non-urban areas within the portions of the five RMC participating counties within the SFBRWQCB boundary, and the eastern portion of Contra Costa County which drains to the CVRWQCB region. A map of the BASMAA RMC area, equivalent to the area covered by the regional/probabilistic design “sample frame,” is shown in Figure 2. The sites selected from the regional/probabilistic design master sample draw and monitored in water year 2022 are shown graphically in Figure 1.

The probabilistic design required several years of monitoring to produce sufficient data to develop a statistically robust characterization of regional creek conditions. BASMAA conducted a regional project to analyze bioassessment monitoring data collected during a five-year period (2012-2016) (BASMAA 2019). That analysis was used to help inform recommendations for potential changes to the monitoring program. The project also developed a fact sheet presenting the report findings in a format accessible to a broad audience.

[5] Based on discussion during RMC meetings, with SFBRWQCB staff present, the sample frame was extended to include the portion of Eastern Contra Costa County that ultimately drains to San Francisco Bay to address parallel provisions in CCCWP’s Central Valley Permit for Eastern Contra Costa County.

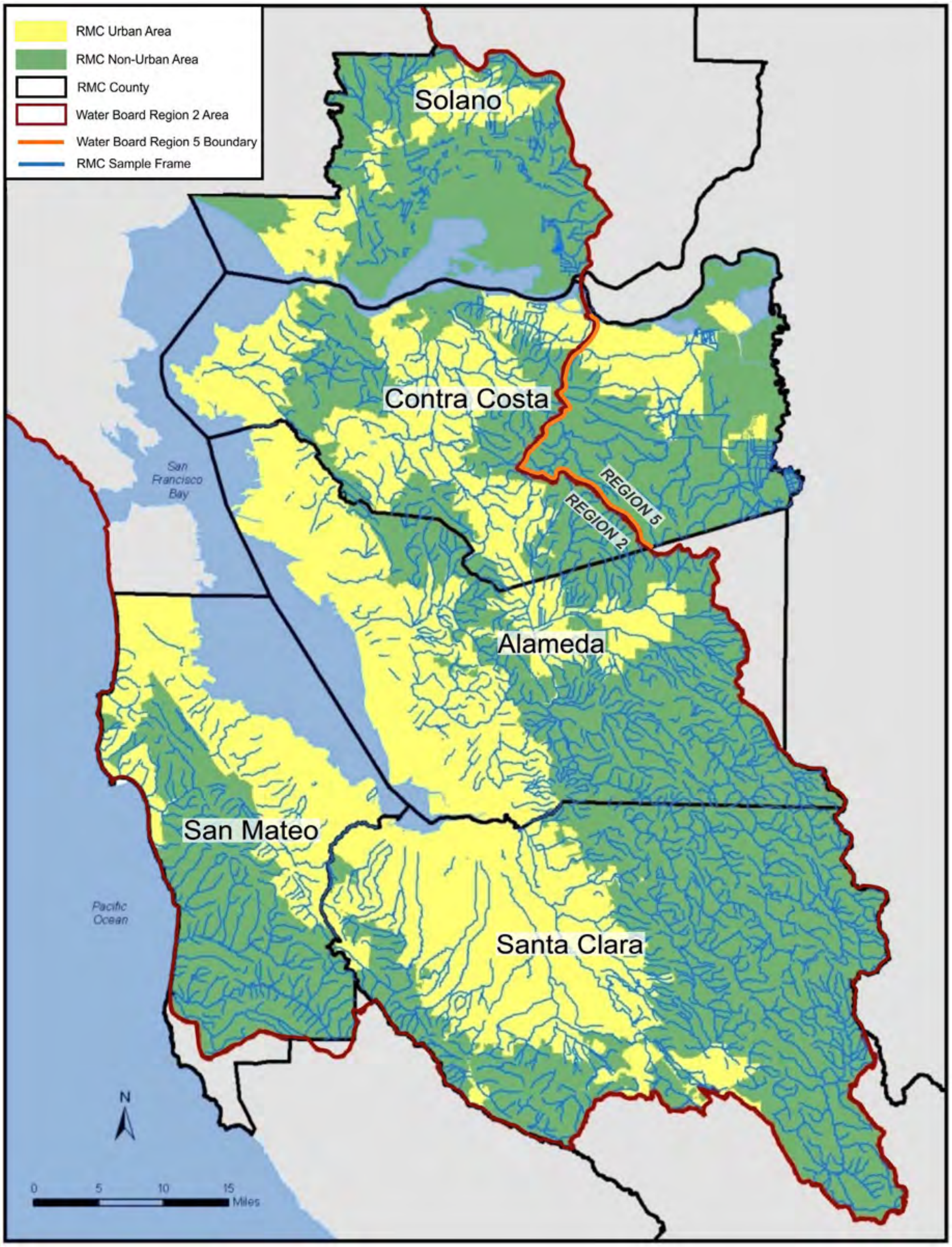

Figure 2. Map of RMC Area, County Boundaries and Major Creeks

4.2 Local/Targeted Monitoring

The Local/Targeted Creek Status Monitoring Report (Appendix 4) documents the results of targeted monitoring performed by CCCWP during water year 2022. Within Contra Costa County, targeted monitoring in water year 2022 was conducted at:

- Four continuous water temperature monitoring locations
- Two general water quality monitoring locations

Site locations were identified using a targeted monitoring design based on the directed principle to address the following management questions:

1. What is the range of general water quality measurements at targeted sites of interest?
2. Do general water quality measurements indicate potential impacts to aquatic life?

Targeted monitoring data were evaluated against MRP 2.0 threshold triggers, to assess the potential need for follow-up. The results of water year 2022 monitoring are summarized in Appendix 4.

4.3 Toxicity, Pesticides and Other Pollutants in Sediment – Dry Weather (MRP 3.0 C.8.g)

Once per year during the dry season (July 1-Sept. 30), sediment samples are collected and tested for toxicity to several different aquatic species, as required by MRP 3.0. Sampling is conducted at a site targeted to address management questions.

Concurrent with the sediment toxicity sampling described above, sediment chemistry samples were collected for analysis of a select list of pesticides, polycyclic aromatic hydrocarbons, trace elements, total organic carbon, and grain size. All sediment analytical chemistry (pesticides and other pollutants), grain size analysis and toxicity test results are presented in Appendix 3.

5 Pollutants of Concern Monitoring (MRP 3.0 C.8.f and C.19.d)

POC monitoring is intended to assess inputs of POCs to the Bay from local tributaries and urban runoff, assess compliance with receiving waters limitations, assess progress toward achieving wasteload allocations for TMDLs, and to help resolve uncertainties associated with loading estimates for these pollutants.

Under MRP 3.0 Provision C.8.f., POC monitoring addresses six priority management information needs:

1. *Source Identification – identifying or confirming which sources or watershed source areas provide the greatest opportunities for reductions of POCs in urban stormwater runoff;*
2. *Contributions to Bay Impairment – identifying which watershed source areas contribute most to the impairment of San Francisco Bay beneficial uses (due to source intensity and sensitivity of discharge location);*
3. *Management Action Effectiveness – evaluating the effectiveness or impacts of exiting management actions, including compliance with TMDLs and other POC requirements and providing support for planning future management actions;*
4. *Loads and Status – providing information on POC loads, concentrations, and presence in local tributaries or urban stormwater discharges;*
5. *Trends – evaluating trends in POC loading to the Bay and POC concentrations in urban stormwater discharges or local tributaries over time; and*
6. *Compliance with Receiving Water Limitations – providing information to assess whether receiving water limitations (RWLs) are achieved.*

Under Provision C.19.d.ii.(2), East County Permittees including the cities of Antioch, Brentwood, and Oakley, unincorporated Contra Costa County, and the Contra Costa County Flood Control and Water Conservation District located in the jurisdiction of the CVRWQCB must comply with POCs monitoring to address the Delta methylmercury TMDL. Methylmercury monitoring in east county is designed to answer the following management questions:

1. *What are the annual methylmercury loads from the MS4 discharge to the Central Delta, Marsh Creek, and West Delta subareas?*
2. *Do the methylmercury loads to each subarea meet the assigned methylmercury wasteload allocations?*
3. *Are there any MS4 design features that increase mercury methylation in the discharge?*
4. *What MS4 water quality controls have been implemented or are planned to be implemented to reduce methylmercury production and transport in the MS4 discharge?*
5. *By January 1, 2024, address whether eutrophication and low dissolved oxygen concentrations increase methylmercury in ponded areas of Marsh Creek during low flow periods (depending on the year, low flow periods can range between mid-March and Mid-November), and, if so:*
    - i. *Under what hydrologic or seasonal circumstances do increased methylmercury concentrations reach the Delta?*

ii. Are there reasonable and foreseeable management actions to ameliorate increased methylmercury concentrations?

5.1 Pollutants of Concern Monitoring Report

In water year 2022, CCCWP conducted source area assessments to investigate high interest parcels and areas for consideration of property referrals for PCBs and mercury controls. Street dirt and drop inlet sediments were sampled for POCs at ten locations including Pittsburg, Bay Point, Martinez, and Richmond, as shown in Figure 1. These sediment monitoring activities addressed Monitoring Types 1, 2, and 5 (source identification, contributions to Bay impairment, and trends). Table 3 presents a summary of water year 2022 POCs monitoring locations. A summary report of these data is presented in the Pollutants of Concern Monitoring Report (Appendix 5).

Table 3. Summary of Water Year 2022 Pollutants of Concern Monitoring Stations

Station ID	Receiving Water Body	Land Use	Latitude	Longitude	City/Town	Street Dirt Sediment
KCrk1	Kirker Creek	Region 2, Urban	38.01513	-121.88796	Pittsburg	X
LawRav1	Lawlor Ravine	Region 2, Urban	38.03002	-121.94336	Bay Point	X
LawRav2	Lawlor Ravine	Region 2, Urban	38.03237	-121.94477	Bay Point	X
LawRav3	Lawlor Ravine	Region 2, Urban	38.02728	-121.94360	Bay Point	X
MtzCrk1	Martinez Creek	Region 2, Urban	38.00087	-122.06725	Martinez	X
SanFeCh2A	Santa Fe Channel	Region 2, Urban	37.93100	-122.36184	Richmond	X
SanFeCh2B	Santa Fe Channel	Region 2, Urban	37.93093	-122.36180	Richmond	X
SanFeCh9	Santa Fe Channel	Region 2, Urban	37.93106	-122.36216	Richmond	X
SanFeCh10	Santa Fe Channel	Region 2, Urban	37.96892	-122.37140	Richmond	X
SanFeCh11	Santa Fe Channel	Region 2, Urban	37.96828	-122.36704	Richmond	X

POCs monitoring activities planned for WY 2023 include:

- Continuation of PCBs and mercury source area assessments to investigate high interest parcels and areas for consideration of property referrals to the Water Board for enforcement action (Monitoring Types 1 and 2), and
- Methylmercury monitoring in Marsh Creek to address whether eutrophication and low dissolved oxygen concentrations increase methylmercury in ponded areas of Marsh Creek during low flow periods and under what hydrologic or seasonal circumstances do increased methylmercury concentrations reach the Delta (management question C.19.ii.(2).e.).

POCs monitoring activities planned for WY 2024 include:

- Continuation of PCBs and mercury source area assessments to investigate high interest parcels and areas for consideration of property referrals to the Water Board for enforcement action (Monitoring Types 1 and 2);
- PCBs and mercury sampling at the bottom of the watershed in old industrial areas that are expected to have few source properties to confirm this assumption (Monitoring Type 4);

- PCBs and mercury sampling at previous monitoring locations to evaluate trends in POC loading to the Bay and POC concentrations in urban stormwater discharges or local tributaries over time (Monitoring Type 5);
- Receiving Water Limitations sampling for Monitoring Type 6 will be conducted per the Receiving Water Limitations Monitoring Plan (Appendix 7), and
- Mercury and methylmercury monitoring in the West Delta and Central Delta Sub-areas to address Provision C.19.d.ii.(2) as detailed in the East County Annual Mercury Monitoring Plan (Appendix 6).

5.2 East County Annual Mercury Monitoring Plan WY 2024

MRP 3.0 Provision C.19.d.iii.(1) requires East County Permittees to submit a mercury monitoring plan annually on March 31 with the Urban Creeks Monitoring Report. The monitoring plan describes the annual monitoring design and specifies the proposed sampling locations for methylmercury sampling required under MRP 3.0 Provision C.19.d.ii.(2). The WY 2024 East County Annual Mercury Monitoring Plan is presented in Appendix 6.

5.3 Receiving Water Limitations Assessment Report

MRP 3.0 Provision C.8.f.ii, Table 8.2, specifies that for POCs receiving water limitations (RWLs) monitoring Permittees must collect, over the permit term, four wet season samples and one dry season sample for copper, zinc, and fecal indicator bacteria and additional analytes determined under Provision C.8.h.iv. Provision C.8.h.iv requires Permittees submit an RWLs Assessment Report by March 31, 2023, for Executive Officer approval. The RWLs Assessment Report is presented in Appendix 7.

5.4 Stormwater Monitoring Strategy for Emerging Contaminants

MRP 3.0 Provision C.8.f.ii requires participation by Permittees in the regional stormwater monitoring strategy for emerging contaminants. Provision C.8.f.ii (Table 8.2, footnote c) of MRP 3.0 states:

> *Permittees, collectively, shall produce or cause to be produced a stormwater monitoring strategy for emerging contaminants (ECs) by April 1, 2023 that prioritizes ECs for stormwater monitoring listed in this table and possibly others and establishes an approach for sampling stormwater ECs based on specific or likely physico-chemical properties, sources, transport pathways, and fate of prioritized ECs. Permittees must conduct or cause to be conducted ECs stormwater monitoring to execute the ECs stormwater monitoring strategy at a level of effort indicated in the table. This level of effort can be satisfied either through sampling and analysis of the number of samples indicated in this table or through augmentation of the San Francisco Bay Regional Monitoring Program Emerging Contaminants Monitoring Strategy in the amount of $100,000 per year for all Permittees combined.*

As approved by the CCCWP Management Committee, Permittees have agreed to satisfy this MRP 3.0 requirement by annually contributing their share of $100,000 to augment the San Francisco Bay

Regional Monitoring Program (RMP) Emerging Contaminant Monitoring Strategy[6]. For Permittees in Contra Costa County, annual contributions of $21,649 will be made through CCCWP (Table 4).

Table 4. Contributions the MRP Permittees have agreed to make annually to augment the RMP's Emerging Contaminant Monitoring Strategy during the term of the permit

Permittee Group	Annual Contribution	Relative Percentage[1]
Alameda County Permittees	$30,923	30.92%
Contra Costa County Permittees	$21,649	21.65%
Santa Clara County Permittees	$33,489	33.49%
San Mateo County Permittees	$13,939	13.94%
Total	*$100,000*	*100%*

1 Relative percentage is based on the populations within the MRP-associated portions of each county at the start of MRP 3.0 (Department of Finance January 2022).

The stormwater portion of the RMP's Emerging Contaminants Monitoring Strategy is currently under development and builds upon a stormwater emerging contaminants screening study conducted from 2018-2023. The stormwater portion of the RMP's Emerging Contaminants Monitoring Strategy is scheduled for completion in late 2023 and will be implemented through the RMP during the MRP 3.0 permit term. This portion of the RMP's Emerging Contaminant Monitoring Strategy includes both watershed and stormwater modeling and monitoring tasks to address high priority management questions established collaboratively through the RMP consistent with those included in MRP 3.0.

A letter presenting the Regional Stormwater Monitoring Strategy for Emerging Contaminants is included in Appendix 8.

[6] https://www.sfei.org/sites/default/files/biblio_files/CEC%20Strategy%20-%202020%20Update%20-%20Final_92320.pdf

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Appendix 1

Low Impact Development (LID) Monitoring Status Report: Water Year 2022

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Contra Costa Clean Water Program

Low Impact Development (LID) Monitoring Status Report: Water Year 2022

Submitted to the San Francisco Bay and Central Valley Regional Water Quality Control Boards

In Compliance with NPDES Permit Provision C.8.h.iii.(1)
Municipal Regional Stormwater Permit (Order No. R2-2022-0018)

March 31, 2023

Prepared for

Contra Costa Clean Water Program
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Contra Costa Clean Water Program

Low Impact Development (LID) Monitoring Status Report: Water Year 2022

March 31, 2023

Prepared for

Contra Costa Clean Water Program
255 Glacier Drive
Martinez, California 94553

Contra Costa Clean Water Program Participants

- Cities of: Antioch, Brentwood, Clayton, Concord, Danville (Town), El Cerrito, Hercules, Lafayette, Martinez, Moraga (Town), Oakley, Orinda, Pinole, Pittsburg, Pleasant Hill, Richmond, San Pablo, San Ramon, and Walnut Creek
- Contra Costa County
- Contra Costa County Flood Control & Water Conservation District

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Acronyms and Abbreviations

ACCWP	Alameda Countywide Clean Water Program
BAMSC	Bay Area Municipal Stormwater Collaborative
BASMAA	Bay Area Stormwater Management Agency Association
CCCWP	Contra Costa Clean Water Program
CEDEN	California Environmental Data Exchange Network
LID	Low Impact Development
MRP	Municipal Regional Permit
NPDES	National Pollutant Discharge Elimination System
O&M	operations and maintenance
QAPP	quality assurance project plan
QAPrP	quality assurance program plan
SCVURPPP	Santa Clara Valley Urban Runoff Pollution Prevention Program
SFBRWQCB	San Francisco Bay Regional Water Quality Control Board
SMCWPPP	San Mateo Countywide Water Pollution Prevention Program
SSA	Solano Stormwater Alliance
SWAMP	Surface Water Ambient Monitoring Program
TAG	Technical Advisory Group
WQO	water quality objective
WY	water year

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1 Introduction

This Low Impact Development (LID) Monitoring Status Report documents monitoring activities performed by Contra Costa Clean Water Program (CCCWP) during water year (WY) 2022 (Oct. 1, 2021-Sept. 30, 2022) on behalf of its 21 member agencies (19 cities/towns, the County of Contra Costa, and the Contra Costa County Flood Control and Water Conservation District), which are subject to the National Pollutant Discharge Elimination System (NPDES) stormwater permit for Bay Area municipalities, referred to as the Municipal Regional Permit (MRP).

The MRP was first adopted by the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB or Regional Water Board) on Oct. 14, 2009 as Order No. R2-2009-0074 (SFBRWQCB 2009; referred to as MRP 1.0). On Nov. 19, 2015, the Regional Water Board updated and reissued the MRP as Order No. R2-2015-0049 (SFBRWQCB 2015; referred to as MRP 2.0). The current, and third, version of the MRP (SFBRWQCB 2022; referred to as MRP 3.0,) was issued by the Regional Water Board as Order No. R2-2022-0018 and became effective July 1, 2022.

This report fulfills the requirements of Provision C.8.h.iii.(1) of MRP 3.0 for summarizing the LID monitoring accomplishments from the preceding water year (WY 2022) conducted in compliance with Provision C.8.d (LID Monitoring) of the MRP. Consistent with the requirements of Provision C.8.d, LID monitoring activities in WY 2022 focused on planning rather than sample collection. This report summarizes LID monitoring planning actions from July 1, 2022 (when MRP 3.0 became effective) through Sept. 30, 2022 (the end of WY 2022).

2 LID Monitoring Requirements

"Low Impact Development" refers to structural control facilities or devices that treat stormwater runoff from urban infrastructure (roadways, parking lots, hardscape, buildings, etc.). LID is designed to meet some of the following goals: 1) slow the transport of stormwater to receiving waters, 2) attenuate peak runoff volumes and velocities, 3) promote infiltration into native soils, and 4) reduce pollutant loads to receiving waters through a variety of treatment methods, such as settling, infiltration, biofiltration, mechanical filtration. Incorporation of post-construction LID measures into new development and redevelopment projects has been a key aspect of Contra Costa County's stormwater management for the past 10+ years, and each iteration of Provision C.3 of the MRP has progressively prescribed more and more specific and stringent LID design and siting criteria.

MRP 3.0 is the first version of the MRP to specifically require LID effectiveness monitoring for all Permittees. Provision C.8.d directs Permittees to conduct LID monitoring during the permit term, and identifies specific parameters and monitoring frequencies that must be achieved to address the following management questions:

- What are the pollutant removal and hydrologic benefits, such as addressing impacts associated with hydromodification, of different types of LID facilities, systems, components, and design variations, at different spatial scales (e.g., single control vs. watershed or catchment scale), and how do they change over time?
- What are the minimum levels of operations and maintenance (O&M) necessary to avoid deteriorated LID facilities, systems, and components that reduce pollutant removal and hydrologic performance?

In Contra Costa County, a minimum of 25 water quality sampling events must be conducted during the MRP 3.0 permit term, with an annual minimum of three events beginning WY 2024. Each sampling event must consist of paired flow-weighted composite samples of the LID facility influent and effluent collected with automated samplers. Provision C.8.d.iv of the MRP specifies that all composite samples must be analyzed for total mercury, total polychlorinated biphenyls (PCBs), total suspended solids (TSS), per- and polyfluoroalkyl substances (PFAS), total petroleum hydrocarbons (TPH), total and dissolved copper, total hardness, and pH. In addition, flow must be measured at both influent and effluent sampling locations.

Permittees are required to submit LID monitoring plans at the regional or countywide level which demonstrate how the requirements in Provision C.8.d.iii-iv will be met. Permittees must submit their LID monitoring plans for approval to the executive officer of the Regional Water Board by May 1, 2023, and must begin implementation of their approved or conditionally approved LID monitoring plans by Oct. 1, 2023.

To assist development and implementation of scientifically-sound LID monitoring plans, to facilitate regional consistency with respect to sampling and analytical methodology, and to make recommendations about allocation of samples between and within different sites, Provision C.8.d.ii requires Permittees to form and convene a Technical Advisory Group (TAG) which includes impartial science advisors and Regional Water Board staff. The TAG will be asked to review and make recommendations regarding the LID monitoring plans (including their study design, analysis methods, results, and conclusions) prior to submission of the LID monitoring plans to the executive officer. To effectuate this review, the Permittees must submit their draft LID monitoring plans to the TAG by March 1, 2023. Prior to the executive officer's approval or conditional approval of the LID monitoring plans, the TAG shall be convened at least biannually. Thereafter, it shall be convened at least annually to provide continued feedback regarding the implementation of the LID monitoring plans.

3 WY 2022 LID Monitoring accomplishments

During the limited portion of WY 2022 when MRP 3.0 was in effect (July 1-Sept. 30, 2022), CCCWP made significant progress toward convening the LID TAG and developing an LID monitoring plan that will meet the requirements of Provision C.8.d

CCCWP joined with other countywide stormwater programs subject to the MRP to form the Bay Area Municipal Stormwater Collaborative (BAMSC) LID Monitoring Workgroup. Other members of the group include:

- Alameda Countywide Clean Water Program (ACCWP)
- San Mateo Countywide Water Pollution Prevention Program (SMCWPPP)
- Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP)
- Solano Stormwater Alliance (SSA)

The BAMSC LID Monitoring Workgroup meets every other month to discuss issues related to development of the LID monitoring plans, site selection, and convening of the TAG.

3.1 LID Technical Advisory Group (TAG)

During WY 2022, the BAMSC LID Monitoring Workgroup recruited technical experts to serve as LID TAG members, scheduled the first LID TAG meeting to take place on Dec. 8, 2022, and developed an agenda for the meeting. The LID TAG members include monitoring experts from throughout the state. More information about TAG members and their expertise is provided below:

- **Keith Lichten** is a division chief at the San Francisco Bay Regional Water Board, where he leads the Board's Clean Water Act stormwater programs. He has worked in stormwater for more than 25 years, including authoring permit language supporting a low impact development approach and foundational language on hydromodification management. He is the current chair of the Environmental and Water Resources Institute of the American Society of Civil Engineers Urban Water Resources Research Council.
- **Alicia Gilbreath** is an environmental scientist at the San Francisco Estuary Institute (SFEI), where she splits her time between field-based monitoring and investigations and office-based data analysis, research, and writing. Alicia earned a BA in Philosophy and BS in Psychology from UC Davis, and an MLA with an emphasis in Environmental Planning from UC Berkeley. She joined SFEI's Watersheds Program in 2006. Alicia's work for the Institute is focused on monitoring and modeling pollutant concentrations and loads in stormwater.
- **Dipen Patel** is a research engineer at the Office of Water Programs at Sacramento State University. He has a PhD in water quality management, a master's degree in engineering hydrology, a BS in chemical engineering, and he's also a professional engineer in the State of California. He has over 20 years of experience in the stormwater field, mostly helping Caltrans with its stormwater program.
- **Eric Strecker** is a professional engineer in both California and Oregon, and has worked for more than 35 years as a water resources engineer assisting both public and private sector clients. His focus has been on the design, monitoring and evaluation of stormwater best management practices, the development of watershed master plans, and overall assessment and management planning to protect aquatic resources. For over 20 years, he was a principal investigator for the International BMP Database, the most comprehensive database of LID and other BMP performance field monitoring data sets.
- **Michael K. Stenstrom** is a distinguished professor at UCLA in the Civil and Environmental Engineering Department. His research and teaching are in environmental engineering, with emphasis on biological treatment methods and applications of computing technologies to environmental engineering research. Over the past 15 years, he has performed research to characterize stormwater and minimize its impacts on the environment.

3.2 LID Monitoring Plan Development

During WY 2022, CCCWP began the process of developing an LID monitoring plan that would meet the requirements of Provision C.8.d of MRP 3.0.

3.2.1 Site Selection

CCCWP reviewed the permit requirements and decided monitoring should be conducted at a minimum of two LID facilities to meet the required number of sampling events (n=25) that must be collected during the permit term. CCCWP then identified ideal criteria for selection of LID facilities that could be monitored using the methods prescribed in the MRP.

Ideal criteria include:

- Public projects – to facilitate easier access/permission to install equipment;
- Old industrial and/or old urban land uses in the drainage area – to increase the likelihood that the influent contains measurable quantities of the required monitoring analytes;
- Safe and accessible for field crews;
- Space to install a utility box to house sampling equipment for the duration of the project;
- Single influent point to the LID facility and single effluent point from the LID facility; and
- Structural design that allows for accurate flow measurement at influent and effluent points.

CCCWP then began the process of identifying LID facilities in the county that could meet these criteria. This process included meetings with Permittees to discuss design details about promising facilities, and reconnaissance visits to LID facilities to confirm opportunities for influent and effluent monitoring locations and to envision how the required monitoring equipment could be installed. As of the end of WY 2022, CCCWP was still in the process of identifying sampleable LID facilities.

3.2.2 Quality Assurance Project Plan

A key element of any monitoring program is a comprehensive Quality Assurance Project Plan (QAPP). The QAPP is a written document describing the procedures that the monitoring project will use to ensure the data it collects and analyzes meet project requirements. In this case, all data must be comparable to the California Surface Water Ambient Monitoring Program (SWAMP). This means the project measurement quality objectives (MQOs) (i.e., acceptance criteria for the data) must be equivalent to or exceed SWAMP MQOs which are described in the SWAMP Quality Assurance Program Plan (QAPrP)[1]. In the interest of achieving regional consistency among LID monitoring conducted by MRP Permittees, the BAMSC LID Monitoring Workgroup initiated a "Project of Regional Benefit" to develop a common QAPP for LID monitoring. The QAPP will be SWAMP comparable to the extent practical, including MQOs, sampling and handling protocols, and target reporting limits for analytical constituents. Work on the QAPP began in WY 2022.

4 Recommendations

In WY 2023, CCCWP will continue to comply with the Provision C.8.d requirements. Specific WY 2023 tasks include:

- CCCWP will participate in the LID TAG, which met on Dec. 8, 2022, and will meet again in March 2023 to inform development of the LID monitoring plans.
- CCCWP will work with Permittees to identify sampleable LID facilities and gain approval to conduct monitoring throughout the permit term.

[1] The current version of the SWAMP QAPrP is available here: https://www.waterboards.ca.gov/water_issues/programs/swamp/docs/swamp-qaprp-2022.pdf.

- CCCWP will work with members of the BAMSC LID Monitoring Workgroup and the LID TAG to develop monitoring approaches and data evaluation methods. These will be documented in the regional QAPP and in a CCCWP monitoring plan.
- CCCWP will develop a draft LID monitoring plan for TAG review by March 1, 2023. The draft plan will be updated based on comments received from the TAG and will be submitted by May 1, 2023 to the executive officer of the Regional Water Board for approval.
- CCCWP will procure and install necessary monitoring equipment for automated, flow-weighted, whole-storm composite sampling at two LID facilities so that monitoring can begin at the start of WY 2024 (i.e., Oct. 1, 2023).
- The BAMSC LID Monitoring Workgroup will continue to meet, as needed, to continue to facilitate TAG input on the regional QAPP and program-specific monitoring plans, discuss monitoring issues that may arise in the future, and generally support regional consistency across the LID monitoring conducted in the five counties.

5 References

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

San Francisco Bay Regional Water Quality Control Board (SFBRWQCB). 2015. Municipal Regional Stormwater NPDES Permit, Order No. R2-2015-0049, NPDES Permit No. CAS612008. 152 pp plus appendices.

San Francisco Bay Regional Water Quality Control Board (SFBRWQCB). 2022. San Francisco Region Water Quality Municipal Regional Stormwater NPDES Permit, Order No. R2-2022-0018, NPDES Permit No. CAS612008.

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Appendix 2

Annual Trash Monitoring Progress Report: Water Year 2022

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Contra Costa Clean Water Program

Annual Trash Monitoring Progress Report: Water Year 2022

Submitted to the San Francisco Bay and Central Valley Regional Water Quality Control Boards

In Compliance with NPDES Permit Provision C.8.h.iii.(2)

Municipal Regional Stormwater Permit (Order No. R2-2022-0018)

March 31, 2023

Prepared for

CONTRA COSTA CLEAN WATER PROGRAM

Contra Costa Clean Water Program
255 Glacier Drive
Martinez, California 94553

Prepared by

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Contra Costa Clean Water Program

Annual Trash Monitoring Progress Report: Water Year 2022

March 31, 2023

Prepared for

Contra Costa Clean Water Program
255 Glacier Drive
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Contra Costa Clean Water Program Participants

- Cities of: Antioch, Brentwood, Clayton, Concord, Danville (Town), El Cerrito, Hercules, Lafayette, Martinez, Moraga (Town), Oakley, Orinda, Pinole, Pittsburg, Pleasant Hill, Richmond, San Pablo, San Ramon, and Walnut Creek
- Contra Costa County
- Contra Costa County Flood Control & Water Conservation District

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Acronyms and Abbreviations

ACCWP	Alameda Countywide Clean Water Program
BAMSC	Bay Area Municipal Stormwater Collaborative
CCCWP	Contra Costa Clean Water Program
GIS	geographical information system
MRP	Municipal Regional Permit
MS4	municipal separate storm sewer systems
NPDES	National Pollutant Discharge Elimination System
QAPP	Quality Assurance Project Plan
SCVURPPP	Santa Clara Valley Urban Runoff Pollution Prevention Program
SFBRWQCB	San Francisco Bay Regional Water Quality Control Board
SMCWPPP	San Mateo Countywide Water Pollution Prevention Program
SSA	Solano Stormwater Alliance
SWRCB	State Water Resources Control Board
TAG	Technical Advisory Group
TMA	trash management area
USEPA	U.S. Environmental Protection Agency
WQIF	San Francisco Bay Water Quality Improvement Fund
WY	Water Year

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1 Introduction

This Annual Trash Monitoring Progress Report documents monitoring activities performed by Contra Costa Clean Water Program (CCCWP) during water year (WY) 2022 (Oct. 1, 2021-Sept. 30, 2022) on behalf of its 21 member agencies (19 cities/towns, the County of Contra Costa, and the Contra Costa County Flood Control and Water Conservation District), which are subject to the National Pollutant Discharge Elimination System (NPDES) stormwater permit for Bay Area municipalities, referred to as the Municipal Regional Permit (MRP).

The MRP was first adopted by the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB or Regional Water Board) on Oct. 14, 2009 as Order R2-2009-0074 (SFBRWQCB 2009; referred to as MRP 1.0). On Nov. 19, 2015, the Regional Water Board updated and reissued the MRP as Order No. R2-2015-0049 (SFBRWQCB 2015; referred to as MRP 2.0). The current, and third, version of the MRP (SFBRWQCB 2022; referred to as MRP 3.0) was issued by the Regional Water Board as Order No. R2-2022-0018 and became effective July 1, 2022.

This report fulfills the requirements of Provision C.8.h.iii.(2) of MRP 3.0 for summarizing trash monitoring accomplishments from the preceding water year (WY 2022) conducted in compliance with Provision C.8.e (Trash Monitoring) of the MRP. Consistent with the requirements of Provision C.8.e, trash monitoring activities in WY 2022 focused on conducting initial planning tasks in preparation for trash monitoring activities that will begin in WY 2024. This report summarizes trash monitoring activities conducted from the start of MRP 3.0 (July 1, 2022) to the end of WY 2022 (Sept. 30, 2022).

2 Trash Monitoring Requirements

The level of trash in California's receiving waters has increased substantially over the past few decades, causing one of the state's most significant water quality issues (SWRCB 2015). Over the last decade, MRP Permittees have invested significant public resources to implement source controls, stormwater infrastructure improvements, and numerous other control measures to reduce the amount of trash discharged from their municipal separate storm sewer systems (MS4s) to receiving waters. Many of these actions are prescribed by Provision C.10 of MRP 3.0, which mandates that Permittees achieve a 100% reduction of trash in stormwater discharges from baseline (2009) levels by June 2025.

With the adoption of MRP 3.0 in WY 2022, the Regional Water Board also added significant trash monitoring requirements. Provision C.8.e directs Permittees to conduct trash monitoring at MS4 outfalls and in receiving waters, and prescribes specific monitoring location criteria, methods and frequencies that must be achieved to address the management questions and monitoring questions listed below. Provision C.8.e.v requires Permittees to submit a "collective" (i.e., regional) trash monitoring plan that demonstrates how the requirements in Provision C.8.e will be met. Permittees must submit the trash monitoring plan to the executive officer of the Regional Water Board for approval by July 31, 2023. The trash monitoring plan should be designed to address the following management and monitoring questions:

Management Questions:

1. Have the Permittees' trash management actions effectively prevented trash in their jurisdictions from discharging to receiving waters?

2. Are discharges of trash from areas within the trash management areas controlled to a low trash generation level causing and/or contributing to adverse trash impacts in receiving water?

Monitoring Questions:

1. What is the trash condition and approximate level of trash (volume, type, and size) within and discharging into receiving waters in areas that receive MS4 runoff controlled to a low trash generation via the installation of full trash capture devices, or the implementation of other trash management actions equivalent to full trash capture systems?
2. Does the level of trash in the receiving water correlate strongly with the conditions of the tributary drainage area of the MS4?

2.1 Outfall Monitoring

Beginning Oct. 1, 2023 in Contra Costa County, a minimum of two outfalls must be monitored during a minimum of three wet weather events per year. Monitoring must be conducted with netting (or equivalent) devices attached to the end of the outfall pipe or other equivalent location that allows for capture of trash discharging through the MS4. Targeted outfalls must drain areas that are controlled to the "Low" trash generation level and must be representative with respect to the types of trash controls present across the region. Provision C.8.e.ii also requires direct measurement of flow at the monitoring station (to calculate loading) and collection of data on the type of material collected.

2.2 Receiving Water Monitoring

The MRP requires Permittees to implement a pilot program to directly sample sections of receiving waters which receive runoff primarily from MS4 outfalls that drain tributary areas controlled to the Low trash generation level. In Contra Costa County, a minimum of one receiving water location must be monitored during a minimum of three wet weather events per year beginning Oct. 1, 2024. Targeted storm events should be likely to result in discharges of trash through the MS4 system, and targeted receiving water monitoring locations should not be downstream of direct discharge sites (e.g., homeless encampments, illegal dumping sites). Provision C.8.e.ii also requires direct measurement of flow at the monitoring station (to calculate loading) and collection of data on the type of material collected.

2.3 Technical Advisory Group

To assist in development and implementation of a scientifically-sound trash monitoring plan, Provision C.8.e.iv requires Permittees to form and convene a Technical Advisory Group (TAG) which includes impartial science advisors and Regional Water Board staff. The TAG will be asked to review and provide input on site selection, monitoring methods, permitting, and analysis methods, results, and conclusions. Prior to the submission of the trash monitoring plan, the TAG must be convened at least biannually. Thereafter, it shall be convened at least annually to provide continued feedback regarding the implementation of the trash monitoring plan. In addition, Provision C.8.e.v requires Permittees to provide opportunities for input on development of the trash monitoring plan by interested parties and scientific experts other than those participating in the TAG.

3 WY 2022 Trash Monitoring accomplishments

The trash monitoring methods prescribed in MRP 3.0 have not been conducted by municipalities in the region, state, or even nationwide. Limited direct experience with installation of trash nets on MS4 outfalls to creeks (or within creeks themselves) for monitoring purposes presents challenges to Provision C.8.e implementation. However, during the limited portion of WY 2022 when MRP 3.0 was in effect (i.e., July 1 through Sept. 30, 2022), CCCWP made significant progress toward convening the TAG, identifying potential outfall locations for monitoring, developing a grant application to support receiving water trash monitoring, and developing program-specific portions of the collective trash monitoring plan that will meet the requirements of Provision C.8.e.

CCCWP joined with other countywide stormwater programs subject to the MRP to form the Bay Area Municipal Stormwater Collaborative (BAMSC) Trash Monitoring Workgroup. Other members of the group include:

- Alameda Countywide Clean Water Program (ACCWP)
- San Mateo Countywide Water Pollution Prevention Program (SMCWPPP)
- Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP)
- Solano Stormwater Alliance (SSA)

The BAMSC Trash Monitoring Workgroup meets at least every other month to discuss issues related to development of the trash monitoring plan, convening of the TAG, site selection, monitoring methods, permitting, and other requirements related to implementation of Provision C.8.e. In addition, this workgroup developed and submitted a grant application for funding under the San Francisco Bay Water Quality Improvement Fund (WQIF) to support trash monitoring, public outreach, and information dissemination.

3.1 WQIF Application

In September 2022, the San Mateo City/County Association of Governments submitted a grant application for funding via the U.S. Environmental Protection Agency (USEPA) San Francisco Bay WQIF (EPA-R9-SFBWQIF-22-01). The application was collectively developed by and submitted on behalf of all Trash Monitoring Workgroup members. A total of $3.35 million in funding was requested to support the *Watching Our Watersheds – Improving Trash Monitoring Methods and Pollution Prevention Strategies* program through regional partnerships in the Bay Area. Roughly an equivalent level of funding is pledged by workgroup members as a match to the grant funds. If awarded, the grant and match funds will support TAG coordination and TAG-member honorariums; evaluation of trash source control measures; implementation of a public outreach campaign; trash monitoring planning, permitting, and implementation; trash characterization and associated public engagement events; and dissemination of information and knowledge gained through trash monitoring via a guidance document, a web portal, and a Bay Area trash symposium.

As of Sept. 30, 2022, USEPA had not made any decisions regarding WQIF awards. However, in January 2023, USEPA staff informally notified San Mateo City/County Association of Governments that the project scored high and would likely be selected for a second round (FY 2023) of WQIF funding with an anticipated project start date in the summer of 2023 (Luisa Valiela, personal communication).

3.2 Trash Advisory Group (TAG)

During WY 2022, the BAMSC Trash Monitoring Workgroup began formulation of the TAG by identifying and communicating with technical experts who would eventually be invited to serve as TAG members. It is anticipated that the first TAG meeting will take place in March 2023. The TAG members and their affiliations are listed below:

- **Tony Hale, PhD –** Director of the Environmental Informatics Program, San Francisco Estuary Institute (SFEI)
- **Shelly Moore –** Executive Director, Moore Institute for Plastic Pollution Research
- **Tom Mumley, PhD –** Assistant Executive Officer, San Francisco Bay Regional Water Board
- **Dawn Petschauer –** Stormwater Program Administrator, City of Pasadena
- **Ted Von Bitner, PhD –** Assistant Vice President, WSP USA

3.3 Trash Monitoring Plan Development

During WY 2022, CCCWP began implementing initial planning tasks in preparation for trash monitoring activities that will begin in WY 2024. The following sections summarize the tasks completed through Sept. 30, 2022.

3.3.1 Selection of Outfalls

Identification of potential outfalls for trash monitoring included desktop analysis and field verification. Desktop analysis incorporated available storm drain information (i.e., pipes, inlets, outfalls), GIS data, satellite imagery, and Google Street View. There are hundreds of outfalls countywide. CCCWP identified priority trash management areas (TMAs) based on proximate location to a creek and area controlled to low trash generation levels. CCCWP then manually reviewed outfalls in priority TMAs and their approximate drainage areas for the following priority criteria:

- Safe and feasible to monitor;
- Catchment area controlled to low trash generation with minimal to no areas with baseline low trash generation levels;
- Outfall size is less than or equal to 36 inches and ideally 18 inches to allow for manual net attachment/detachment;
- Outfall discharges to an earthen or improved channel with shallow banks;
- Maintenance access for a truck-mounted crane;
- Outfall elevation above the high-water mark;
- Minimal potential impacts on the creek and habitat to minimize permitting issues;
- Outfall pipe is concrete; and
- A variety of trash control mechanisms in the drainage areas (large vs. inlet-based full trash capture devices).

The initial desktop review yielded 10 potential locations throughout the County. Field visits eliminated all but two outfalls. For example, eliminated outfalls were buried or could not be found, equipped with flap gate valves, adjacent to homeless encampments, not accessible by a maintenance vehicle, or would likely be entirely submerged during the wet season. CCCWP continues to identify outfalls that could be monitored for trash in Contra Costa County and intends to complete this process in the spring or summer of 2023.

3.3.2 Monitoring Methods

Although trash control nets have been installed by cities and/or flood control districts at a few locations throughout the Bay Area, they do not have widespread implementation, and nets at outfalls for use as trash monitoring devices are even more rare. Therefore, the specific equipment necessary to conduct trash outfall monitoring is not well known, nor does CCCWP or other members of the BAMSC Trash Monitoring Workgroup have experience retrofitting MS4 systems to install a trash monitoring netting system. In WY 2022, CCCWP began identifying netting system vendors and contractors with experience designing, fabricating, and installing trash capture nets to learn more about this equipment and how it may be installed and maintained in a practical manner to support trash monitoring. There appears to be one vendor/contractor with this type of expertise in the Bay Area (i.e., Oldcastle Infrastructure, formerly KriStar). CCCWP and other members of the BAMSC Trash Monitoring Workgroup plan to continue working with Oldcastle in WY 2023 to understand potential trash net configurations, equipment needs, MS4 retrofit options, installation details, and maintenance opportunities.

3.3.3 Quality Assurance Project Plan (QAPP)

A key element of any monitoring program is a comprehensive Quality Assurance Project Plan (QAPP). The QAPP is a written document that describes the procedures the monitoring project will use to ensure the data it collects and analyzes meet project requirements. In the interest of achieving regional consistency among trash monitoring conducted by MRP Permittees, the BAMSC Trash Monitoring Workgroup initiated a Project of Regional Benefit to develop a common QAPP for trash monitoring. Work on the QAPP will begin in WY 2023.

4 Next Steps

In WY 2023, CCCWP will continue to comply with Provision C.8.e requirements. Specific WY 2023 tasks include:

- CCCWP will participate in the TAG, which will initially meet in March 2023 and again in spring 2023, to inform development of the trash monitoring plan.
- CCCWP will work with its Permittees to identify outfalls for trash monitoring and gain approval and local encroachment permits to conduct monitoring throughout the permit term.
- CCCWP will work with members of the BAMSC Trash Monitoring Workgroup and Regional Water Board staff to identify and pursue required local, state, and federal regulatory permits.
- CCCWP will work with members of the BAMSC Trash Monitoring Workgroup and the TAG to develop trash monitoring approaches and data evaluation methods. These will be documented in the regional QAPP.
- CCCWP will develop program-specific sections of the trash monitoring plan for TAG review. The draft plan will be updated based on comments received from the TAG and will be submitted by July 31, 2023 to the executive officer of the Regional Water Board for approval.

- CCCWP will acquire and install the necessary trash outfall monitoring equipment (e.g., nets and MS4 retrofits) at three outfalls so that monitoring can begin at the start of WY 2024 (i.e., Oct. 1, 2023).
- The trash monitoring plan, which must be submitted to the Regional Water Board for executive officer approval by July 31, 2023, will likely focus primarily on details related to trash outfall monitoring, which must begin Oct. 1, 2023. Identification of sites and specific methods for trash receiving water monitoring, which must begin by Oct. 1, 2024, will continue into WY 2024, with a revised trash monitoring plan anticipated by July 31, 2024.
- The BAMSC Trash Monitoring Workgroup will continue to meet, as needed, to facilitate the TAG and to discuss monitoring issues that may arise in the future.

5 References

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

San Francisco Bay Regional Water Quality Control Board (SFBRWQCB). 2015. Municipal Regional Stormwater NPDES Permit, Order No. R2-2015-0049, NPDES Permit No. CAS612008. 152 pp plus appendices.

San Francisco Bay Regional Water Quality Control Board (SFBRWQCB). 2022. San Francisco Region Water Quality Municipal Regional Stormwater NPDES Permit, Order No. R2-2022-0018, NPDES Permit No. CAS612008.

State Water Resources Control Board (SWRCB). 2015. Amendment to the Water Quality Control Plan for the Ocean Waters of California to Control Trash and Part 1 Trash Provisions of the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays, and Estuaries of California. Final Staff Report including the Substitute Environmental Documentation.

Appendix 3

Regional/Probabilistic Creek Status Monitoring Report: Water Year 2022

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Contra Costa Clean Water Program

Regional/Probabilistic Creek Status Monitoring Report: Water Year 2022
(October 2021-September 2022)

Submitted to the San Francisco Bay and Central Valley Regional Water Quality Control Boards

In Compliance with NPDES Permit Provision C.8.h.iii
Municipal Regional Stormwater Permit
(Order No. R2-2019-0004)

March 31, 2023

Prepared for

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Contra Costa Clean Water Program

Regional/Probabilistic Creek Status Monitoring Report: Water Year 2022
(October 2021-September 2022)

March 31, 2023

Submitted to

Contra Costa Clean Water Program
255 Glacier Drive
Martinez, California 94553

Submitted by

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Acronyms and Abbreviations

ACCWP	Alameda Countywide Clean Water Program
AFDM	ash-free dry mass
A-IBI	algal index of biological integrity
ASCI	Algal Stream Condition Index
BAMSC	Bay Area Municipal Stormwater Collaborative
Basin Plan	common term for the Regional Water Quality Control Plan
BASMAA	Bay Area Stormwater Management Agencies Association
B-IBI	benthic index of biological integrity
BMI	benthic macroinvertebrate
CCCWP	Contra Costa Clean Water Program
Central Valley Permit	East Contra Costa County Municipal NPDES Permit
cm	centimeter
CSCI	California Stream Condition Index
CVRWQCB	Central Valley Regional Water Quality Control Board
FSURMP	Fairfield-Suisun Urban Runoff Management Program
GIS	geographic information system
GRTS	Generalized Random Tessellated Stratified
IBI	Index of Biological Integrity
IPI	Index of Physical Integrity
Kinnetic	Kinnetic Environmental, Inc.
LC_{50}	lethal concentration to 50% of test organisms
LCS	laboratory control standard
LCSD	laboratory control standard duplicate
m	meter
MCL	maximum contaminant level
MDL	method detection limit
MMI	multimetric index
MQO	measurement quality objective
MRP	Municipal Regional Permit
MS/MSD	matrix spike/matrix spike supplicate
MUN	municipal and domestic water supply
ND	not detected
NPDES	National Pollutant Discharge Elimination System
NT	non-target
NZMS	New Zealand Mudsnail
PAH	polycyclic aromatic hydrocarbon
PEC	probable effect concentration
PHab	physical habitat assessment
PSA	perennial streams assessment
QA/QC	quality assurance/quality control
QAPP	quality assurance project plan
RL	reporting limit
RMC	Regional Monitoring Coalition
RPD	relative percent difference
SCVURPPP	Santa Clara Valley Urban Runoff Pollution Prevention Program

SFBRWQCB	San Francisco Bay Regional Water Quality Control Board
SMC	Southern California Stormwater Monitoring Coalition
SMCWPPP	San Mateo Countywide Water Pollution Prevention Program
SOP	standard operating procedure
SSID	stressor/source identification
STE	Standard Taxonomic Effort
SWAMP	Surface Water Ambient Monitoring Program
TEC	threshold effect concentration
TKN	Total Kjeldahl Nitrogen
TNS	target not sampled (or sampleable)
TOC	total organic carbon
TS	target sampled
TST	Test of Significant Toxicity
TU	toxic unit
U	unknown
UCMR	Urban Creeks Monitoring Report
USEPA	U.S. Environmental Protection Agency
WY	water year

Acknowledgements

This report was prepared by Armand Ruby Consulting, in association with Kinnetic Environmental, Inc., under contract to and supervision of the Contra Costa Clean Water Program (CCCWP). The report format and organization are in part derived from the original region-wide Regional Monitoring Coalition (RMC) monitoring report for water year 2012 (Regional Urban Creeks Status Monitoring Report, Appendix A to the Water Year 2012 Urban Creeks Monitoring Report), prepared jointly by EOA, Inc. and Armand Ruby Consulting as a regional project for the RMC participants (BASMAA 2013).

In addition to the RMC participants, San Francisco Bay Regional Water Quality Control Board staff members Kevin Lunde and Jan O'Hara participated in the RMC work group meetings, which contributed to the design and implementation of the RMC Monitoring Plan. These staff members also provided input on the outline of the initial regional urban creek status monitoring report and threshold trigger analyses conducted herein.

The CCCWP Monitoring Committee, facilitated by Karin Graves of CCCWP and Lisa Austin and Lisa Welsh of Geosyntec Consultants, provided project supervision and review of draft documents. Christian Kocher served as project manager for Kinnetic Environmental and lead consultant to CCCWP. The staff of Kinnetic Environmental also contributed to both the content and production of this report, with respect to data compilation and extraction, organization of metadata, and graphics production. Marco Sigala, Director of Marine Pollution Studies Laboratory at Moss Landing Marine Laboratories, provided algae data analysis and interpretation, and assistance with preparation of watershed GIS information and other metrics used in the computation of CSCI and IPI scores.

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Preface

The Regional Monitoring Coalition (RMC) was formed in early 2010 as a collaboration among several Bay Area Stormwater Management Agencies Association (BASMAA) members to implement the creek status monitoring requirements of the original San Francisco Bay Regional Water Quality Control Board (SFBRWQCB) 2009 Municipal Regional Stormwater Permit (MRP 1.0) through a regionally coordinated effort. The RMC developed a probabilistic design for regional characterization of selected creek status monitoring parameters.

While BASMAA dissolved on June 28, 2021, the Contra Costa Clean Water Program and other RMC participants continue to coordinate their monitoring activities through the Bay Area Municipal Stormwater Collaborative (BAMSC) to perform creek status monitoring and report results in accordance with the RMC regional/probabilistic study design, as in prior years.

This report fulfills MRP reporting requirements for regional/probabilistic creek status monitoring data generated within Contra Costa County during water year 2022 (Oct. 1, 2021-Sept. 30, 2022) for certain parameters monitored per MRP 2.0 (SFBRWQCB 2015) Provisions C.8.d and C.8.g. This report is an appendix to the Contra Costa Clean Water Program's Urban Creeks Monitoring Report for water year 2022, and complements similar reports submitted by each of the other RMC participants on behalf of their respective permittees.

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Executive Summary

This report documents the results of monitoring performed by Contra Costa Clean Water Program (CCCWP) during water year 2022 (Oct. 1, 2021-Sept. 30, 2022), for parameters originally covered under the regional/probabilistic monitoring design developed by the Regional Monitoring Coalition (RMC).

Other creek status monitoring parameters were addressed using a targeted design, with regional coordination and common methodologies. Together with the creek status monitoring data reported in the local/targeted creek status monitoring report for water year 2022 (Kinnetic 2023), this submittal fulfills reporting requirements for creek status monitoring specified in Provisions C.8.d and C.8.g of the Municipal Regional Permit (MRP) for urban stormwater issued by the San Francisco Bay Regional Water Quality Control Board per Order No. R2-2015-0049 (MRP 2.0), as amended by Order No. R2-2019-0004, incorporating the eastern portion of Contra Costa County within the requirements of the MRP.

On May 11, 2022, the San Francisco Bay Regional Water Quality Control Board adopted the third Municipal Regional Stormwater NPDES Permit per Order No. R2-2022-0018 (MRP 3.0). This permit became effective July 1, 2022, the start of the fourth quarter of water year 2022. Because the water year 2022 monitoring was conducted according to MRP 2.0 protocols and was largely complete on the effective date of MRP 3.0, this report addresses the results of the water year 2022 monitoring according to the interpretive methods and reporting requirements specified in MRP 2.0 Provision C.8.

During water year 2022, 10 sites were monitored by CCCWP under the RMC regional/probabilistic design for bioassessment, physical habitat, and water chemistry parameters. One site also was monitored for water and sediment toxicity and sediment chemistry.

The bioassessment and related data are used to develop a preliminary condition assessment for the monitored sites. The water and sediment chemistry and toxicity data are used in conjunction with physical habitat data to evaluate potential stressors which may affect aquatic habitat quality and beneficial uses. Various metrics and indices are also computed to aid in the condition assessment and stressor analysis.

The water year 2022 data were fairly consistent with the results of previous creek status monitoring performed by CCCWP under MRP 1.0 and 2.0.

Every CCCWP bioassessment site monitored in water year 2022 produced a California Stream Condition Index (CSCI) score below the MRP 2.0 threshold of 0.795, indicating a degraded benthic biological community relative to reference conditions. The invasive New Zealand Mudsnail (NZMS) was found in five of the 10 benthic samples.

The algal stream condition index (ASCI) metrics produced similar results in water year 2022. Nine of the 10 bioassessment monitoring sites scored as “Likely Altered” or “Very Likely Altered” for both the diatoms and hybrid algal community indices.

Based on the benthic macroinvertebrate (BMI) and algal community indices, along with the NZMS data, the biological community conditions of all CCCWP sites monitored in 2022 are characterized as impacted.

IPI (index of physical integrity) scores were again calculated from the PHab data compiled during the spring 2022 bioassessment monitoring, and the IPI scores were related to condition categories as

recommended by SWAMP guidance. Seven sites are rated as Likely Intact, one is ranked as Possibly Altered, one is ranked as Likely Altered, and one is ranked as Very Likely Altered.

The IPI scores are in contrast to the CSCI and ASCI scores for these sites. Given that the water year 2022 CSCI scores indicate “degraded” BMI communities at all sites, and in most cases the 2022 ASCI multimetric index (MMI) scores indicate Likely Altered or Very Likely Altered algal communities relative to reference conditions, physical habitat as represented by IPI scores does not appear to be a principal stressor for those biological communities.

Of the 12 water quality parameters required in association with bioassessment monitoring, applicable water quality standards were only identified for ammonia, chloride, and nitrate+nitrite (for sites with MUN beneficial use only). None of the results generated from the 10 sites monitored during water year 2022 exceeded the applicable water quality standards.

Water samples collected from Las Trampas Creek (site 207R04819) on July 12, 2022 were determined not to be toxic to any of the test species: *Selenastrum capricornutum* (chronic test), *Ceriodaphnia dubia* (acute and chronic), *Chironomus dilutus* (acute), *Hyalella azteca* (acute), or Fathead Minnow (acute and chronic).

Sediment samples also collected from Las Trampas Creek (site 207R04819) on July 12, 2022, after water samples were collected at the same site, were tested for acute toxicity (survival) to *Hyalella azteca* and *Chironomus dilutus*, and found not to be toxic to either test species.

Several of the common urban pyrethroid pesticides were detected at the water year 2022 sediment monitoring site, with bifenthrin at the highest concentration, as is typical in urban creeks in California. The calculated toxic unit (TU) equivalent of 0.53 for the sum of the pyrethroids in sediment is less than 1.0, so it is not surprising that this sample did not cause statistically significant toxicity to *Chironomus dilutus* or *Hyalella azteca* in sediment toxicity testing.

Bioassessment, sediment toxicity, and sediment chemistry results from water year 2022 were evaluated as the three lines of evidence used in the triad approach for assessing overall stream condition and added to the compiled results for water years 2012-2022.

Good correlation is observed throughout that 11 year period between sediment toxicity and pyrethroid pesticide concentrations. Sediment toxicity was observed in every case where the sum of pyrethroids TU equivalents was $\geq$1, and also in the 2018 Marsh Creek sediment sample, where the calculated TU equivalent was 0.95. Sediment toxicity was not observed in any sample where the pyrethroids sum of TU equivalents was <0.95.

Based on the results of the past 11 years, chemical stressors, particularly pyrethroid pesticides, may be contributing to the degraded benthic biological conditions, as indicated by the low biological index scores in many of the monitored streams.

However, unmeasured factors also apparently contribute to the “very poor” and “degraded” benthic biological condition category scores in some cases, as there are several such instances where there was neither sediment toxicity nor sum of pyrethroids TU equivalents nearly or greater than 1.

1 Introduction

This report documents the results of monitoring performed by Contra Costa Clean Water Program (CCCWP) during water year 2022 (Oct. 1, 2021-Sept. 30, 2022), for parameters originally covered under the regional/probabilistic monitoring design developed by the Regional Monitoring Coalition (RMC). Other creek status monitoring parameters were addressed using a targeted design, with regional coordination and common methodologies. Together with the creek status monitoring data reported in the local/targeted creek status monitoring report for water year 2022 (Kinnetic 2023), this submittal fulfills reporting requirements for creek status monitoring specified in Provisions C.8.d and C.8.g of the Municipal Regional Permit (MRP) for urban stormwater issued by the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB) per Order No. R2-2015-0049 (MRP 2.0), as amended by Order No. R2-2019-0004, incorporating the eastern portion of Contra Costa County within the requirements of the MRP.

On May 11, 2022, the SFBRWQCB adopted the third Municipal Regional Stormwater NPDES Permit (MRP 3.0) per Order No. R2-2022-0018. This permit became effective July 1, 2022, at the start of the fourth quarter of water year 2022. Because the water year 2022 monitoring was conducted according to MRP 2.0 protocols and was largely complete on the effective date of MRP 3.0, this report addresses the results of the water year 2022 monitoring according to the interpretive methods and reporting requirements specified in MRP 2.0, Provision C.8.

1.1 Regulatory Context

Contra Costa County lies within the jurisdictions of both the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB; Region 2) and the Central Valley Regional Water Quality Control Board (CVRWQCB; Region 5). Municipal stormwater discharges in Contra Costa County previously were regulated by the requirements of two National Pollutant Discharge Elimination System (NPDES) stormwater permits: the MRP in Region 2 (Order No. R2-2015-0049[1]), and the East Contra Costa County Municipal NPDES Permit (Central Valley Permit) in Region 5 (Order No. R5-2010-0102[2]).

Prior to the reissuance of the MRP in 2015 (MRP 2.0), the requirements of the two permits were effectively identical. With the issuance of MRP 2.0, there were some differences between the MRP and the Central Valley Permit, although in most respects the creek status monitoring and reporting requirements remained similar. For this report, the creek status monitoring and reporting requirements specified in MRP 2.0 are considered to be the prevailing requirements. Sites in the Central Valley Region have been monitored as part of the creek status monitoring required by both permits. Per agreement between the Central Valley and San Francisco Regional Water Quality Control Boards on Feb. 13, 2019,

[1] The SFBRWQCB adopted the reissued Municipal Regional Stormwater NPDES Permit (Order R2-2015-0049) to 76 cities, counties and flood control districts (i.e., permittees) in the Bay Area on Nov. 19, 2015 (SFBRWQCB 2015), effective Jan. 1, 2016. The BASMAA programs supporting MRP regional projects include all MRP permittees, plus the eastern Contra Costa County cities of Antioch, Brentwood, and Oakley, which have voluntarily elected to participate in the RMC. The RMC regional monitoring design was expanded to include the eastern portion of Contra Costa County, which is within the Central Valley Region (Region 5), to assist CCCWP in fulfilling parallel Provisions in the Central Valley Permit.

[2] The CVRWQCB issued the East Contra Costa County Municipal NPDES Permit (Order R5-2010-0102) on Sept. 23, 2010 (CVRWQCB 2010). This Order was superseded by Order R2-2019-0004, incorporating the eastern portion of Contra Costa County within the requirements of the MRP (Order R2-2015-0049) on Feb. 13, 2019.

the SFBRWQCB adopted Order No. R2-2019-0004, to include the eastern portion of Contra Costa County under the jurisdiction of MRP 2.0, rendering the Central Valley Permit obsolete for the purposes of this report.

CCCWP conducted extensive bioassessment monitoring prior to the adoption of the original MRP (MRP 1.0; SFBRWQCB 2009). Summaries of those findings can be found in "Preliminary Assessment of Aquatic Life Use Condition in Contra Costa Creeks, Summary of Benthic Macroinvertebrate Bioassessment Results (2001-2006)" (CCCWP 2007), and "Contra Costa Monitoring and Assessment Program, Summary of Benthic Macroinvertebrate Bioassessment Results (2011)" (ARC 2012).

1.2 Regional Monitoring Coalition

The regional/probabilistic design was developed and implemented by the Regional Monitoring Coalition of the Bay Area Stormwater Management Agencies Association (BASMAA). This monitoring design allows each RMC participating program to assess stream ecosystem conditions within its program area (e.g., county boundary), while contributing data to answer regional management questions about water quality and beneficial use conditions in the creeks of the San Francisco Bay Area.

The RMC was formed in early 2010 as a collaboration among several BASMAA members representing MRP permittees (Table 1.1) to implement the creek status monitoring requirements of MRP 1.0 through a regionally coordinated effort. While BASMAA dissolved in 2021, RMC participants continue to meet on an ongoing basis through the Bay Area Municipal Stormwater Collaborative (BAMSC) to plan and coordinate monitoring, data management, and reporting activities, among others.

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
Alameda Countywide Clean Water Program (ACCWP)	Cities of Alameda, Albany, Berkeley, Dublin, Emeryville, Fremont, Hayward, Livermore, Newark, Oakland, Piedmont, Pleasanton, San Leandro, and Union City; Alameda County; Alameda County Flood Control and Water Conservation District; and Zone 7 Water Agency
Contra Costa Clean Water Program (CCCWP)	Cities/Towns 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 Countywide Water Pollution Prevention Program (SMCWPPP)	Cities and towns 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 established by the RMC were to:

- Assist RMC permittees in complying with requirements in MRP 1.0 Provision C.8 (water quality monitoring)

- Develop and implement regionally consistent creek monitoring approaches and designs in the San Francisco Bay Area through improved coordination among RMC participants and other agencies sharing common goals (e.g., regional water quality control boards, Regions 2 and 5, and the Surface Water Ambient Monitoring Program [SWAMP])
- Stabilize the costs of creek status monitoring by reducing duplication of effort and streamlining monitoring and reporting

The RMC Work Group was a subgroup of the BASMAA Monitoring and Pollutants of Concern Committee, which met and communicated regularly to coordinate planning and implementation of monitoring-related activities. The RMC Work Group meetings were coordinated by an RMC coordinator and funded by the RMC's participating county stormwater programs. This work group included staff from the SFBRWQCB at two levels: those generally engaged with the MRP, as well as those working regionally with SWAMP. Through the RMC Work Group, the BASMAA RMC developed a quality assurance project plan (QAPP) (BASMAA 2020), standard operating procedures (SOPs) (BASMAA 2016), data management tools, and reporting templates and guidelines. Costs for these activities were shared among RMC members.

The RMC divided the creek status monitoring requirements required by MRP 2.0 Provisions C.8.d and C.8.g into those parameters which could reasonably be included within a regional/probabilistic design and those which, for logistical and jurisdictional reasons, should be implemented locally using a targeted (non-probabilistic) design. The assignments of the various activities have adapted over time; the monitoring elements currently included in each category are specified in Table 1.2. Creek status monitoring data collected by CCCWP at local/targeted sites (and not included in the regional/probabilistic design) are reported separately in Appendix 4 of the water year 2022 Urban Creeks Monitoring Report (UCMR) (Kinnetic 2023).

Table 1.2 Creek Status Monitoring Elements per MRP 2.0 Provisions C.8.d. and C.8.g., Monitored as Either Regional/Probabilistic or Local/Targeted Parameters

Biological Response and Stressor Indicators	Monitoring Design	
	Regional (Probabilistic)	Local (Targeted)
Bioassessment, physical habitat assessment, CSCI	X	X[1]
Nutrients (and other water chemistry associated with bioassessment)	X	X[1]
Chlorine	X	X[2]
Water toxicity (wet and dry weather)	NA	NA
Water chemistry (pesticides, wet weather)	NA	NA
Sediment toxicity (dry weather)	NA	NA
Sediment chemistry (dry weather)	NA	NA
Continuous water quality (sondes data: temperature, dissolved oxygen, pH, specific conductance)		X
Continuous water temperature (data loggers)		X
Pathogen indicators (bacteria)		X

1 Provision C.8.d.i.(6) allows for up to 20% of sample locations to be selected under a targeted monitoring design. This design change was made under MRP Order No. R2-2015-0049.

2 Provision C.8.d.ii.(2) provides options for probabilistic or targeted site selection. In water year 2022, chlorine was measured at probabilistic sites.

CSCI California Stream Condition Index

NA Monitoring parameter not specific to either monitoring design

1.3 Report Organization

The remainder of this report addresses study area and monitoring design (Section 2), data collection and analysis methods (Section 3), results and data interpretation (Section 4), and conclusions and next steps (Section 5). Additional information on other aspects of permit-required monitoring is found elsewhere in the CCCWP water year 2022 UCMR and its appendices.

2 Study Area and Monitoring Design

2.1 Regional Monitoring Coalition Area

For the purposes of the regional/probabilistic monitoring design, the study area was defined as equal to the RMC area, encompassing the political boundaries of the five former RMC participating counties, including the eastern portion of Contra Costa County which drains to the Central Valley region. A map of the BASMAA RMC area, equivalent to the area covered by the regional/probabilistic design sample frame, is shown in Figure 2.1.

2.2 Regional Monitoring Design

In 2011, the RMC developed a regional/probabilistic monitoring design to identify ambient conditions of creeks in the five main counties subject to the requirements of MRP 1.0. The regional design was developed using the Generalized Random Tessellation Stratified (GRTS) approach developed by the U.S. Environmental Protection Agency (USEPA) and Oregon State University (Stevens and Olson 2004). The GRTS approach has been implemented in California by several agencies, including the statewide Perennial Streams Assessment (PSA) conducted by SWAMP (Ode et al. 2011) and the regional monitoring conducted by the Southern California Stormwater Monitoring Coalition (SMC) (see SMC 2007, updated by Mazor 2015). The RMC area is considered to define the sample frame and represent the sample universe from which the regional “sample draw” (the randomized list of potential monitoring sites) is produced.

2.2.1 Management Questions

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

- What is the condition of aquatic life in creeks in the RMC area? Are water quality objectives met and are beneficial uses supported?
- 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?
- What is the condition of aquatic life in RMC participant counties? Are water quality objectives met and are beneficial uses supported?
- To what extent does the condition of aquatic life in urban and non-urban creeks differ in the RMC area?
- To what extent does the condition of aquatic life in urban and non-urban creeks differ in each of the RMC participating counties?
- What are major stressors to aquatic life in the RMC area?
- What are major stressors to aquatic life in the urbanized portion of the RMC area?
- What are the long-term trends in water quality in creeks over time?

The regional design includes bioassessment monitoring to address the first set of questions regarding aquatic life condition. 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).

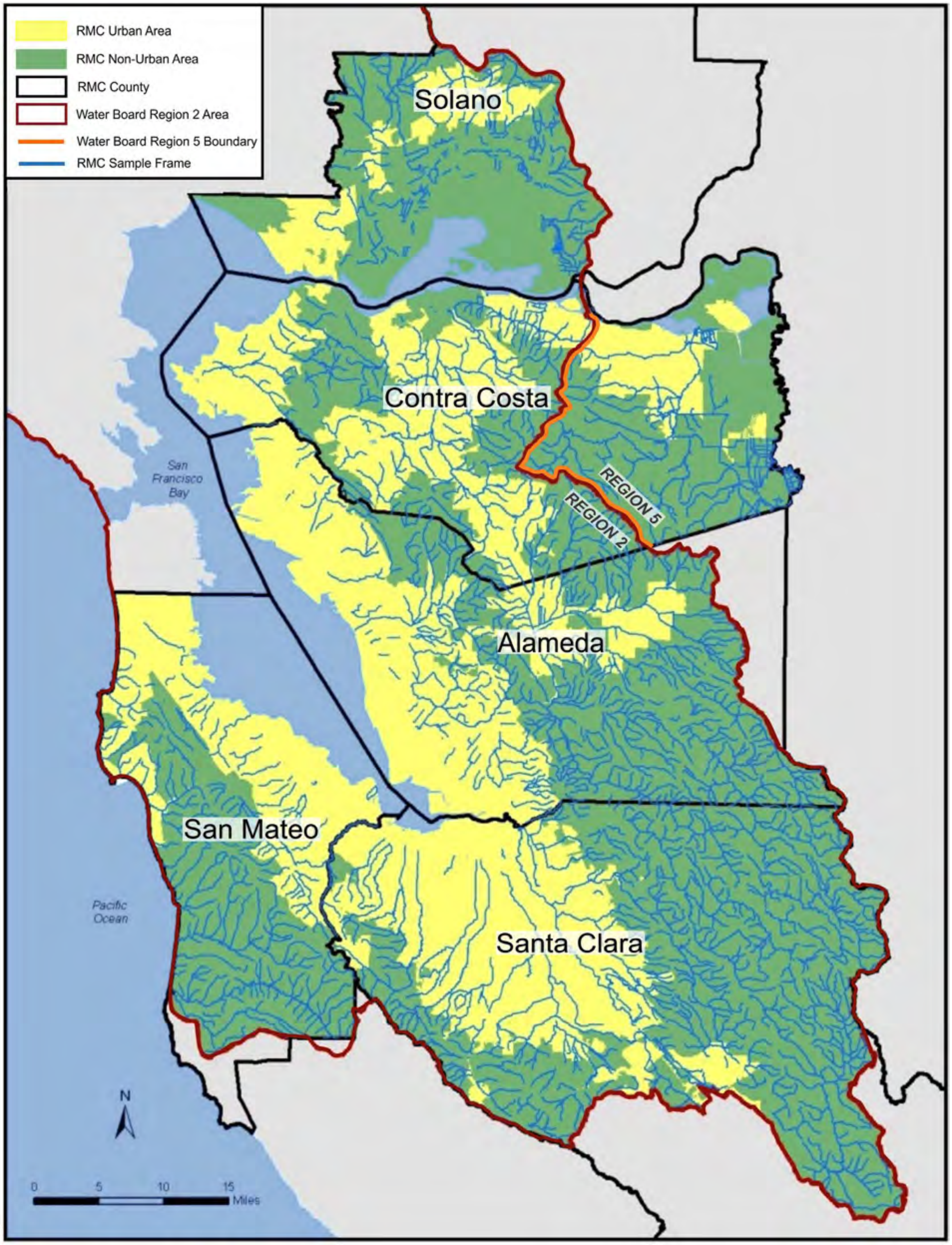

Figure 2.1 Map of BASMAA RMC Area, County Boundaries and Major Creeks

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, as well as to physical habitat, both in the stream channel and along the riparian zone. Due to their relatively long lifecycles (approximately one year) and limited migration, BMIs are particularly susceptible to site-specific stressors (Barbour et al. 1999).

Algae also are increasingly used as indicators of water quality, as they form the autotrophic base of aquatic food webs and exhibit relatively short life cycles which respond quickly to chemical and physical changes. Diatoms are found to be particularly useful for interpreting some causes of environmental degradation (Hill et al. 2000); therefore, both BMI and algae taxonomic data are used in the aquatic life assessments.

Additional water quality parameters, including water and sediment toxicity testing and chemical analysis, along with physical habitat characteristics, are then used to assess potential stressors to aquatic life.

2.2.2 Site Selection

Creek status monitoring was conducted in non-tidally influenced, flowing water bodies (i.e., creeks, streams, and rivers). The water bodies monitored were drawn from a master list which included all perennial and non-perennial creeks and rivers running through urban and non-urban areas within the RMC area. 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 2011), within five management units corresponding to the five participating RMC counties. The National Hydrography Dataset Plus (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 stratified by county and land use (i.e., urban and non-urban) to allow for comparisons within those strata. Urban areas were delineated by combining urban area boundaries and city boundaries defined by the U.S. Census Bureau of 2000. Non-urban areas were defined as the remainder of the areas within the sample universe (RMC area).

Based on discussions during RMC meetings with SFBRWQCB staff present, RMC participants weight their sampling to ensure at least 80% of monitored sites are in urban areas and not more than 20% are in non-urban areas. RMC participants coordinated with SWAMP and Regional Water Quality Control Board staff by identifying additional non-urban sites from their respective counties for SWAMP monitoring. For Contra Costa County, SWAMP monitoring included non-urban bioassessment sites chosen from the probabilistic sample draw in the Region 2 (San Francisco Bay) area of Contra Costa County, with the regional focus varying annually.

2.3 Monitoring Design Implementation

The number of probabilistic sites monitored annually in water years 2012-2022 by CCCWP are shown by land use category in Table 2.1. This tally includes non-urban sites monitored by SWAMP personnel. In 2022 CCCWP monitoring, all monitored sites were in areas of urban land use.

Table 2.1 Number of Urban and Non-Urban Bioassessment Sites Sampled by CCCWP and SWAMP in Contra Costa County During Water Years 2012-2022

Monitoring Year	Contra Costa County Land Use	
	Urban Sites	Non-Urban Sites[1]
WY 2012	8	2/2
WY 2013	10	0/3
WY 2014	10	0/1
WY 2015	10	0/1
WY 2016	10	0/0
WY 2017	10	0/0
WY 2018	9	1/0
WY 2019	9	1/0
WY 2020	9	1/0
WY 2021	10	0/0
WY 2022	10	0/0
Total	105	12

1 Non-urban sites are shown as sampled by CCCWP/SWAMP for each year. The total represents combined non-urban sites, including those monitored by SWAMP in Contra Costa County.

3 Monitoring Methods

3.1 Site Evaluation

Sites identified in the regional sample draw are evaluated by CCCWP in numerical order using the process defined in the RMC SOPs (BASMAA 2016). Each site is evaluated to determine if it meets the following RMC sampling location criteria:

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

In the first step, these criteria were evaluated for the current water year to the extent possible using desktop analysis.

For sites which successfully passed the initial desktop analysis, site evaluations were completed during the second step via field reconnaissance visits. Based on the outcome of the site evaluations, sites were classified into one of four categories:

Target Sampleable (TS): sites meeting all seven criteria were classified as target sampleable (TS)

Target Non-Sampleable (TNS): sites meeting criteria 1 through 4, but not meeting at least one of criteria 5 through 7, were classified as target non-sampleable (TNS)

Non-Target (NT): sites not meeting at least one of criteria 1 through 4 were classified as non-target (NT) status and were not sampled

Unknown (U): sites were classified with unknown (U) status and not sampled when it could be reasonably inferred, either via desktop analysis or a field visit, the site was a valid receiving water body and information for any of the seven criteria was unconfirmed

The outcomes of these site evaluations for CCCWP sites for water year 2022 are illustrated in Figure 3.1. Typically, a relatively small fraction of sites evaluated each year are classified as target sampleable sites, but over half of the sites evaluated for 2022 were determined to be target sampleable.

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

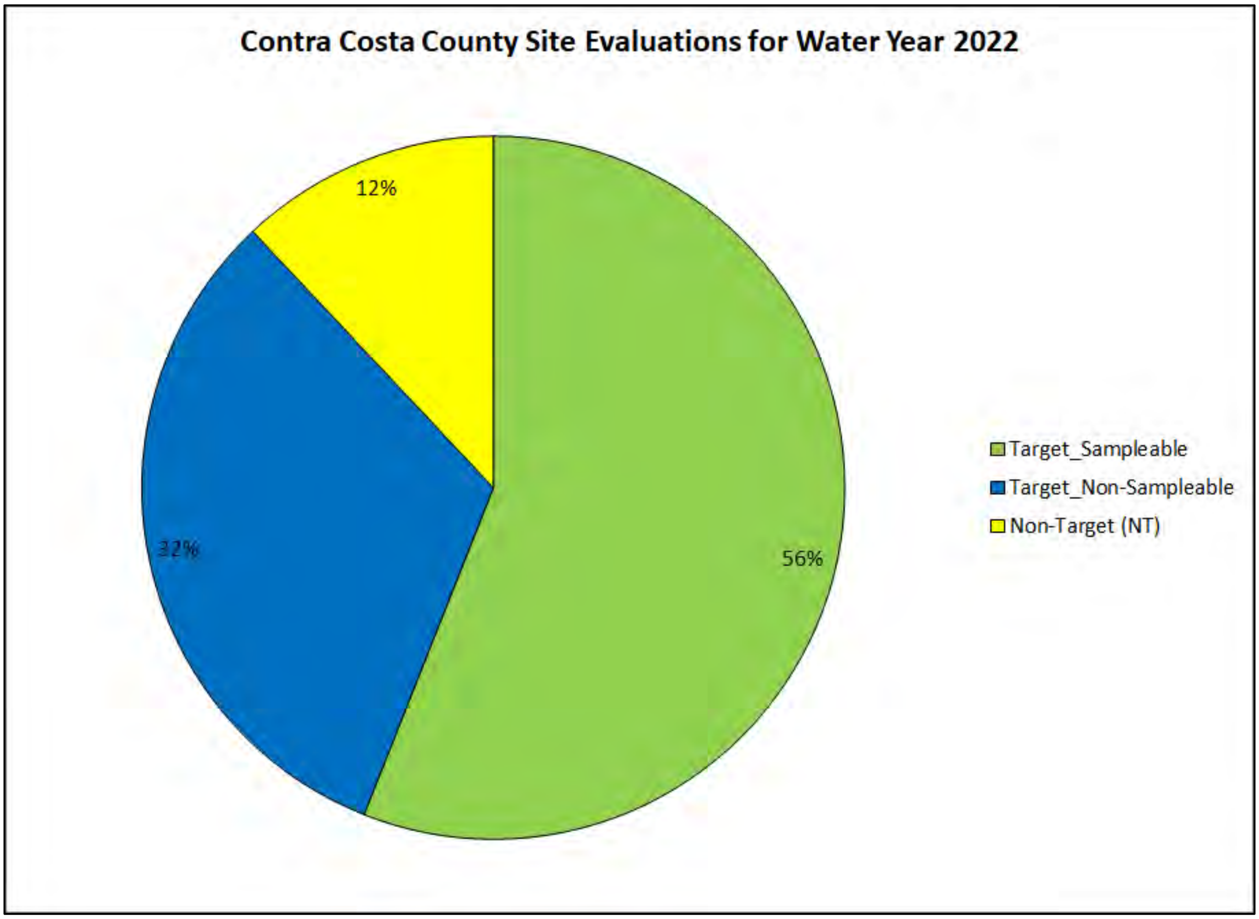

Figure 3.1 Results of CCCWP Site Evaluations for Water Year 2022

During the site evaluation field visits, flow status was recorded as one of five categories:

Wet Flowing: continuously wet or nearly so; flowing water

Wet Trickle: continuously wet or nearly so; very low flow; trickle less than 0.1 L/second

Majority Wet: discontinuously wet; greater than 25% by length of stream bed covered with water; isolated pools

Minority Wet: discontinuously wet; less than 25% of stream bed by length covered with water; isolated pools

No Water: no surface water present

Observations of flow status during pre-wet-weather, fall site reconnaissance events and during post-wet-weather, spring sampling were combined to classify sites as perennial or nonperennial as follows:

Perennial: fall flow status is either Wet Flowing or Wet Trickle, and spring flow is sufficient to sample

Non-Perennial: fall flow status is Majority Wet, Minority Wet, or No Water, and spring flow is sufficient to sample

The probabilistic sites selected for monitoring in water year 2022, following site evaluation, are shown graphically in Figure 3.2 as the bioassessment sites, and are listed with additional site information in Table 3.1. As shown in Table 3.1, one additional site (Las Trampas Creek, site 207R04819) was selected for dry weather water toxicity, sediment toxicity and sediment chemistry testing. Wet weather (stormwater) chemistry and toxicity testing was not conducted in water years 2019-2022, as the relevant MRP 2.0 requirements had previously been met.

Table 3.1 Site Locations, Monitoring Parameters and Dates Sampled at CCCWP Sites from the RMC Probabilistic Monitoring Design in Water Year 2022

Site ID	Creek Name	Land Use	Latitude	Longitude	Bioassessment, PHab, Chlorine, Nutrients	Stormwater Toxicity and Chemistry[1] (Wet Weather)	Water Toxicity and Sediment Toxicity and Chemistry (Dry Weather)
204R03652	West Branch Alamo Creek	U	37.80805	-121.89786	05/16/22		
206R03479	Wildcat Creek	U	37.93098	-121.28738	05/03/22		
206R03584	Rodeo Creek	U	38.0076	-122.22544	05/17/22		
207R02756	San Ramon Creek	U	37.77228	-121.98737	05/04/22		
207R03211	Reliez Creek	U	37.90409	-122.09425	050/2/22		
207R03447	East Branch Grayson Creek	U	37.94974	-122.06763	05/05/22		
207R03639	Walnut Creek	U	37.9965	-122.05472	05/16/22		
207R03659	Grizzly Creek	U	37.86963	-122.09768	05/02/22		
207R03780	Bollinger Canyon Creek	U	37.77108	-121.98964	05/04/22		
544R03529	Marsh Creek	U	37.99622	-121.69563	05/26/22		
207R04819	Las Trampas Creek	U	37.8927	-122.11037			07/12/22

1 Wet weather monitoring was not conducted in water years 2019-22
U urban land use
NU non-urban land use

3.2 Field Sampling and Data Collection Methods

Field data and samples were collected in accordance with existing SWAMP-comparable methods and procedures, as described in the RMC QAPP (BASMAA 2020) and the associated SOPs (BASMAA 2016). The SOPs were developed using a standard format describing health and safety cautions and considerations, relevant training, site selection, and sampling methods/procedures. Sampling methods and procedures include pre-fieldwork mobilization activities to prepare equipment, field collection of samples, and demobilization activities to preserve and transport samples, including procedures to prevent transporting invasive species between creeks. The SOPs relevant to the monitoring discussed in this report are listed in Table 3.2.

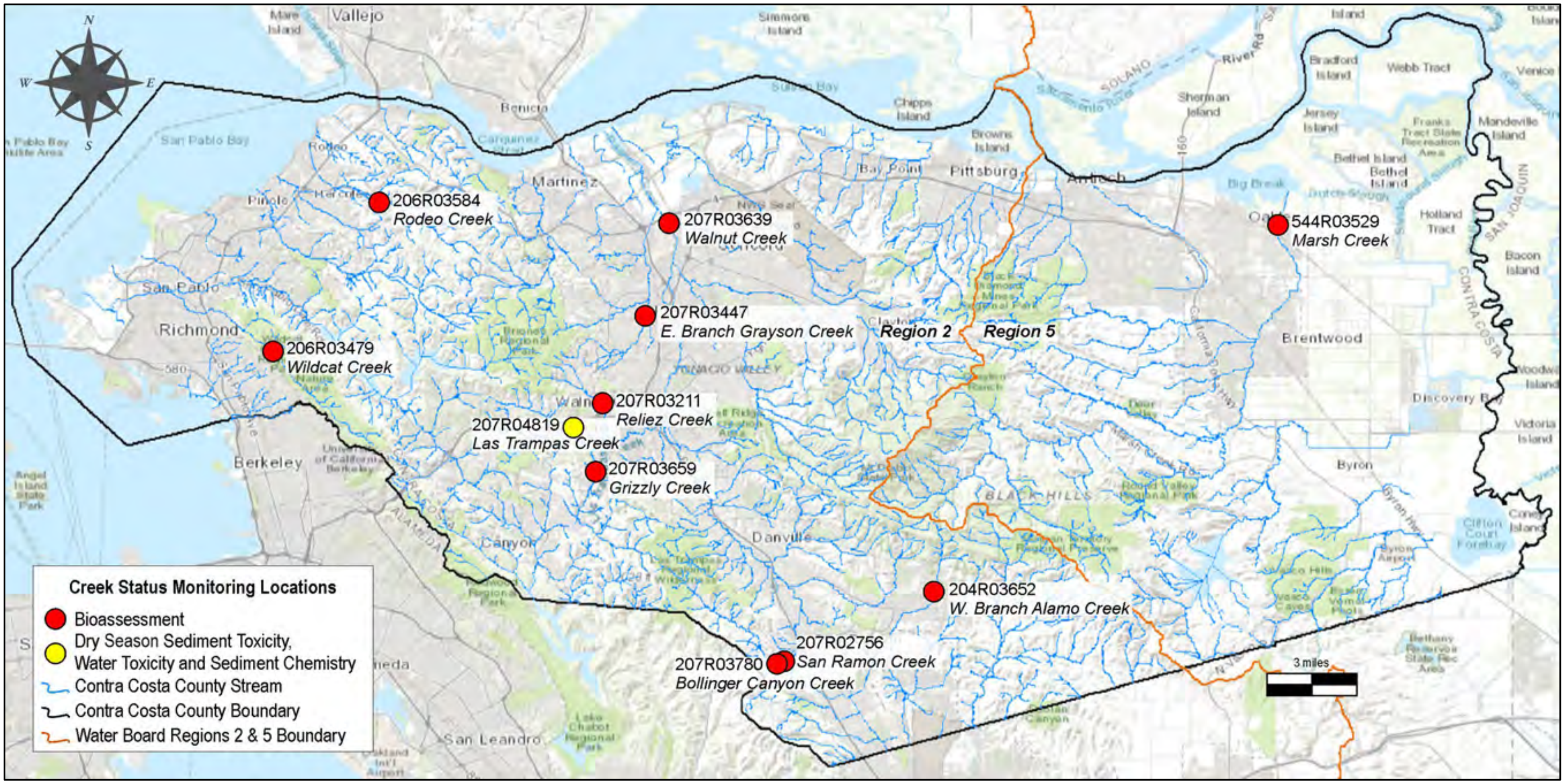

Figure 3.2 Contra Costa County Creek Status Sites Monitored in Water Year 2022

(Note: Bioassessment sites are those selected from the RMC Probabilistic Monitoring Design.)

Table 3.2 RMC Standard Operating Procedures Pertaining to Regional Creek Status Monitoring

SOP	Procedure
FS-1	BMI and algae bioassessments and physical habitat assessments
FS-2	Water quality sampling for chemical analysis, pathogen indicators, and toxicity testing
FS-3	Field measurements, manual
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 data sheets
FS-11	Site and sample naming convention
FS-12	Ambient creek status monitoring site evaluation
FS-13	Quality assurance and quality control (QA/QC) data review

Procedures for sample container size and type, preservative type, and associated holding times for each regional/probabilistic analyte are described in RMC SOP FS-9 (BASMAA 2016). Procedures for completion of field data sheets are provided in RMC SOP FS-10, and procedures for sample bottle labeling are described in RMC SOP FS-11 (BASMAA 2016).

3.2.1 Bioassessments

In accordance with the RMC QAPP (BASMAA 2020), bioassessments were conducted during the spring index period, nominally defined as approximately April 15 to July 15, with a minimum of 30 days after any significant storm (roughly defined as at least 0.5 inch of rainfall within a 24-hour period).

Each bioassessment monitoring site consisted of an approximately 150-meter stream reach divided into 11 equidistant transects placed perpendicular to the direction of flow. The sampling position within each transect alternated between 25, 50 and 75 percent distance of the wetted width of the stream (see SOP FS-1, BASMAA 2016).

3.2.1.1 Benthic Macroinvertebrates (BMI)

BMIs were collected via kick net sampling using the reach-wide benthos method described in RMC SOP FS-1 (BASMAA 2016), based on the SWAMP bioassessment procedures (Ode et al. 2016a and 2016b). Samples were collected from a 1 square foot area approximately 1 meter downstream of each transect. The benthos was disturbed by manually rubbing areas of coarse substrate, followed by disturbing the upper layers of finer substrate to a depth of 4 to 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. Material collected from the 11 subsamples was composited in the field by transferring the entire sample into one to two 1,000 mL wide-mouth jar(s), and the samples were preserved with 95% ethanol.

3.2.1.2 Algae

Filamentous ("soft") algae and diatom samples also were collected at the 10 bioassessment sites using the reach-wide benthos method per SOP FS-1 (BASMAA 2016), based on the SWAMP bioassessment procedures (Ode et al. 2016a and 2016b). Algae samples were collected synoptically with BMI samples. The sampling position within each transect was the same as used for BMI sampling, except algae samples were collected 6 inches upstream of the BMI sampling position and following BMI collection from that location. The algae were collected using a range of methods and equipment, depending on the substrate occurring at the site (e.g., erosional, depositional, large and/or immobile), per RMC SOP FS-1. Erosional substrates included any material (substrate or organics) small enough to be removed from the stream bed but large enough to isolate an area equal to a rubber delimiter (12.6 cm^2 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 11 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 taken from the algae composite sample and combined with 10 mL of 10% formalin into a 50 mL sample tube for taxonomic identification of diatoms.

The algae composite sample also was 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 µm pore size) using a filtering tower apparatus in the field. The AFDM sample was collected using a similar process which employs pre-combusted filters. Both filter samples were placed in Whirl-Pak® bags, covered in aluminum foil, and immediately placed on ice for transport to the analytical laboratory.

3.2.1.3 Physical Habitat (PHab)

PHab assessments were conducted during each BMI bioassessment monitoring event using the SWAMP PHab protocols (Ode et al. 2016a and 2016b) and RMC SOP FS-1 (BASMAA 2016). PHab data were collected at each of the 11 transects and 10 additional inter-transects (located between each main transect) by implementing the “Full” SWAMP level of effort (as prescribed in the MRP). At algae sampling locations, additional assessment of the presence of micro- and macroalgae was conducted during the pebble counts. In addition, water velocities were measured per SWAMP protocols at a single location in the sample reach (when possible).

3.2.2 Physicochemical Measurements

Dissolved oxygen, temperature, conductivity, and pH were measured during bioassessment monitoring using a multi-parameter probe (see SOP FS-3, BASMAA 2016). Dissolved oxygen, specific conductivity, water temperature, and pH measurements were made by submersion of the instrument probe directly into the sample stream. Water quality measurements were taken approximately 0.1 meter below the water surface at locations of the stream appearing to be completely mixed, ideally at the centroid of the stream. Measurements were recorded upstream of sampling personnel and equipment and upstream of areas where bed sediments have been disturbed or prior to such bed disturbance.

3.2.3 Chlorine

Water samples were collected and analyzed for free and total chlorine using CHEMetrics™ test kits (K-2511 for low range and K-2504 for high range). Chlorine measurements in water were conducted during late spring bioassessment monitoring.

3.2.4 Nutrients and Conventional Analytes (Water Chemistry)

Water samples were collected during bioassessment monitoring for nutrient analyses using the standard grab sample collection method, as described in SOP FS-2 (BASMAA 2016). Sample containers were rinsed using ambient water and filled and recapped below the water surface whenever possible. An intermediate container was used to collect water for all sample containers containing preservative added in advance by the laboratory. Sample container size and type, preservative type, and associated holding times for each analyte are described in Table 1 of SOP FS-9 (BASMAA 2016). The syringe filtration method was used to collect samples for analyses of dissolved orthophosphate. All sample containers were labeled and stored on ice for transport to the analytical laboratory, except for analysis of AFDM and chlorophyll-*a* samples, which were field-frozen on dry ice by sampling teams, where appropriate.

3.2.5 Water Toxicity

Samples were collected for water toxicity using the standard grab sample collection method described above, filling the required number of labeled 3.7-liter amber glass bottles with ambient water, putting them on ice to cool to 4° C ± 2° C, and delivered to the laboratory within the required hold time. The laboratory was notified of the impending sample delivery to ensure meeting the 24-hour sample delivery time requirement. Procedures used for sample collection and transport are described in SOP FS-2 (BASMAA 2016).

3.2.6 Sediment Chemistry and Sediment Toxicity

In cases where sediment samples and water samples were collected at the same event, sediment samples were collected after water samples were collected. Before conducting sediment sampling, field personnel surveyed the proposed sampling area to identify appropriate fine-sediment depositional areas and to avoid disturbing possible sediment collection sub-sites. Personnel carefully entered the stream and began 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 aliquoted into separate jars for chemical and toxicological analysis using standard clean sampling techniques (see SOP FS-6, BASMAA 2016). Sample jars were submitted to the respective laboratories per SOP FS-9 (BASMAA 2016).

3.3 Laboratory Analysis Methods

RMC participants agreed to use the same set of analytical laboratories for regional/probabilistic parameters, developed standards for contracting with the labs, and coordinated quality assurance issues. All samples collected by RMC participants sent to laboratories for analysis were analyzed and reported per SWAMP-comparable methods, as described in the RMC QAPP (BASMAA 2020). The following analytical laboratory contractors were used for biological, chemical, and toxicological analysis:

BioAssessment Services, Inc. – BMI taxonomic identification

The laboratory performed taxonomic identification nominally on a minimum of 600 BMI individuals for each sample, per standard taxonomic effort Level 1, as established by the Southwest Association of Freshwater Invertebrate Taxonomists, with additional identification of chironomids to subfamily/tribe level (corresponding to a Level 1a standard taxonomic effort).

EcoAnalysts, Inc. – Algae taxonomic identification

Samples were processed in the laboratory following draft SWAMP protocols to provide count (diatom and soft algae), biovolume (soft algae), and presence (diatom and soft algae) data. Laboratory processing included identification and enumeration of 300 natural units of soft algae and 600 diatom valves to the lowest practical taxonomic level. Diatom and soft algae identifications were not fully harmonized with the California Algae and Diatom Taxonomic Working Group's Master Taxa List, and 12 taxa were not included in the data analysis.

Caltest Analytical Laboratory, Inc. – Water chemistry (nutrients, etc.), sediment chemistry, chlorophyll-a, AFDM

Upon receipt at the laboratory, samples were immediately logged and preserved, as necessary. USEPA-approved testing protocols were then applied for analysis of water and sediment samples.

Pacific EcoRisk, Inc. – Water and sediment toxicity

Testing of water and sediment samples was performed per species-specific protocols published by USEPA.

3.4 Data Analysis – Water Year 2022 Data

Only data collected by CCCWP during water year 2022 for regional/probabilistic parameters are presented and analyzed in this report. This includes data collected during bioassessment monitoring (BMI and algae taxonomy, water chemistry, and physical habitat evaluations at 10 sites), as well as dry weather water and sediment toxicity and sediment chemistry data from one additional site. The bioassessment data are used to evaluate stream conditions, and the associated physical, chemical and toxicity testing data are then analyzed to identify potential stressors which may impact water quality and biological conditions.

Creek status monitoring data generated by CCCWP for local/targeted parameters (not included in the probabilistic design), per MRP 2.0 Provision C.8.d, are reported in Local/Targeted Creek Status Monitoring Report: Water year 2022, found in Appendix 4 of the CCCWP water year 2022 UCMR (Kinnetic 2023).

Under MRP 2.0, creek status monitoring results were subject to potential follow-up actions, per MRP 2.0 Provisions C.8.d and C.8.g, if they meet certain specified threshold triggers, as shown in Table 3.3 for the regional/ probabilistic parameters. If monitoring results met the requirements for follow-up actions as shown in Table 3.3, the results were compiled in a list for consideration as potential stressor/source identification (SSID) projects, per MRP 2.0 Provision C.8.e, and used by RMC programs to help inform the MRP 2.0 SSID project selection process.

As part of the stressor assessment for this report, water and sediment chemistry and toxicity data generated during water year 2022 also were analyzed and evaluated against the relevant threshold triggers to identify potential stressors which might contribute to degraded or diminished biological conditions.

In addition to those threshold triggers for potential MRP 2.0 SSID projects, the results were compared to other regulatory standards, including San Francisco Bay Water Quality Control Plan (Basin Plan) (SFBRWQCB 2019) water quality objectives, where available and applicable.

Table 3.3 Requirements for Follow-up for Regional/Probabilistic Creek Status Monitoring Results Per MRP 2.0 Provisions C.8.d and C.8.g

Constituent	Threshold Trigger Level	MRP Provision	Provision Text
CSCI Score	< 0.795 (plus see Provision text =>)	C.8.d.i.(8)	Sites scoring less than 0.795 per CSCI are appropriate for an MRP 2.0 SSID project, as defined in Provision C.8.e. Such a score indicates a substantially degraded biological community relative to reference conditions. Sites where there is a substantial difference in CSCI score observed at a location relative to upstream or downstream sites are also appropriate for an MRP 2.0 SSID project. If many samples show a degraded biological condition, sites where water quality is most likely to cause and contribute to this degradation may be prioritized by the permittee for an MRP 2.0 SSID project.
Chlorine	> 0.1 mg/L	C.8.d.ii.(4)	The permittees shall immediately resample if the chlorine concentration is greater than 0.1 mg/L. If the resample is still greater than 0.1 mg/L, then permittees shall report the observation to the appropriate permittee central contact point for illicit discharges, so the illicit discharge staff can investigate and abate the associated discharge in accordance with Provision C.5.e (Spill and Dumping Complaint Response Program).
Toxicity	TST "fail" on initial and follow-up sample test; both results have > 50% effect	C.8.g.iv	The permittees shall identify a site as a candidate MRP 2.0 SSID project when analytical results indicate any of the following: (1) a toxicity test of growth, reproduction, or survival of any test organism is reported as "fail" in both the initial sampling, and (2) a second, follow up sampling, and both have ≥ 50% effect. Note: Applies to dry and wet weather, water column and sediment tests.
Pesticides (Water)	> Basin Plan water quality objectives	C.8.g.iv	The permittees shall identify a site as a candidate MRP 2.0 SSID project when analytical results indicate a pollutant is present at a concentration exceeding its water quality objective in the Basin Plan.
Pesticides and Other Pollutants (Sediment)	Result exceeds PEC or TEC (per MacDonald et al., 2000)	C.8.g.iv	The permittees shall identify a site as a candidate MRP 2.0 SSID project when analytical results indicate any of the following: (1) a pollutant is present at a concentration exceeding its water quality objective in the Basin Plan, and (2) for pollutants without water quality objectives, results exceed PEC or TEC.

CSCI California Stream Condition Index
MRP Municipal Regional Permit
PEC probable effects concentrations
SSID stressor/source identification
TEC threshold effects concentrations
TST test of significant toxicity
Notes: Per RMC decision, with Water Board staff concurrence, in accordance with MRP 2.0 Provision C.8.g.iii.(3), this monitoring commenced in water year 2017. Per MRP 2.0 Provision C.8.d. and C.8.g., these are the data thresholds which trigger listings as candidate SSID projects.

3.4.1 Biological Data

The biological condition of each probabilistic site monitored by CCCWP in water year 2022 was evaluated principally through analysis of BMI and algal taxonomic metrics, and calculation of associated index of biological integrity (IBI) scores. An IBI is an analytical tool involving calculation of a site condition score based on a compendium of biological metrics.

3.4.1.1 Benthic Macroinvertebrate (BMI) Data Analysis

Under MRP 2.0, the BMI taxonomic data are evaluated principally through calculation of the California Stream Condition Index (CSCI), a bioassessment index developed by California SWAMP for statewide use, with methods updated in 2020 (Boyle et al. 2020). CSCI scores evaluate stream health based on comparison of metric characteristics of the observed BMI taxonomy (as reported by the lab), versus the expected BMI community characteristics that would, in theory, be present in a reference stream with similar geographic characteristics as the monitored stream, based on a specific set of watershed (GIS) parameters.

The CSCI score is computed as the average of two other indices: O/E, the observed (O) taxonomic diversity at the monitoring site divided by the taxonomic composition expected (E) at a reference site with similar geographical characteristics, and MMI, a multimetric index incorporating several metrics reflective of BMI community attributes (such as measures of assemblage richness, composition, and diversity), as predicted for a site with similar physical characteristics. The six metrics selected for inclusion in the MMI calculations were taxonomic richness, number of shredder taxa, percent clinger taxa, percent Coleoptera taxa, percent EPT (Ephemeroptera, Plecopter, and Trichoptera) taxa, and percent intolerant taxa (Rehn et al. 2015; Rehn 2016).

CSCI scores were calculated using 'R' statistical software (per Boyle et al. 2020). The CSCI is calculated from empirical data organized into two input files: the "stations" data, derived from the GIS characteristics associated with each monitoring site, and "bugs" data, the taxonomic data derived from laboratory analysis of the BMI samples.

CSCI scores run from a minimum of 0 (indicating no correspondence to modeled reference site conditions) to a maximum of 1 (perfect correspondence with modeled reference site conditions). A CSCI score below 0.795 indicates biological degradation and a potential candidate site for an MRP 2.0 SSID project. This index produces conservative values relative to urban creeks.

The various taxonomic metrics derived from the BMI taxonomic data, as produced by Tom King of Bioassessment Services, also are presented in this report. For consistency and comparison with the water year 2012 regional UCMR (BASMAA, 2013), subsequent urban creeks monitoring reports, and other RMC programs, the Southern California Benthic Index of Biological Integrity (B-IBI) score (per Ode et al., 2005) is also computed and presented in this report.

3.4.1.2 Algae Data Analysis

Algae taxonomic data can be evaluated through a variety of metrics and indices. MRP 2.0 did not specify analytical metrics or threshold trigger levels for algae data.

In accordance with general practice among Bay Area municipal stormwater programs, algal biological stream condition is assessed for this report via a set of algal indices developed for statewide use by California SWAMP. Algal Stream Condition Index (ASCI) multi-metric indices (MMIs) were developed for diatoms, soft algae, and a diatom/soft algae hybrid, for use in assessing biological integrity in wadable streams in California per methods published in Boyle et al. (2020). These statewide ASCI MMIs are expected to be more robust across a wider range of environmental conditions than the former standard algal indices of biotic integrity (A-IBIs).

As with the CSCI score calculations, ASCI scores are computed using the watershed characteristics of each monitored site, and comparisons of the observed algal taxonomic characteristics to those which may be expected from healthy sites with similar watershed characteristics. The ASCI MMIs are calculated from empirical data organized into two input files: the "stations" data, derived from the GIS characteristics associated with each monitoring site, and "algae_tax" data, the taxonomic data derived from laboratory analysis of the algae samples.

The watersheds were delineated using the Watershed Conversion Tool (Geographic Information Center) and NHD Basin Delineator (Boyle et al. 2020). Delineations were checked against catchment borders and topography for accuracy using ArcGIS. Based on input from Kinnetic Environmental staff, adjustments were made to sites 207R03780 and 544R03529. GIS metrics were calculated using the Indices Processor toolbox version 4.7.2 (Boyle et al. 2020).

ASCI scores and output were calculated using ASCI R scripts version 2.5.2 (Boyle et al. 2020). ASCI score categories were applied to diatom (D_ASCI) and hybrid (H_ASCI) results as defined in Theroux et al. (2020). The soft algae (S_ASCI) output is not recommended for use at this time since it did not perform well in development (per S. Theroux and R. Mazor, SCCWRP, as reported by Marco Sigala, personal communication, 2022). H_ASCI includes soft algae and diatom data and performed as well or slightly less than D_ASCI. However, D_ASCI is likely to be the most frequently reported index statewide and is the preferred index for assessment (Marco Sigala, personal communication, 2022).

3.4.1.3 Biological Condition Categories

During development of the CSCI and ASCI indices, the developers divided the range of possible scores for each index into categories representing the relative likelihood that the biota observed at monitored sites were intact or altered, when compared to conditions prevailing in similar creeks under unimpacted conditions (Rehn et al. 2015; Theroux et al. 2020). Those condition categories are defined in Table 3.4 for the CSCI and the three ASCI MMIs.

Table 3.4 CSCI and ASCI Multimetric Scoring Ranges by Condition Category

	Likely Intact	Possibly Altered	Likely Altered	Very Likely Altered
B-IBI (BMI) Index				
CSCI	≥ 0.92	≥ 0.79 and < 0.92	≥ 0.63 and < 0.79	< 0.63
ASCI (Algae) Indices				
Diatom MMI	≥ 0.94	≥ 0.86 and < 0.94	≥ 0.76 and < 0.86	< 0.76
Soft Algae MMI	≥ 0.86	≥ 0.65 and < 0.86	≥ 0.38 and < 0.65	< 0.38
Hybrid MMI	≥ 0.94	≥ 0.86 and < 0.94	≥ 0.76 and < 0.86	< 0.76

3.4.2 Physical Habitat (PHab) Condition

The MRP does not define analytical metrics or threshold trigger levels for interpretation of PHab data. PHab condition was assessed for the CCCWP bioassessment monitoring sites principally using the Index of Physical Habitat Integrity (IPI), a multimetric index developed by California SWAMP to characterize physical habitat condition for streams in California (Rehn et al. 2018a). The IPI is based on the concept that physical habitat characteristics have a profound effect on stream health, and that high-quality physical habitat is essential for maintaining beneficial uses. Interim instructions for calculating IPI using GIS and the analytical software platform “R” were published by SWAMP in 2018 (Rehn et al. 2018b) and updated in 2020 (Boyle et al. 2020).

During method development, the IPI model was calibrated such that:

- the mean score of reference sites is 1
- scores near 0 indicate substantial departure from reference condition and serious degradation of physical condition

- scores greater than 1 indicate greater physical complexity than predicted for a site, given its natural environmental setting

IPI scores were calculated for the water year 2022 CCCWP bioassessment sites according to SWAMP IPI protocols (Rehn et al. 2018b) using 'R' statistical software (per Boyle et al. 2020). As with the CSCI and ASCI, the IPI is calculated from empirical data organized into two input files: the "stations" data, derived from the GIS characteristics associated with each monitoring site, and "PHab" data, which include about a dozen physical habitat characteristics derived from metrics present in the bioassessment EDD produced from the bioassessment fieldwork.

The SWAMP IPI protocols provide guidance on IPI score condition categories that can be used in interpretation of the calculated IPI scores, based on the 30th, 10th, and 1st percentiles of IPI scores at reference sites (Rehn et al. 2018a). The IPI scoring ranges so derived fall into four categories of physical condition, as follows:

- IPI $\geq$ 0.94 = likely intact condition
- IPI $\geq$ 0.84 and < 0.94 = possibly altered condition
- IPI $\geq$ 0.71 and < 0.84 = likely altered condition
- IPI < 0.71 = very likely altered condition

The IPI scores computed from the water year 2022 PHab data are assigned to condition categories according to these ranges.

3.4.3 Water and Sediment Chemistry and Toxicity

As part of the stressor assessment for this report, water and sediment chemistry and toxicity data generated during water year 2022 were analyzed and evaluated to identify potential stressors that may contribute to degraded or diminished biological conditions. Results were evaluated in relation to MRP threshold triggers, and water chemistry results were evaluated with respect to applicable water quality objectives, where feasible.

For sediment chemistry trigger criteria, comparisons to threshold effects concentrations (TECs) and probable effects concentrations (PECs) are calculated as defined in MacDonald et al. (2000), as specified in the MRP. For each constituent for which there is a published TEC or PEC value, the ratio of the measured concentration to the respective TEC or PEC value was computed as the TEC or PEC quotient, respectively. All results where a TEC quotient was equal to or greater than 1.0 were identified. For each site, the mean PEC quotient was then computed, and any sites where mean PEC quotient was equal to or greater than 0.5 were identified.

Toxic unit (TU) equivalents also were computed for pyrethroid pesticides in sediment, based on available literature LC_{50} values (LC_{50} is the concentration of a chemical which is lethal on average to 50% of test organisms). Because organic carbon mitigates the toxicity of pyrethroid pesticides in sediments, the LC_{50} values were derived based on organic carbon-normalized pyrethroid concentrations. Therefore, the RMC pyrethroid concentrations reported by the lab also were divided by the measured total organic compound (TOC) concentration at each site (as a percentage), and the TOC-normalized concentrations were then used to compute TU equivalents for each pyrethroid. For each site, the TU equivalents for the individual pyrethroids were summed, and sites where the summed TU equivalents were equal to or greater than 1.0 were identified.

3.5 Quality Assurance/Quality Control (QA/QC)

The RMC established a set of guidance and tools to help ensure data quality and consistency. Key BASMAA functions are now coordinated through BASMC, and the RMC QAPP (BASMAA 2020) and SOPs (BASMAA 2016) are still considered to be the applicable references for implementation of monitoring required by the MRP.

Data quality assurance and quality control (QA/QC) procedures are described in detail in the BASMAA RMC QAPP (BASMAA 2020) and in RMC SOP FS13, QA/QC Data Review (BASMAA 2016).

Data quality objectives were established to ensure the data collected are of sufficient quality for the intended use. Data quality objectives include both quantitative and qualitative assessment of the acceptability of data. The qualitative goals include representativeness and comparability. The quantitative goals include completeness, sensitivity (detection and quantitation limits), precision, accuracy, and contamination. To ensure consistent and comparable field techniques, pre-monitoring field training and *in situ* field assessments were conducted.

Data were collected per the procedures described in the relevant SOPs (BASMAA 2016), 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.

All data were thoroughly reviewed by the programs responsible for collecting them. Data were checked for conformance with QAPP requirements and field procedures were reviewed for compliance with the methods specified in the relevant SOPs. Data review was performed per protocols defined in RMC SOP FS13, QA/QC Data Review (BASMAA 2016). Data quality was assessed and qualifiers were assigned as necessary, in accordance with SWAMP requirements.

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4 Results and Discussion

4.1 Statement of Data Quality

A comprehensive QA/QC program was implemented by CCCWP, following protocols as required by the MRP and as defined in the RMC QAPP (BASMAA 2020) and SOPs (BASMAA 2016), covering all aspects of the regional/probabilistic monitoring. In general, QA/QC procedures were implemented as specified in the RMC QAPP (BASMAA 2020), and monitoring was performed per protocols specified in the RMC SOPs (BASMAA 2016) and in conformity with SWAMP protocols. QA/QC issues noted by the laboratories and/or field crews are summarized below.

4.1.1 Bioassessment

Taxonomic procedures for BMI identification and enumeration included components identified in the RMC QAPP (BASMAA 2020):

- Minimum 600 organism subsample when possible
- Sorting measurement quality objective: a check of remnants for organisms missed by original subsampler
- Interlaboratory quality control: submission of 10% of processed samples (one sample for this project) to an independent lab for review of taxonomic accuracy/precision and conformance to standard taxonomic level

All water year 2022 samples met the minimum sample count threshold of 600 individuals specified in the QAPP for benthic invertebrates. Seven of the 10 algae samples met the 600-count threshold for diatom valve counts, with three samples having counts between 595 and 596.

An interlaboratory quality control review was completed for BMI taxonomy on one CCCWP sample. The consulting laboratory reported finding one taxonomic discrepancy and no counting errors. The taxonomic discrepancy involved tagalongs, which are not considered taxonomic errors. SWAMP bioassessment measurement quality objectives (MQOs) all were well below the threshold error rates.

Field duplicate samples were collected at Walnut Creek (site 207R03403) and each sample was analyzed separately for BMI taxonomy and algal taxonomy, with subsequent calculation of taxonomic metrics. Analysis of the comparative results from the field duplicate samples produced the following:

- The average relative percent difference (RPD) between the duplicate samples for 30 individual BMI taxonomic metrics is 17%; most of the RPDs (25 of 30) are <25%
- The RPD for the CSCI scores computed from this duplicate data set is 3%
- The RPD computed for the three ASCI scores is 4% for the diatoms MMI, 10% for the hybrid MMI, and 0% for the soft algae MMI

The RPD results for the BMI, CSCI and ASCI metrics overall are considered to represent an acceptable level of variation between duplicate sets of taxonomic data.

In the course of performing the data analysis for computation of the ASCI multimetric indices, three algae taxonomic classifications ("FinalIDs" in the CEDEN database format) were found to not match the current ASCI Standard Taxonomic Effort (STE) list, and were labeled as Unrecognized Taxa. These taxa were not included in the ASCI calculations (Marco Sigala, personal communication, 2022).

The presence of the New Zealand mudsnail (*Potamopyrgus antipodarum*), a non-native invasive species, was identified at five of the 10 bioassessment sites, most notably at Reliez Creek (site code 207R03211), with 20.5% mudsnail by count; see results in Table 4.2, below. The presence of this invasive species, especially at sites where it was found in very high numbers, is a confounding factor in the stressor analysis, as presented below.

4.1.2 Water Chemistry

Field duplicate samples were collected for water quality analysis as part of the bioassessment field work from Wildcat Creek (site 206R03479) on May 3, 2022. The average RPD between the duplicate samples for 10 water quality analytes is 14%, which is generally acceptable from a quality assurance standpoint.

For eight of the 10 analytical constituents, the field duplicate RPD is less than 15%, conforming with the relevant measurement quality objective (RPD <25%) specified in the RMC QAPP (BASMAA 2020). For Ash-free Dry Mass (AFDM_Algae), the calculated RPD (28%) slightly exceeds the MQO, but for Total Kjeldahl Nitrogen (TKN) the RPD is 67%, substantially higher than the MQO.

Caltest reported a slightly high percent recovery quality control result for a lab control standard (LCS) sample for AFDM (121% vs. Caltest limits of 80-120%), but the other QC sample results were within acceptable ranges for AFDM, including the LCS duplicate result for the same LCS sample.

Due to prior issues with duplicate sample RPDs for AFDM and Chlorophyll, additional duplicate samples were analyzed for those two constituents, with RPDs calculated for the three duplicate pairs as follows:

	206R03479	**204R03652**	**207R03447**
AFDM_Algae	28.0%	14.6%	27.0%
Chlorophyll a	11.8%	4.4%	7.1%

These results are less than or close to the 25% RPD MQO for field duplicate samples. Based on the acceptability of other quality control results, the AFDM data are considered to be of acceptable quality.

There were no lab qualifiers reported for TKN. The matrix spike (MS) and MS duplicate (MSD) percent recovery results for ammonia (143% and 145%) were higher than the acceptable range (80-120%), indicating possible matrix interference in the sample. Ammonia is a component of TKN, so it is possible that matrix interference is a factor in the high RPD observed in the TKN field duplicate samples. These field duplicate results also may imply some variation in field sample collection that may have caused elevated RPDs in the affected samples.

In prior years there were occasional instances of analytical anomalies involving ammonia and TKN. In coordination with CCCWP, during water year 2021 Caltest investigated this issue to compare analytical results for ammonia samples using both the previously standard distillation method (SM 4500-NH_3 B, C-11) and the newer low-level method (SM 4500-NH_3 G-11), which has been employed in recent years to achieve the lower ammonia analytical MDL required by the MRP. Some laboratory testing of water quality samples using the low-level method previously had resulted in ammonia concentrations greater than corresponding TKN concentrations, which is technically impossible because TKN is defined analytically as the sum of ammonia and organic nitrogen.

Having determined that the low-level ammonia method (SM 4500-NH_3 G-11) generally provides more accurate and reliable results at the typically low concentrations of ammonia found in Contra Costa County creeks, this method was used for analysis of the water year 2022 samples. For all 10 samples TKN concentration was greater than ammonia, indicating that this issue appears to have been resolved.

Caltest also reported that percent recovery was not calculated for a silica matrix spike sample, due to the high concentration in the original sample; this is considered to be a minor issue.

Free and total chlorine were measured in the field using CHEMetrics™ test kits during bioassessment monitoring. Only one water year 2022 water sample (Rodeo Creek, site 206R03584) produced a measurable level of free or total chlorine, at 0.1 mg/L (free) and 0.04 mg/L (total). The mandatory retest showed 0.08 mg/L (free) and 0.04 mg/L (total). These results are incongruous, as free chlorine cannot exceed total chlorine. This is an issue that also has arisen in the past, without explanation.

4.1.3 Sediment Chemistry

The CCCWP sediment sample was collected from Las Trampas Creek (site 207R04819) on July 12, 2022. This sample was not selected by the laboratory (Caltest) for the batch matrix spike/matrix spike duplicate quality control sample; the matrix spike/matrix spike duplicate (MS/MSD) analyses were performed on other samples in their respective analytical batches.

Caltest reported that batch MS and MSD percent recovery results for permethrin (152% and 165%) were slightly higher than the acceptable range (50-150%), indicating possible matrix interference in the sample.

The MS percent recovery result for chromium (129%) also was above the acceptable range (75-125%); however, the percent recovery for the MSD sample (123%) was within the acceptable range.

For both chromium and permethrin, the QC results are considered acceptable, based on LCS and other internal lab results.

A set of field duplicate sediment samples were collected by RMC participant program SMCWPPP, also on July 12, 2022, and analyzed for the same suite of sediment analytical constituents. RPDs calculated for the field duplicate samples were within acceptable ranges for all constituents except total organic carbon (TOC), for which the calculated RPD of 28% was slightly above the acceptable level (25%), and pebbles (small, 4 to <8 mm) with RPD = 50%. These results are not considered to affect the validity or reliability of the CCCWP sediment sample analysis.

Otherwise, no significant quality control issues were reported for the sediment sample analyses.

4.1.4 Sediment Toxicity

For the sediment sample collected from Las Trampas Creek (site 207R04819) on July 12, 2022, the *Chironomus* and *Hyalella* tests were initiated within the required holding times. No significant quality control issues were noted by the laboratory.

4.1.5 Water Toxicity

No significant quality control issues were reported in the laboratory toxicity testing of the water sample collected from Las Trampas Creek (site 207R04819) on July 12, 2022. The water toxicity tests were initiated within required holding times. Pathogen-related mortality was not observed in any sample replicates tested for water year 2022.

4.2 Biological Condition Assessment

Biological condition assessment addresses the RMC's core management question: what is the condition of aquatic life in creeks in the RMC area and are aquatic life beneficial uses supported? The designated beneficial uses listed in the San Francisco Bay Region Basin Plan (SFBRWQCB 2019) for RMC creeks monitored by CCCWP for bioassessment in water year 2022 are shown in Table 4.1.

The BASMAA Five-Year Bioassessment Report (BASMAA 2019) provides additional analysis of bioassessment data to assess benthic community health at the countywide program and regional levels, and includes comparisons between urban and non-urban land use sites.

Additionally, for the comprehensive, multi-year analysis required for the 2020 Integrated Monitoring Report (Armand Ruby Consulting, 2020), the accumulated CCCWP data from water years 2012-2019 were used to develop a statistically representative dataset to address management questions related to condition of aquatic life for the RMC region.

Table 4.1 Designated Beneficial Uses Listed in the San Francisco Bay Region Basin Plan for CCCWP Bioassessment Sites Monitored in Water Year 2022

Site Code	Creek Name	Human Consumptive Uses							Aquatic Life Uses									Recreational Uses		
		AGR	MUN	FRSH	GWR	IND	PROC	COMM	SHELL	COLD	EST	MAR	MIGR	RARE	SPWN	WARM	WILD	REC-1	REC-2	NAV
204R03652	West Branch Alamo Creek				E					P			E	E	E	E	E	E	E	
206R03479	Wildcat Creek			E						E			E	E	E	E	E	E	E	
206R03584	Rodeo Creek									E					E	E	E	E	E	
207R02756	San Ramon Creek															E	E	E	E	
207R03211	Reliez Creek									E				E		E	E	E	E	
207R03447	East Branch Grayson Creek									E			E	E		E	E	E	E	
207R03639	Walnut Creek									E			E	E	E	E	E	E	E	
207R03659	Grizzly Creek									E				E		E	E	E	E	
207R03780	Bollinger Canyon Creek									E					E	E	E	E	E	
544R03529	Marsh Creek							E						E		E	E	P	P	

E existing beneficial use

P potential beneficial use

Note: Per Basin Plan Ch. 2 (SFBRWQCB 2019), beneficial uses for freshwater creeks include municipal and domestic supply (MUN), agricultural supply (AGR), industrial process supply (PRO), groundwater recharge (GWR), water contact recreation (REC1), noncontact water recreation (REC2), wildlife habitat (WILD), cold freshwater habitat (COLD), warm freshwater habitat (WARM), fish migration (MIGR), and fish spawning (SPWN). The San Francisco Bay Estuary supports estuarine habitat (EST), industrial service supply (IND), and navigation (NAV) in addition to all the uses supported by streams. Coastal waters' beneficial uses include water contact recreation (REC1); noncontact water recreation (REC2); industrial service supply (IND); navigation (NAV); marine habitat (MAR); shellfish harvesting (SHELL); ocean, commercial and sport fishing (COMM); and preservation of rare and endangered species (RARE). Where creek is not named in Basin Plan, designated uses for nearest named downstream tributary are shown above.

4.2.1 Benthic Macroinvertebrate (BMI) Metrics

Detailed BMI taxonomic metrics are shown in Table 4.2 for the CCCWP creek status sites monitored in the spring index period of water year 2022. For consistency with the 2012 regional UCMR (BASMAA 2013), subsequent CCCWP urban creeks monitoring reports, and other RMC programs, the SoCal B-IBI score is computed from the BMI taxonomic data and included in the results shown in Table 4.2, but then is not included further in the condition assessment analysis in this report. The principal metric used by Bay Area municipal stormwater programs to evaluate benthic biotic community health is the CSCI score.

CSCI scores were computed from the BMI taxonomy data and site-specific watershed characteristics for each bioassessment monitoring site. CSCI scores run from a minimum of 0 (indicating no correspondence to modeled reference site conditions) to a maximum of 1 (perfect correspondence with modeled reference site conditions). Per the interpretive specifications included in MRP 2.0, a CSCI score of less than 0.795 is degraded.

The essential results of the CSCI calculations are presented in Table 4.3. Every CCCWP bioassessment site monitored in water year 2022 produced a CSCI score below the MRP 2.0 threshold of 0.795, indicating a degraded biological community relative to reference conditions.

The water year 2022 CSCI scores range from a low of 0.324 at Grizzly Creek (site 207R03659; tributary to Las Trampas Creek) to a high of 0.648 at Wildcat Creek (site 206R03479), as shown in Table 4.3. Using the state's biological condition status categories, only the Wildcat Creek result would be characterized as Likely Altered, while the other nine CSCI scores would fall into the Very Likely Altered category (per score ranges shown in Table 3.4).

The invasive New Zealand Mudsnail (NZMS) was found in five of the 10 benthic samples. The relevant results are shown in Table 4.2. The highest numbers of this invasive snail species (20.5% of the sample organism count) were recorded at Reliez Creek (site code 207R03211).

Table 4.2 Benthic Macroinvertebrate Metrics for CCCWP Bioassessment Sites Monitored in Water Year 2022

BMI Metrics for CCCWP Bioassessment Sites, Spring 2022										
Creek Name:	WB Alamo	Wildcat	Rodeo	San Ramon	Reliez	EB Grayson	Walnut	Grizzly	Bollinger Canyon	Marsh
Site Code:	204R03652	206R03479	206R03584	207R02756	207R03211	207R03447	207R03639	207R03659	207R03780	544R03529
Richness										
Taxonomic	20	22	23	11	13	14	24	18	17	15
EPT	1	7	0	1	1	2	3	1	4	1
Ephemeroptera	1	3	0	1	1	1	3	1	3	0
Plecoptera	0	2	0	0	0	0	0	0	0	0
Trichoptera	0	2	0	0	0	1	0	0	1	1
Coleoptera	0	4	2	2	0	0	0	0	2	0
Predator	7	9	10	4	3	2	7	7	3	2
Diptera	9	8	11	4	7	7	5	8	6	4
Composition										
EPT Index (%)	1.8	23	0.0	30	13	1.7	0.5	20	33	2.9
Sensitive EPT Index (%)	0.0	4.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Shannon Diversity	2.04	1.77	2.09	1.67	1.57	1.78	2.29	1.82	1.69	2.38
Dominant Taxon (%)	34	47	32	30	46	31	26	32	32	20
Non-insect Taxa (%)	40	14	35	27	38	36	50	39	29	60
Tolerance										
Tolerance Value	6.5	5.4	6.4	5.4	6.2	5.9	5.9	5.6	5.5	6.7
Intolerant Organisms (%)	0.0	5.3	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Intolerant Taxa (%)	0.0	27	8.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tolerant Organisms (%)	38	1.5	24	1.2	21	10	15	5.4	1.1	38
Tolerant Taxa (%)	25	4.5	26	18	31	21	42	28	29	40
Functional Feeding Groups										
Collector-Gatherers (%)	73	45	86	75	32	65	72	61	68	68
Collector-Filterers (%)	16	47	0.8	23	47	27	11	32	29	2.4
Collectors (%)	4.3	0.3	1.9	1.0	21	5.0	5.7	5.0	0.7	24
Scrapers (%)	5.3	5.4	12	0.8	0.7	0.5	11	1.8	1.6	2.8
Predators (%)	0.3	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 4.2 Benthic Macroinvertebrate Metrics for CCCWP Bioassessment Sites Monitored in Water Year 2022

BMI Metrics for CCCWP Bioassessment Sites, Spring 2022										
Creek Name:	WB Alamo	Wildcat	Rodeo	San Ramon	Reliez	EB Grayson	Walnut	Grizzly	Bollinger Canyon	Marsh
Site Code:	204R03652	206R03479	206R03584	207R02756	207R03211	207R03447	207R03639	207R03659	207R03780	544R03529
Shredders (%)	0.2	0.0	0.0	0.5	0.0	1.7	0.0	0.2	0.3	2.9
Other (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Estimated Abundance										
Composite Sample (11 ft^2)	3,619	14,544	2,592	6,475	2,947	11,360	1,462	3,232	5,577	5,632
#/ft^2	329	1,322	236	589	268	1,033	133	294	507	512
#/m^2	3,514	14,120	2,517	6,286	2,861	11,029	1,419	3,138	5,415	5,468
Supplemental Metrics										
Non-Gastropoda Scrapers (%)	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0
Shredder Taxa (%)	5.0	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Diptera Taxa[a]	6	5	7	3	4	3	2	5	3	1
IBI Scores										
SoCal IBI Score	17	54	30	23	14	14	13	14	20	10
New Zealand Mudsnail Abundance										
NZMS Individuals	0	0	0	6	126	0	14	29	0	81
% NZMS	0.0	0.0	0.0	1.0	20.5	0.0	2.3	4.8	0.0	13.1

a Calculated based on Chironomids identified to family level

Notes: Metrics are calculated from standard classifications, based on level I standard taxonomic effort, except Chironomids, which are identified to subfamily/ tribe.
Standard taxonomic effort source: Southwest Association of Freshwater Invertebrate Taxonomists (http://www.waterboards.ca.gov/swamp/docs/safit/ste_list.pdf)

Table 4.3 Results of CSCI Calculations for Water Year 2022 CCCWP Bioassessment Sites

Site Code	Creek Name	Sample Date	BMI Count	O/E	MMI	CSCI
204R03652	West Branch Alamo Creek	05/16/22	622	0.569	0.137	0.353
206R03479	Wildcat Creek	05/03/22	606	0.671	0.625	0.648
206R03584	Rodeo Creek	05/17/22	648	0.432	0.244	0.338
207R02756	San Ramon Creek	05/04/22	607	0.385	0.385	0.385
207R03211	Reliez Creek	05/02/22	614	0.530	0.189	0.359
207R03447	East Branch Grayson Creek	05/05/22	639	0.526	0.360	0.443
207R03639	Walnut Creek	05/16/22	609	0.491	0.222	0.357
207R03659	Grizzly Creek	05/02/22	608	0.518	0.130	0.324
207R03780	Bollinger Canyon Creek	05/04/22	610	0.502	0.502	0.502
544R03529	Marsh Creek	05/26/22	616	0.445	0.328	0.387

Note: CSCI scores less than 0.795 indicate a substantially degraded biological community relative to reference conditions, and such sites are candidates for MRP 2.0 SSID projects.

4.2.2 Algae Metrics

CCCWP sampled soft algae and diatoms at 10 sites during bioassessment monitoring in May 2022, following the SWAMP Reach-Wide Benthos collection method (Ode et al. 2016a and 2016b). Samples were processed in the laboratory by EcoAnalysts following SWAMP protocols (Stancheva et al. 2015) to provide count (diatom and soft algae), biovolume (soft algae), and “presence” (diatom and soft algae) data. Three taxonomic classifications (“FinalIDs” in the CEDEN database format) did not match the current ASCI STE list; these organisms were labeled as Unrecognized Taxa and were not included in the ASCI calculations.

ASCI MMI Scores

Following the SWAMP ASCI computational protocols (Boyle et al. 2020) (see Section 3.4.1.2, above), diatom, soft algae, and hybrid MMIs were calculated for the water year 2022 CCCWP bioassessment sites; the results for the diatoms and hybrid MMI scores are shown in Table 4.4. Because of questions regarding the reliability of the soft algae MMI (Marco Sigala, personal communication, 2022), only the diatoms MMI and hybrid MMI scores are reported here.

The ASCI MMI scores for the water year 2022 samples were assigned to condition categories as described above (see Table 3.4); these results also are shown in Table 4.4.

Reliez Creek (site 207R03211, tributary to Las Trampas Creek) produced the highest score for the hybrid MMI (0.96; the only 2022 ASCI score which is in the Likely Intact status category) and second highest score for the diatoms MMI (0.86; Likely Altered category).

The West Branch Alamo Creek (site 204R03652) produced the highest score for the diatoms MMI (0.87) and second highest score for the hybrid MMI (0.87); these were the only 2022 ASCI scores which fell into the Possibly Altered status category. The nine other sites scored as Likely Altered or Very Likely Altered for both the diatoms and hybrid indices.

Table 4.4 ASCI MMI Scores for Water Year 2022 CCCWP Bioassessment Sites

Site Code	Creek Name	Sample Date	Diatoms MMI	Diatoms Status	Hybrid MMI	Hybrid Status
204R03652	West Branch Alamo Creek	05/16/22	0.87	Possibly Altered	0.87	Possibly Altered
206R03479	Wildcat Creek	05/03/22	0.85	Likely Altered	0.75	Very Likely Altered
206R03584	Rodeo Creek	05/17/22	0.55	Very Likely Altered	0.46	Very Likely Altered
207R02756	San Ramon Creek	05/04/22	0.65	Very Likely Altered	0.79	Likely Altered
207R03211	Reliez Creek	05/02/22	0.86	Likely Altered	0.96	Likely Intact
207R03447	East Branch Grayson Creek	05/05/22	0.44	Very Likely Altered	0.42	Very Likely Altered
207R03639	Walnut Creek	05/16/22	0.46	Very Likely Altered	0.45	Very Likely Altered
207R03659	Grizzly Creek	05/02/22	0.79	Likely Altered	0.82	Likely Altered
207R03780	Bollinger Canyon Creek	05/04/22	0.55	Very Likely Altered	0.65	Very Likely Altered
544R03529	Marsh Creek	05/26/22	0.46	Very Likely Altered	0.62	Very Likely Altered

4.3 Stressor Assessment

This section addresses the question: what are the major stressors to aquatic life in the RMC area? The biological, physical, chemical, and toxicity testing data produced by CCCWP during water year 2022 were compiled, evaluated, and analyzed against the threshold trigger criteria shown in Table 3.3. When the data analysis indicated the associated trigger criteria were exceeded, those sites and results were identified as potentially warranting further investigation.

When interpreting analytical chemistry results, it is important to account for laboratory data reported as either below method detection limits or between detection and reporting limits. Dealing with data in this range of the analytical spectrum introduces some level of uncertainty, especially when attempting to generate summary statistics for a dataset. In the following compilation of statistics for analytical chemistry, in some cases non-detect data (ND) were substituted with a concentration equal to half of the respective MDL, as reported by the laboratory.

4.3.1 Physical Habitat (PHab) Parameters

Field crews recorded an array of physical habitat characteristics on the SWAMP field data sheets during bioassessment monitoring at the 10 CCCWP bioassessment sites in water year 2022. These field-measured parameters, along with an array of watershed parameters generated through GIS analysis, were used to compute IPI scores, following SWAMP protocols (Boyle et al. 2020).

The IPI scores calculated from the PHab data compiled during bioassessment monitoring conducted in spring 2022 are shown in Table 4.5. Seven sites are rated as Likely Intact, one is ranked as Possibly Altered, one is ranked as Likely Altered, and one is ranked as Very Likely Altered.

Given that the water year 2022 CSCI scores indicate “degraded” benthic macroinvertebrate communities at all sites, and the ASCI MMI scores in most cases indicate Likely Altered or Very Likely Altered algal communities relative to reference conditions, physical habitat does not appear to be a principal stressor for those biological communities, as represented by the predominance of “Likely Intact” IPI scores.

The influence of physical habitat as a potential stressor on biological community health may be complicated by the occurrence of the New Zealand Mudsnail, as discussed further below.

Table 4.5 Index of Physical Habitat Integrity (IPI) Scores for CCCWP Bioassessment Sites Monitored in Water Year 2021

Site Code	Creek Name	Sample Date	IPI Score	IPI Category
204R03652	West Branch Alamo Creek	05/16/22	1.06	Likely Intact
206R03479	Wildcat Creek	05/03/22	1.07	Likely Intact
206R03584	Rodeo Creek	05/17/22	0.85	Possibly Altered
207R02756	San Ramon Creek	05/04/22	1.03	Likely Intact
207R03211	Reliez Creek	05/02/22	0.96	Likely Intact
207R03447	East Branch Grayson Creek	05/05/22	0.12	Very Likely Altered
207R03639	Walnut Creek	05/16/22	0.80	Likely Altered
207R03659	Grizzly Creek	05/02/22	1.03	Likely Intact
207R03780	Bollinger Canyon Creek	05/04/22	1.03	Likely Intact
544R03529	Marsh Creek	05/26/22	0.95	Likely Intact

4.3.2 Correlations of Biological and Physical Habitat Parameters

The principal biological and physical habitat condition scores are shown together in Table 4.6, and correlations among the key biological and physical habitat condition scores are shown in Table 4.7.

For the 2022 analysis, there is generally poor-to-moderate correlation among the various biological and physical habitat indices, except for the two algal indices (Diatoms MMI and Hybrid MMI), which correlate well with each other (R=0.881).

The CSCI scores are poorly correlated with scores from the two algal indices (for D_MMI, R=0.111; for H_MMI, R=-0.040) and the physical habitat index (R=0.032).

Conversely, the IPI scores correlate moderately well with the Diatoms MMI (R=0.576) and Hybrid MMI (R=0.663).

Because of the presence of New Zealand Mudsnail as identified in numerous bioassessment samples in recent years, including in several of the water year 2022 samples (see Table 4.2), correlations also were computed for percent New Zealand Mudsnail (%NZMS) versus CSCI, Diatoms MMI, Hybrid MMI, and IPI scores; those results also are shown in Table 4.7.

The correlations of %NZMS with the biological indices are generally weak for the water year 2022 data, with no consistent pattern. %NZMS correlates negatively with CSCI, as might be expected, but positively with the two algal indices.

The regression analysis was expanded to incorporate the water year 2019-2022 results (n=40) to further investigate the relationship of IPI scores to the biological indices and %NZMS.

Over the four-year period, IPI scores correlate poorly with CSCI scores (R=0.05). The algal indices correlate better with IPI scores (for D_MMI, R=0.43; for H_MMI, R=0.56); this is fairly consistent with the water year 2022 results.

For IPI vs. %NZMS, the low correlation coefficient (R=0.12) over the course of the four-year period provides further evidence of a weak relationship between IPI score and %NZMS. This may reflect the opportunistic nature of the NZMS colonization process.

The discrepancy in correlation of IPI scores with CSCI (weak) vs. ASCI scores (moderate) is puzzling. There are some questions regarding the accuracy of IPI scores and their reliability in characterizing physical habitat quality. In particular, the IPI may not accurately reflect altered or degraded physical habitat conditions where there has been significant human disturbance of the natural channel, especially relating to hydromodification. An example from the 2021 CCCWP data is Walnut Creek site 207R02871, which is in an engineered channel in an urbanized area with effectively no riparian zone, and yet received a moderate IPI score of 0.90. The developers of the IPI program may be investigating this situation, to evaluate the IPI's response under such conditions (Rehn, personal communication, 2022).

Table 4.6 Summary of PHab and Biological Condition Scores for CCCWP Bioassessment Sites Monitored in Water Year 2022

Site Code	Creek Name	Sample Date	CSCI Score	Diatoms MMI ASCI Score	Hybrid MMI ASCI Score	IPI Score
204R03652	West Branch Alamo Creek	05/16/22	0.353	0.87	0.87	1.06
206R03479	Wildcat Creek	05/03/22	0.648	0.85	0.75	1.07
206R03584	Rodeo Creek	05/17/22	0.338	0.55	0.46	0.85
207R02756	San Ramon Creek	05/04/22	0.385	0.65	0.79	1.03
207R03211	Reliez Creek	05/02/22	0.359	0.86	0.96	0.96
207R03447	East Branch Grayson Creek	05/05/22	0.443	0.44	0.42	0.12
207R03639	Walnut Creek	05/16/22	0.357	0.46	0.45	0.80
207R03659	Grizzly Creek	05/02/22	0.324	0.79	0.82	1.03
207R03780	Bollinger Canyon Creek	05/04/22	0.502	0.55	0.65	1.03
544R03529	Marsh Creek	05/26/22	0.387	0.46	0.62	0.95

Table 4.7 Correlations for PHab and Biological Condition Scores for CCCWP Sites Monitored in Water Year 2022

Comparison	Correlation Coefficient (R)	R Squared
CSCI:DiatomsMMI	0.111	0.012
CSCI:HybridMMI	-0.040	0.002
CSCI:IPI	0.032	0.001
DiatomsMMI:HybridMMI	0.881	0.775
DiatomsMMI:IPI	0.576	0.332
HybridMMI:IPI	0.663	0.439
Correlations with % New Zealand Mudsnail:		
CSCI:%NZMS	-0.299	0.090
DiatomsMMI:%NZMS	0.193	0.037
HybridMMI:%NZMS	0.443	0.196
IPI:%NZMS	0.156	0.024

Note: Correlations are based on scores shown in Table 4.8 and %NZMS provided by Tom King, invertebrate taxonomist, as part of the water year 2022 lab data report submitted by BioAssessment Services.

4.3.3 Water Chemistry Parameters

At all 10 bioassessment sites, water samples were collected for nutrient and other conventional analyses using the standard grab sample collection method, as described in SOP FS-2 (BASMAA 2016). Standard field parameters (water temperature, dissolved oxygen, pH, and specific conductance) also were measured in the field using a portable handheld multi-meter and YSI sonde.

Of the 12 water quality constituents monitored in association with the bioassessment monitoring, water quality standards or established thresholds are available only for ammonia (un-ionized form[4]), chloride[5], and nitrate + nitrite[6] – the latter for waters with MUN beneficial use only, as indicated in Table 4.8.

Table 4.8 Water Quality Thresholds Available for Comparison to Water Chemistry Constituents

Sample Parameter	Threshold	Units	Frequency/Period	Application	Source
Ammonia	0.025	mg/L	Annual Median	Un-ionized ammonia, as N (maxima also apply to Central Bay and u/s [0.16] and Lower Bay [0.4])	SF Bay Basin Plan (Ch. 3)
Chloride	230	mg/L	Criterion Continuous Concentration	Freshwater aquatic life	USEPA National Recreation Water Quality Criteria, Aquatic Life Criteria Table
Chloride	860	mg/L	Criteria Maximum Concentration	Freshwater aquatic life	USEPA National Recreation Water Quality Criteria, Aquatic Life Criteria Table
Chloride	250	mg/L	Secondary Maximum Contaminant Level	Alameda Creek watershed above Niles and MUN waters; Title 22 drinking waters	SF Bay Basin Plan (Ch. 3); California Title 22; USEPA Drinking Water Standards Secondary MCL
Nitrate + Nitrite (as N)	10	mg/L	Maximum Contaminant Level	Areas designated as MUN	SF Bay Basin Plan (Ch. 3)

The comparisons of the measured nutrients concentrations to the thresholds listed in Table 4.8 are shown in Table 4.9. There were no exceedances of the applicable criteria for un-ionized ammonia, chloride, or nitrate+nitrite at any of the 10 sites monitored in water year 2022.

[4] For ammonia, the standard provided in the Basin Plan (SFBRWQCB 2019, section 3.3.20) applies to the un-ionized fraction, as the underlying criterion is based on un-ionized ammonia, which is the more toxic form. Conversion of RMC monitoring data from the measured total ammonia to un-ionized ammonia was based on a formula provided by the American Fisheries Society, which calculates un-ionized ammonia in freshwater systems from analytical results for total ammonia and field-measured pH, temperature, and electrical conductivity (see: http://fisheries.org/hatchery).

[5] For chloride, a Secondary Maximum Contaminant Level (MCL) of 250 mg/L 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, and per the Basin Plan (Table 3-7) applies to waters in the Alameda Creek watershed above Niles. Per RMC decision as noted in the UCMR for water year 2012 (BASMAA 2013), for all other waters, the Criterion Continuous Concentration (CCC) of 230 mg/L (USEPA Water Quality Criteria*) for the protection of aquatic life is used as a conservative benchmark for comparison for all locations not specifically identified within the Basin Plan (i.e., sites not within the Alameda Creek watershed above Niles nor identified as MUN).

*See: http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm

[6] The nitrate + nitrite 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.

Water samples also were collected and analyzed for free and total chlorine in the field using CHEMetrics™ test kits during bioassessment monitoring. As shown in Table 4.10, only one water year 2022 water sample (Rodeo Creek, site 206R03584) produced a measurable level of free or total chlorine, at 0.1 mg/L (free) and 0.04 mg/L (total). The mandatory retest showed 0.08 mg/L (free) and 0.04 mg/L (total). These results are incongruous, as free chlorine cannot exceed total chlorine; this is an issue that also has arisen in the past, without explanation. In any case the results do not exceed the 0.1 mg/L MRP 2.0 threshold.

Table 4.9 Comparison of Water Quality (Nutrient) Data to Associated Water Quality Thresholds for Water Year 2022 Water Chemistry Results

Site Code	Creek Name	MUN?	Parameter and Threshold			Number of Parameters > Threshold/ Water Body
			Un-ionized Ammonia (as N)	Chloride	Nitrate + Nitrite (as N)	
			25 µg/L	230/250 mg/L[1]	10 mg/L[2]	
204R03652	West Branch Alamo Creek	No	0.47	49	0.192	0
206R03479	Wildcat Creek	No	0.88	25	0.221	0
206R03584	Rodeo Creek	No	0.49	140	1.20	0
207R02756	San Ramon Creek	No	0.70	25	0.282	0
207R03211	Reliez Creek	No	0.84	73	0.395	0
207R03447	East Branch Grayson Creek	No	2.14	130	0.414	0
207R03639	Walnut Creek	No	1.42	84	0.231	0
207R03659	Grizzly Creek	No	1.06	44	0.412	0
207R03780	Bollinger Canyon Creek	No	1.35	26	0.192	0
544R03529	Marsh Creek	No	1.03	210	1.01	0
Number of Values > Threshold			0	0	0	0
Percent of Values > Threshold			0%	0%	0%	

1 250 mg/L threshold applies for sites with MUN beneficial use and Alameda Creek above Niles per Basin Plan.

2 Nitrate + nitrite threshold applies only to sites with MUN beneficial use. No water year 2022 sites have MUN beneficial use.

Bolded values indicate results above applicable thresholds

Table 4.10 Summary of Chlorine Testing Results for Samples Collected in Water Year 2022 in Comparison to Municipal Regional Permit Trigger Criteria

Site Code	Creek Name	Sample Date	Chlorine, Free	Chlorine, Total	Exceeds Trigger Threshold?
204R03652	West Branch Alamo Creek	05/16/22	0.0	0.0	No
206R03479	Wildcat Creek	05/03/22	0.0	0.0	No
206R03584	Rodeo Creek	05/17/22	0.1	0.04	No
207R02756	San Ramon Creek	05/04/22	0.0	0.0	No
207R03211	Reliez Creek	05/02/22	0.0	0.0	No
207R03447	East Branch Grayson Creek	05/05/22	0.0	0.0	No
207R03639	Walnut Creek	05/16/22	0.0	0.0	No
207R03659	Grizzly Creek	05/02/22	0.0	0.0	No
207R03780	Bollinger Canyon Creek	05/04/22	0.0	0.0	No
544R03529	Marsh Creek	05/26/22	0.0	0.0	No
Number of Samples Exceeding 0.1 mg/L			0	0	
Percentage of Samples Exceeding 0.1 mg/L			0%	0%	

4.3.4 Water Column Toxicity and Chemistry (Wet Weather)

Wet weather samples were not collected during water year 2022, as the relevant MRP monitoring requirement had been fulfilled in previous monitoring years.

4.3.5 Water Column Toxicity (Dry Weather)

Water samples were collected from Las Trampas Creek (site 207R04819) on July 12, 2022, and tested for acute and chronic toxicity to several different aquatic species, as required by the MRP. Water chemistry testing was not required for the dry season sample. The dry weather water toxicity test results are shown in Table 4.11.

The water sample was determined not to be toxic to *Selenastrum capricornutum* (chronic test), *Ceriodaphnia dubia* (acute and chronic), *Chironomus dilutus* (acute), *Hyalella azteca* (acute), or Fathead Minnow (acute and chronic). *Ceriodaphnia* reproduction was reduced by 14% in comparison to the lab control, but the difference was not statistically significant according to the TST method.

Table 4.11 Summary of CCCWP Water Year 2022 Dry Season Water Toxicity Results

Dry Season Water Samples			Toxicity Test Results						
			S. capricornutum	*C. dubia*		*C. dilutus*	*H. azteca*	*P. promelas*	
Site Code	Creek Name	Sample Collection Date	Growth (cells/mL x 10^6)	Survival (%)	Reproduction (No. of neonates/ female)	Survival (%)	Survival (%)	Survival (%)	Growth (mg)
Lab Control			3.42	100	42.0	100	100	95.0	0.85
207R04819	Las Trampas	07/12/22	7.48	100	36.3	100	98.0	95.0	1.02

Note: No test treatment was determined to be significantly less than the lab control treatment response at $p < 0.05$

4.3.6 Sediment Toxicity and Sediment Chemistry

Sediment samples were collected from Las Trampas Creek (site 207R04819) on July 12, 2022, after water samples were collected at the same site for water column toxicity testing. The sediment samples were tested for acute toxicity (survival) to *Hyalella azteca* and *Chironomus dilutus*, and found not to be toxic to either test species. The sediment toxicity test results are shown in Table 4.12.

Table 4.12 Summary of CCCWP Water year 2021 Dry Season Sediment Toxicity Results

Dry Season Sediment Samples			Toxicity Test Results	
			Hyalella azteca	*Chironomus dilutus*
Site Code	Creek Name	Sample Collection Date	Survival (%)	Survival (%)
Lab Control			97.5	86.2
207R04819	Las Trampas	07/12/22	96.2	91.2

Note: No test treatment was determined to be significantly less than the lab control treatment response at $p < 0.05$

The sediment sample also was analyzed for a suite of potential sediment pollutants, as required by MRP 2.0, and the results were compared to the trigger threshold levels specified for follow-up in MRP 2.0 Provision C.8.g.iv. (see Table 3.3). The complete sediment chemistry results are shown in Table 4.13, and the results are shown in comparison to the applicable MRP threshold triggers in Table 4.14.

Sediment chemistry results (Tables 4.13 and 4.14) are summarized as follows:

- No metal constituents had a TEC ratio $\geq$1.0, except nickel at 1.72, as is typical of creek sediments in Contra Costa County
- Only four PAH compounds were detected; none of those had a TEC ratio $\geq$1.0
- The monitored site did not produce a mean PEC ratio $\geq$0.5
- Six of the seven pyrethroid pesticides were detected, but at relatively low levels; as usual the highest was bifenthrin, at 2.8 ng/g
- The TU equivalent calculated from the sum of detected pyrethroid concentrations was 0.53, less than the 1.0 TU equivalent level that would indicate likely toxicity
- The other pesticides tested (carbaryl and the fipronil compounds) were not detected

Sediment TU equivalents were calculated for the pyrethroid pesticides for which there are published LC_{50} levels, and a sum of the calculated TU equivalents was computed for the dry season sediment chemistry results from the monitored site (Las Trampas Creek, site 207R04819). Because organic carbon mitigates the toxicity of pyrethroid pesticides in sediments, the LC_{50} values are based on organic carbon-normalized pyrethroid concentrations. Therefore, the pyrethroid concentrations as reported by the lab were divided by the measured TOC concentration (as a percentage) at each site, and the TOC-normalized concentrations were then used to compute TU equivalents for each pyrethroid (Table 4.15).

Several of the common urban pyrethroid pesticides were detected at the water year 2022 sediment monitoring site, with bifenthrin at the highest concentration, as is typical in urban creeks in California. The calculated TU equivalent of 0.53 for the sum of the pyrethroids in sediment is less than 1.0, so it is not surprising that this sample did not cause statistically significant toxicity to *Chironomus dilutus* or *Hyalella azteca* in sediment toxicity testing.

Table 4.13 CCCWP Water Year 2022 Sediment Chemistry Results

Analyte	Units[1]	Site 207R04819		
		Las Trampas Creek		
		Result	MDL	RL
Metals				
Arsenic	mg/Kg	4	0.12	0.51
Cadmium	mg/Kg	0.21	0.0041	0.04
Chromium	mg/Kg	33	0.12	0.51
Copper	mg/Kg	18	0.06	0.21
Lead	mg/Kg	14	0.038	0.04
Nickel	mg/Kg	39	0.062	0.08
Zinc	mg/Kg	61	0.36	0.4
Polycyclic Aromatic Hydrocarbons (PAHs)				
Acenaphthene	ng/g	ND	2.5	10
Acenaphthylene	ng/g	ND	2.3	10
Anthracene	ng/g	ND	1.9	10
Benz(a)anthracene	ng/g	ND	1.7	10
Benzo(a)pyrene	ng/g	ND	2.5	10
Benzo(b)fluoranthene	ng/g	ND	2.9	10
Benzo(e)pyrene	ng/g	ND	2.5	10
Benzo(g,h,i)perylene	ng/g	ND	2.3	10
Benzo(k)fluoranthene	ng/g	ND	2.7	10
Biphenyl	ng/g	ND	2.3	10
Chrysene	ng/g	ND	2.3	10
Dibenz(a,h)anthracene	ng/g	ND	1.9	10
Dibenzothiophene	ng/g	ND	2.5	10
Dimethylnaphthalene, 2,6-	ng/g	*3.1*	2.5	10
Fluoranthene	ng/g	31	2.3	10
Fluorene	ng/g	ND	2.3	10
Indeno(1,2,3-c,d)pyrene	ng/g	ND	2.3	10
Methylnaphthalene, 1-	ng/g	ND	2.5	10
Methylnaphthalene, 2-	ng/g	ND	2	10
Methylphenanthrene, 1-	ng/g	ND	1.9	10
Naphthalene	ng/g	ND	2.3	10
Perylene	ng/g	ND	3.1	10
Phenanthrene	ng/g	10	1.9	10
Pyrene	ng/g	21	1.6	10
Pyrethroid Pesticides				
Bifenthrin	ng/g	2.8	0.21	1
Cyfluthrin, total	ng/g	*0.31*	0.083	1
Cyhalothrin, Total lambda-	ng/g	*0.22*	0.083	1
Cypermethrin, total	ng/g	*0.12*	0.12	1
Deltamethrin/Tralomethrin	ng/g	1.7	0.21	1
Esfenvalerate/Fenvalerate, total	ng/g	ND	0.33	1
Permethrin	ng/g	1.3	0.74	1

Table 4.13 CCCWP Water Year 2022 Sediment Chemistry Results

Analyte	Units[1]	Site 207R04819 Las Trampas Creek		
		Result	MDL	RL
Other Pesticides				
Carbaryl	ng/g	ND	0.021	0.021
Fipronil	ng/g	ND	0.12	1
Fipronil Desulfinyl	ng/g	ND	0.17	1
Fipronil Sulfide	ng/g	ND	0.17	1
Fipronil Sulfone	ng/g	ND	0.41	1
Organic Carbon				
Total Organic Carbon	%	1.7	0.39	0.78

1 All measurements reported as dry weight
MDL method detection limit
ND not detected
RL reporting limit
Sample results between the MDL and RL are italicized

Table 4.14 Threshold Effect Concentration (TEC) and Probable Effect Concentration (PEC) Quotients for Water Year 2022 Sediment Chemistry Constituents

		Site 207R04819		
		Las Trampas Creek		
	Sample Units[1]	Sample	TEC Ratio	PEC Ratio
Metals				
Arsenic	mg/Kg	4.0	0.41	0.12
Cadmium	mg/Kg	0.21	0.21	0.04
Chromium	mg/Kg	33	0.76	0.30
Copper	mg/Kg	18	0.57	0.12
Lead	mg/Kg	14	0.39	0.11
Nickel	mg/Kg	39	1.72	0.80
Zinc	mg/Kg	61	0.50	0.13
Polycyclic Aromatic Hydrocarbons (PAHs)				
Anthracene	ng/g	ND		
Fluorene	ng/g	ND		
Naphthalene	ng/g	ND		
Phenanthrene	ng/g	10	0.049	0.0085
Benz(a)anthracene	ng/g	ND		
Benzo(a)pyrene	ng/g	ND		
Chrysene	ng/g	ND		
Fluoranthene	ng/g	31	0.073	0.0139
Pyrene	ng/g	21	0.108	0.0138
Total PAHs[a]	ng/g	88	0.055	0.0039
		Number with TEC > 1.0	1	
		Combined TEC Ratio	4.85	
		Average TEC Ratio	0.44	
		Combined PEC Ratio		1.67
		Average PEC Ratio		0.15

a Total PAHs include 24 individual PAH compounds; NDs were substituted at 1/2 MDL to compute total PAHs

Bold TEC or PEC ratio indicates ratio 1.0

ND not detected

Note: All measurements reported as dry weight. TECs and PECs per MacDonald et al. (2000).

Table 4.15 Calculated Pyrethroid Toxic Unit Equivalents, Water Year 2022 Sediment Chemistry Data

Pyrethroid Pesticides	LC_{50} (µg/g organic carbon)	Site 207R04819 Las Trampas Creek Sample (ng/g)	Sample (µg/g organic carbon)	TU Equivalents[1]
Bifenthrin	0.52	2.8	0.16	0.32
Cyfluthrin	1.08	0.31	0.02	0.02
Cyhalothrin, lambda	0.45	0.22	0.01	0.03
Cypermethrin	0.38	0.12	0.01	0.02
Deltamethrin/Tralomethrin	0.79	1.7	0.10	0.13
Esfenvalerate/Fenvalerate	1.54	ND		
Permethrin	10.8	1.3	0.08	0.01
			Sum (Pyrethroid TUs)	0.53

1 TU equivalents are calculated as ratios of organic carbon-normalized pyrethroid sample concentrations to published *H. azteca* LC_{50} values. See http://www.tdcenvironmental.com/resources/Pyrethroids-Aquatic-Tox-Summary.pdf for associated references.

ND Not detected

Note: All sample measurements reported as dry weight.

4.3.7 Analysis of Condition Indicators and Stressors – Water Year 2022

During water year 2022, 10 sites were monitored by CCCWP under the RMC regional/probabilistic design for bioassessment, physical habitat, and water chemistry parameters. One site also was monitored for water and sediment toxicity and sediment chemistry.

The bioassessment and related data are used to develop a preliminary condition assessment for the monitored sites. The water and sediment chemistry and toxicity data are used in conjunction with physical habitat data to evaluate potential stressors which may affect aquatic habitat quality and beneficial uses. Various metrics and indices are computed to aid in the condition assessment and stressor analysis.

Biological Conditions

CSCI scores have been calculated from the CCCWP bioassessment data since water year 2016. The CSCI routine uses location-specific GIS data to compare the observed BMI taxonomic data to expected BMI assemblage characteristics from reference sites with similar geographical characteristics.

Every CCCWP bioassessment site monitored in water year 2022 produced a CSCI score below the MRP threshold of 0.795, indicating a degraded biological community relative to reference conditions.

The water year 2022 CSCI scores range from a low of 0.324 at Grizzly Creek (site 207R03659; tributary to Las Trampas Creek) to a high of 0.648 at Wildcat Creek (site 206R03479).

The invasive New Zealand Mudsnail (NZMS) was found in five of the 10 benthic samples. The highest numbers of this invasive snail species (20.5% of the sample organism count) were recorded at Reliez Creek (site code 207R03211; also tributary to Las Trampas Creek, downstream of the Grizzly Creek confluence).

ASCI scores were calculated for CCCWP bioassessment sites again in water year 2022 and assigned to status categories based on SWAMP guidance. The ASCI routine also makes use of location-specific GIS data to compute multimetric indices based on benthic algal assemblages. Two ASCI scores are used in this analysis: the diatoms MMI and hybrid MMI.

Reliez Creek (site 207R03211, tributary to Las Trampas Creek) produced the highest score for the hybrid MMI (0.96; the only 2022 ASCI score which is in the Likely Intact status category) and second highest score for the diatoms MMI (0.86; Likely Altered category).

The West Branch Alamo Creek (site 204R03652) produced the highest score for the diatoms MMI (0.87) and second highest score for the hybrid MMI (0.87); these were the only 2022 ASCI scores which fell into the Possibly Altered status category. The nine other sites scored as Likely Altered or Very Likely Altered for both the diatoms and hybrid indices.

Based on the BMI and algal community indices, along with the NZMS data, the biological community conditions of all CCCWP sites monitored in 2022 are characterized as impacted.

Eight of the 10 2022 CCCWP bioassessment sites have designated existing or potential aquatic life uses that include COLD (cold water fish habitat). The biological data assembled for this report indicate that conditions in these creeks may not adequately support this beneficial use.

Physical Habitat (PHab) Conditions

IPI scores were again calculated from the PHab data compiled during the spring 2022 bioassessment monitoring, and the IPI scores were related to condition categories as recommended by SWAMP guidance. Seven sites are rated as Likely Intact, one is ranked as Possibly Altered, one is ranked as Likely Altered, and one is ranked as Very Likely Altered.

The IPI scores contrast with the CSCI and ASCI scores for these sites. Given that the water year 2022 CSCI scores indicate "degraded" benthic macroinvertebrate communities at all sites, and in most cases the 2022 ASCI MMI scores indicate Likely Altered or Very Likely Altered algal communities relative to reference conditions, physical habitat as represented by IPI scores does not appear to be a principal stressor for those biological communities.

Regression analysis of IPI scores shows a very weak correlation with CSCI scores, but moderate correlations with the ASCI Diatoms MMI and Hybrid MMI scores.

Previous analysis (ARC 2020, summarized below) has shown that specific physical habitat factors do correlate with biological index scores, bringing into question whether the IPI is a reliable indicator of physical habitat quality as it affects in-stream biological communities.

Water Quality

Of 12 water quality parameters required in association with bioassessment monitoring, applicable water quality standards are identified only for ammonia, chloride, and nitrate+nitrite (for sites with MUN beneficial use only). None of the results generated at the 10 sites monitored during water year 2022 exceeded the applicable water quality standards. The threshold set by the MRP for free chlorine also was not exceeded at any of the 10 sites.

Water Toxicity

Water samples collected from Las Trampas Creek (site 207R04819) on July 12, 2022 were determined not to be toxic to *Selenastrum capricornutum* (chronic test), *Ceriodaphnia dubia* (acute and chronic), *Chironomus dilutus* (acute), *Hyalella azteca* (acute), or Fathead Minnow (acute and chronic). *Ceriodaphnia* reproduction was reduced by 14% in comparison to the lab control, but the difference was not statistically significant according to the TST method.

Sediment Toxicity

Sediment samples also collected from Las Trampas Creek (site 207R04819) on July 12, 2022, after water samples were collected at the same site, were tested for acute toxicity (survival) to *Hyalella azteca* and *Chironomus dilutus*, and found not to be toxic to either test species.

Sediment Chemistry

Several of the common urban pyrethroid pesticides were detected in the water year 2022 sediment sample, with bifenthrin having the highest concentration, as is typical in urban creeks in California. The calculated TU equivalent of 0.53 for the sum of the pyrethroids in sediment is less than 1.0, so it is not surprising that this sample did not cause statistically significant toxicity to *Chironomus dilutus* or *Hyalella azteca* in sediment toxicity testing.

Sediment Triad Analysis

Bioassessment, sediment toxicity, and sediment chemistry results from water year 2022 were evaluated as the three lines of evidence used in the triad approach for assessing overall stream condition and added to the compiled results for water years 2012-2022.

Good correlation is observed in the triad analysis throughout that 11-year period between sediment toxicity and pyrethroid pesticide concentrations, as represented by the calculated sum of TU equivalents due to pyrethroids. Sediment toxicity was observed in every case where the sum of pyrethroids TU equivalents was ≥1, and also in the 2018 Marsh Creek sample, where the calculated TU equivalent was 0.95, as shown in Table 4.16.

Sediment toxicity was not observed in any sample where the pyrethroids sum of TU equivalents was <0.95.

The correlation of sediment toxicity with the number of TEC quotients for other toxics, including metals and PAHs, was not consistent.

Based on the results of the past 11 years, chemical stressors, particularly pyrethroid pesticides, may be contributing to the degraded benthic biological conditions as indicated by the low biological index scores in many of the monitored streams.

However, unmeasured factors also apparently contribute to the "very poor" and "degraded" B-IBI condition category scores in some cases, as there are several such instances where there was neither sediment toxicity nor sum of pyrethroids TU equivalents nearly or greater than 1.

Table 4.16 Summary of Sediment Quality Triad Evaluation Results – Water Years 2012-2022 Data

Water Year	Water Body	Site ID	B-IBI Condition Category	Sediment Toxicity	No. of TEC Quotients > 1.0	Mean PEC Quotient	Pyrethroids: Sum of TU Equivalents
2012	Grayson Creek	207R00011	Very Poor	Yes	10	0.14	2.17
2012	Dry Creek	544R00025	Very Poor	Yes	11	0.51	3.62
2013	Sycamore Creek	207R00271	Very Poor	Yes	0	0.04	10.5
2013	Marsh Creek	544R00281	Very Poor	Yes	4	0.13	1.03
2014	San Pablo Creek	206R00551	Very Poor	No	1	0.09	.016
2014	Grizzly Creek	207R00843	Very Poor	No	1	0.12	.11
2015	Rodeo Creek	206R01024	Poor	No	1	0.11	0.32
2015	Green Valley Creek	207R00891	Very Poor	Yes	3	0.12	1.11
2016	Rimer Creek	204R01519	Degraded (CSCI)	No	1	0.12	0.89
2017	West Branch Alamo Creek	204R01412	Degraded (CSCI)[1]	No	3	0.21	0.255
2018	Marsh Creek	544R01737	Degraded (CSCI)	Yes	1	0.09	0.95
2019	Marsh Creek	544R02505	Degraded (CSCI)	Yes	3	0.25	1.84
2020	Grayson Creek	207R01547	[not tested]	No	1	0.11	0.55
2021	Walnut Creek	207R03403	Degraded (CSCI)	No	1	0.14	0.84
2022	Las Trampas Creek	207R04819	[not tested]	No	1	0.15	0.53

1 Based on water year 2016 bioassessment data

Note: Yellow-highlighted cells indicate results exceed permit trigger threshold.

Comparisons to Conclusions of the Comprehensive Multi-Year Analysis

The multi-year analysis of regional/probabilistic parameters included within the water year 2019 Integrated Monitoring Report (ARC 2020) produced the following conclusions:

- Biological conditions in Contra Costa County urban creeks are generally impacted, as indicated by analysis of bioassessment results from 76 monitoring sites over the course of eight years (2012-2019). Physical habitat factors play a significant role in degradation of in-stream biota, with water quality factors and antecedent rainfall also contributing to in-stream conditions.
- Factors that have a positive correlation with in-stream biological conditions for BMI and algae include higher percentages of fast water within the reach, higher percentages of coarse gravel, and higher diversity of natural substrate types.
- Factors that tend to negatively impact in-stream biota include higher percentages of fines or substrate smaller than sand, higher percentages of slow water in the reach, and elevated chloride or conductivity.
- Algal assemblages tend to benefit from higher antecedent rainfall in the 60- to 90-day range and are negatively impacted by elevated temperatures.
- Throughout the study period, sediment toxicity and occasional water toxicity are chronic occurrences, with toxicity typically attributable to the presence of pyrethroid and sometimes other pesticides, including the recent presence of fipronil and imidacloprid.

These findings are generally supported in the water year 2022 analysis with respect to biological conditions, although sediment toxicity was not observed in the water year 2022 dry weather monitoring.

The apparently detrimental effect of the heightened presence of the invasive New Zealand Mudsnail presents a complicating and inconsistent factor in the analysis.

Sediment chemistry and toxicity clearly are linked to “very poor” B-IBI scores and “degraded” CSCI scores, but those factors do not always completely explain very poor/degraded biological conditions as indicated from the bioassessment results. Where the sum of pyrethroid pesticide Toxic Unit equivalents approaches or exceeds 1, sediment toxicity consistently occurs. Where sediment toxicity occurs, IBI and CSCI scores consistently indicate “very poor” and “degraded” conditions, but “very poor” and “degraded” conditions are not always associated with sediment toxicity or pyrethroid TU equivalents exceeding 1.

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5 Conclusions and Next Steps

5.1 Water Year 2022 Results

The water year 2022 data were fairly consistent with the results of previous creek status monitoring performed by CCCWP under the MRP.

Every CCCWP bioassessment site monitored in water year 2022 produced a CSCI score below the MRP 2.0 threshold of 0.795, indicating a degraded benthic biological community relative to reference conditions. The invasive New Zealand Mudsnail (NZMS) was found in five of the 10 benthic samples.

The algae metrics (ASCI scores) produced similar results in water year 2022. Nine of the 10 bioassessment monitoring sites scored as “Likely Altered” or “Very Likely Altered” for both the diatoms and hybrid algal community indices.

Based on the BMI and algal community indices, along with the NZMS data, the biological community conditions of all CCCWP sites monitored in 2022 are characterized as impacted.

IPI scores were again calculated from the PHab data compiled during the spring 2022 bioassessment monitoring, and the IPI scores were related to condition categories as recommended by SWAMP guidance. Seven sites are rated as Likely Intact, one is ranked as Possibly Altered, one is ranked as Likely Altered, and one is ranked as Very Likely Altered.

The IPI scores are in contrast to the CSCI and ASCI scores for these sites. Given that the water year 2022 CSCI scores indicate “degraded” benthic macroinvertebrate communities at all sites, and in most cases the 2022 ASCI MMI scores indicate Likely Altered or Very Likely Altered algal communities relative to reference conditions, physical habitat as represented by IPI scores does not appear to be a principal stressor for those biological communities.

Of the 12 water quality parameters required in association with bioassessment monitoring, applicable water quality standards were only identified for ammonia, chloride, and nitrate+nitrite (for sites with MUN beneficial use only). None of the results generated from the 10 sites monitored during water year 2022 exceeded the applicable water quality standards.

Water samples collected from Las Trampas Creek (site 207R04819) on July 12, 2022 were determined not to be toxic to any of the test species: *Selenastrum capricornutum* (chronic test), *Ceriodaphnia dubia* (acute and chronic), *Chironomus dilutus* (acute), *Hyalella azteca* (acute), or Fathead Minnow (acute and chronic).

Sediment samples also collected from Las Trampas Creek (site 207R04819) on July 12, 2022, after water samples were collected at the same site, were tested for acute toxicity (survival) to *Hyalella azteca* and *Chironomus dilutus*, and found not to be toxic to either test species.

Several of the common urban pyrethroid pesticides were detected at the water year 2022 sediment monitoring site, with bifenthrin at the highest concentration, as is typical in urban creeks in California. The calculated TU equivalent of 0.53 for the sum of the pyrethroids in sediment is less than 1.0, so it is not surprising that this sample did not cause statistically significant toxicity to *Chironomus dilutus* or *Hyalella azteca* in sediment toxicity testing.

Bioassessment, sediment toxicity, and sediment chemistry results from water year 2022 were evaluated as the three lines of evidence used in the triad approach for assessing overall stream condition and added to the compiled results for water years 2012-2022.

Good correlation is observed throughout that period between sediment toxicity and pyrethroid pesticide concentrations, as represented by the calculated sum of TU equivalents due to pyrethroids. Sediment toxicity was observed in every case where the sum of pyrethroids TU equivalents was ≥1, and also in the 2018 Marsh Creek sample, where the calculated TU equivalent was 0.95, as shown in Table 4.16. Sediment toxicity was not observed in any sample where the pyrethroids sum of TU equivalents was <0.95.

Based on the results of the past 11 years, chemical stressors, particularly pyrethroid pesticides, may be contributing to the degraded benthic biological conditions as indicated by the low biological index scores in many of the monitored streams.

However, unmeasured factors also apparently contribute to the "very poor" and "degraded" benthic biological condition category scores in some cases, as there are several such instances where there was neither sediment toxicity nor sum of pyrethroids TU equivalents nearly or greater than 1.

5.2 Next Steps

The data generated by bioassessment monitoring conducted by RMC participants during water years 2012-2021 will be included in the comprehensive, region-wide bioassessment final report required under MRP 3.0, Provision C.8.h.vi. The water year 2022 CCCWP bioassessment data could be included in that comprehensive report.

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Appendix 4

Local/Targeted Creek Status Monitoring Report: Water Year 2022

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Contra Costa Clean Water Program

Local/Targeted Creek Status Monitoring Status Report: Water Year 2022

(October 2021 – September 2022)

Submitted to the San Francisco Bay and Central Valley Regional Water Quality Control Boards

In Compliance with NPDES Permit Provision C.8.h.iii
Municipal Regional Stormwater Permit (Order No. R2-2019-0004)

March 31, 2023

Prepared for

Contra Costa Clean Water Program
255 Glacier Drive
Martinez, California 94553

Prepared by

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9057C Soquel Drive, Suite B
Aptos, California 95003

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Contra Costa Clean Water Program

Local/Targeted Creek Status Monitoring Report: Water Year 2022

(October 2021 – September 2022)

March 31, 2023

Prepared for

Contra Costa Clean Water Program
255 Glacier Drive
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Acronyms and Abbreviations

ACCWP	Alameda Countywide Clean Water Program
ADH	ADH Environmental
ARC	Armand Ruby Consulting
BAMSC	Bay Area Municipal Stormwater Collaborative
BASMAA	Bay Area Stormwater Management Agencies Association
Basin Plan	common term for the Regional Water Quality Control Plan
CCCDD	Contra Costa County Development Department
CCCWP	Contra Costa Clean Water Program
COLD	cold freshwater habitat (steelhead stream)
CVRWQCB	Central Valley Regional Water Quality Control Board
DO	dissolved oxygen
EBMUD	East Bay Municipal Utility District
EBRPD	East Bay Regional Park District
FSURMP	Fairfield-Suisun Urban Runoff Management Program
KEI	Kinnetic Environmental, Inc.
MRP	municipal regional stormwater permit
MWAT	maximum weekly average temperature
NPDES	National Pollutant Discharge Elimination System
pH	hydrogen ion concentration
QAPP	quality assurance project plan
Region 2	San Francisco Bay Regional Water Quality Control Board
Region 5	Central Valley Regional Water Quality Control Board
RMC	Regional Monitoring Coalition
SCVURPPP	Santa Clara Valley Urban Runoff Pollution Prevention Program
SFBRWQCB	San Francisco Bay Regional Water Quality Control Board
SMCWPPP	San Mateo Countywide Water Pollution Prevention Program
SOP	standard operating procedure
SSID	stressor/source identification
SWAMP	Surface Water Ambient Monitoring Program
WARM	warm water habitat (non-steelhead streams)
WAT	weekly average temperature
YSI	Yellow Springs Instrument Company

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Preface

The Regional Monitoring Coalition (RMC) was formed in early 2010 as a collaboration among several Bay Area Stormwater Management Agencies Association (BASMAA) members to implement the creek status monitoring requirements of the original San Francisco Bay Regional Water Quality Control Board (SFBRWQCB) 2009 Municipal Regional Stormwater Permit (MRP 1.0) through a regionally coordinated effort. The RMC developed a targeted design for local characterization of selected creek status monitoring parameters.

While BASMAA dissolved on June 28, 2021, the Contra Costa Clean Water Program and other RMC participants continue to coordinate their monitoring activities through the Bay Area Municipal Stormwater Collaborative (BAMSC) to perform creek status monitoring and report results in accordance with the RMC local/targeted study design as in prior years.

This report fulfills MRP 2.0 reporting Provision C.8.h.iii for local/targeted creek status monitoring data generated within Contra Costa County during water year 2022 (Oct. 1, 2021-Sept. 30, 2022) for certain parameters monitored per MRP 2.0 (SFBRWQCB 2015) Provision C.8.d. This report is an appendix to the Contra Costa Clean Water Program's Urban Creeks Monitoring Report for water year 2022, and complements similar reports submitted by other RMC participants on behalf of their respective permittees.

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Executive Summary

This report documents the results of monitoring performed by Contra Costa Clean Water Program (CCCWP) during water year 2022 (Oct. 1, 2021-Sept. 30, 2022) for parameters covered under the local/targeted monitoring design developed by the Regional Monitoring Coalition (RMC). Together with creek status monitoring data reported in the regional/probabilistic creek status monitoring report for water year 2022 (ARC 2023), this submittal fulfills reporting requirements for creek status monitoring specified in Provisions C.8.d and C.8.g of the Municipal Regional Permit (MRP) for urban stormwater issued by the San Francisco Bay Regional Water Quality Control Board per Order No. R2-2015-0049, as amended by Order No. R2-2019-0004 (MRP 2.0), incorporating the eastern portion of Contra Costa County within the requirements of the MRP.

On May 11, 2022, the San Francisco Bay Regional Water Quality Control Board adopted the third Municipal Regional Stormwater NPDES Permit (MRP 3.0) per Order No. R2-2022-0018. This permit became effective on July 1, 2022, at the start of the fourth quarter of water year 2022. Because water year 2022 monitoring was conducted according to MRP 2.0 protocols and was largely complete on the effective date of MRP 3.0, this appendix addresses the results of the water year 2022 monitoring according to the interpretive methods and reporting requirements specified in MRP 2.0 Provision C.8.

As fecal indicator bacteria samples under MRPs 1.0 and 2.0 were typically collected in the fourth quarter of a water year, regional collaboration between RMC participants and SFBRWQCB staff agreed to dismiss this monitoring parameter as a requirement in water year 2022 as it was not incorporated in MRP 3.0, effective July 1, 2022.

Within Contra Costa County, targeted monitoring in water year 2022 was conducted at:

- Four continuous water temperature monitoring locations
- Two continuous general water quality monitoring locations

Continuous Water Temperature

Water temperature measurements were recorded at hourly intervals using Onset® HOBO® data loggers (HOBOs) deployed in four creeks on April 11, 2022. One device each was deployed in Rimer Creek, Moraga Creek, Las Trampas Creek, and Bollinger Canyon Creek. The HOBOs were retrieved on Aug. 12, 2022. As the permit term reporting requirements in water year 2022 only apply up to June 30, data collected after June 30, 2022, are not included in this report.

Continuous General Water Quality

Water temperature, dissolved oxygen (DO), hydrogen ion concentration (pH), and specific conductance were continuously monitored at 10-minute intervals by sonde devices in two locations (Lafayette Creek and Walnut Creek) in water year 2022. Data were collected for a two-week period (April 28-May 11, 2022), during a single deployment in the spring index period. As the permit term reporting requirements in water year 2022 only apply up to June 30, a second deployment during the summer index period was not required as it is not a monitoring parameter in MRP 3.0.

Results of Targeted Monitoring Data

All targeted monitoring data were evaluated against numeric trigger thresholds, as described in MRP 2.0 Provision C.8.d. Numeric thresholds are discussed below as presented in MRP 2.0 Provision C.8.d.

Temperature – HOBOs and Sondes

For streams documented to support steelhead fisheries, or for streams maintaining a designated cold freshwater habitat per the Basin Plan, the trigger threshold for temperature is defined in the MRP as 20% or more of instantaneous results exceeding 24 °C, or a maximum weekly average temperature (MWAT) of 17 °C. Per the MRP, for the HOBO temperature data, a maximum of one weekly average temperature (WAT) can exceed the threshold of 17 °C during the deployment period. For temperature data recorded by sonde devices, which are deployed for a much briefer period (one to two weeks), all WATs must be below 17 °C.

Creeks targeted in water year 2022 and their respective designated beneficial uses are listed in Table ES.1. For this report, creeks listed as cold freshwater habitat (COLD) are evaluated as steelhead streams.

Table ES.1. Designated Beneficial Uses Listed in the Basin Plan for Targeted Monitoring Sites in Contra Costa County – Water Year 2022

			Human Consumptive Uses							Aquatic Life Uses									Recreational Uses		
Water Year	Site ID	Water Body	AGR	MUN	FRSH	GWR	IND	PROC	COMM	SHELL	COLD	EST	MAR	MIGR	RARE	SPWN	WARM	WILD	REC-1	REC-2	NAV
2022	204R01519	Rimer Creek			E						E					E	E	E	E	E	
	204SLE204	Moraga Creek			E						E					E	E	E	E	E	
	207R02635	Las Trampas Creek									E				E		E	E	E	E	
	207R03780	Bollinger Canyon Creek									E					E	E	E	E	E	
	207R03403	Walnut Creek									E			E	E	E	E	E	E	E	
	207LFC355	Lafayette Creek									E						E	E	E	E	

E Existing beneficial use

Notes: Per Basin Plan Ch. 2 (SFBRWQCB 2017), beneficial uses for freshwater creeks include municipal and domestic supply (MUN), agricultural supply (AGR), industrial process supply (PRO), groundwater recharge (GWR), water contact recreation (REC1), noncontact water recreation (REC2), wildlife habitat (WILD), cold freshwater habitat (COLD), warm freshwater habitat (WARM), fish migration (MIGR), and fish spawning (SPWN). The San Francisco Bay Estuary supports estuarine habitat (EST), industrial service supply (IND), and navigation (NAV) in addition to all uses supported by streams. Beneficial uses for coastal waters include water contact recreation (REC1); noncontact water recreation (REC2); industrial service supply (IND); navigation (NAV); marine habitat (MAR); shellfish harvesting (SHELL); ocean, commercial and sport fishing (COMM); and preservation of rare and endangered species (RARE).

In water year 2022, streams designated as COLD were targeted for temperature monitoring using HOBO and YSI devices. At the four locations with continuously recorded HOBO temperature data from April-June, all four creeks (Rimer Creek, Moraga Creek, Las Trampas Creek, and Bollinger Canyon Creek) are classified as steelhead streams. At the two locations with continuously recorded YSI temperature data for a two-week period from late April to early May, both creeks (Walnut Creek and Lafayette Creek) are classified as steelhead streams.

Exceedances of the 17 °C WAT threshold occurred at four out of six creeks in water year 2022. This includes the four HOBO monitoring stations along Rimer Creek, Moraga Creek, Las Trampas Creek, and Bollinger Canyon Creek during the April-June deployment period. For the two YSI monitoring stations along Walnut Creek and Lafayette Creek, there was no exceedance of the 17 °C WAT threshold during the spring deployment period.

No water year 2022 temperature monitoring location within steelhead streams recorded more than 20% instantaneous results above 24 °C; therefore, there were no exceedances of this criterion.

Dissolved Oxygen (DO)

The MRP trigger threshold for dissolved oxygen in non-tidal waters is applied as follows: in waters designated as steelhead streams, no more than 20% of instantaneous dissolved oxygen results may drop below 7.0 mg/L (SFBRWQCB 2019).

During the April-May monitoring period, dissolved oxygen measurements in Walnut Creek and Lafayette Creek did not drop below 7.0 mg/L; therefore, there were no exceedances of this criterion.

pH

The MRP trigger threshold for pH in surface waters is applied as follows: no more than 20% of instantaneous pH results may fall outside the range of 6.5 to 8.5. This range was used to evaluate the pH data collected at targeted locations over water year 2022.

During the April-May monitoring period, dissolved oxygen measurements in Walnut Creek and Lafayette Creek were not recorded outside the range of 6.5 to 8.5; therefore, there were no exceedances of this criterion.

Specific Conductance

The MRP trigger threshold for specific conductance in surface waters is applied as follows: no more than 20% of instantaneous specific conductance results may exceed 2,000 µS/cm, and readings should not indicate a spike in specific conductance with no obvious natural explanation.

During the April-May monitoring period, specific conductance measurements in Walnut Creek and Lafayette Creek were not recorded above 2,000 µS/cm; therefore the 20% threshold for specific conductance results above 2,000 µS/cm was not exceeded, and no spikes in the data were observed.

Exceedances for each of the above parameters are summarized in Table ES.2.

Table ES.2 Threshold Exceedances in Contra Costa County - Water Year 2022

Creek	Monitoring Period	Exceedance Period	Parameter	Threshold Exceedance	Number of Results Where WAT > 17 °C
Rimer Creek	04/11/22-06/30/22	06/07/22-06/13/22 06/21/21-06/27/22	Continuous Water Temp. (HOBO)	Two or more WATs >17 °C	2 of 11
Moraga Creek	04/11/22-06/30/22	06/07/22-06/27/22	Continuous Water Temp. (HOBO)	Two or more WATs >17 °C	3 of 11
Las Trampas Creek	04/11/22-06/30/22	05/17/22-06/27/22	Continuous Water Temp. (HOBO)	Two or more WATs >17 °C	6 of 11
Bollinger Canyon Creek	04/11/22-06/30/22	06/07/22-06/13/22 06/21/22-06/27/22	Continuous Water Temp. (HOBO)	Two or more WATs >17 °C	2 of 11

WAT weekly average temperature

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1 Introduction

This Local/Targeted Creek Status Monitoring Report was prepared by the Contra Costa Clean Water Program (CCCWP) on behalf of its 21 member agencies (19 cities/towns, County of Contra Costa, and Contra Costa County Flood Control and Water Conservation District). CCCWP gathers and reports monitoring data to help its program members comply with the Municipal Regional Stormwater National Pollutant Discharge Elimination System (NPDES) Permit (MRP). This report documents the results of monitoring performed by CCCWP during water year 2022 (Oct. 1, 2021-Sept. 30, 2022), for parameters originally covered under the local/targeted monitoring design developed by the Regional Monitoring Coalition (RMC). Other creek status monitoring parameters were addressed using a probabilistic design, with regional coordination and common methodologies. Together with the creek status monitoring data reported in the regional/probabilistic creek status monitoring report for water year 2022 (ARC 2023), this submittal fulfills reporting requirements for creek status monitoring specified in Provisions C.8.d and C.8.g of the Municipal Regional Permit (MRP) for urban stormwater issued by the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB) per Order No. R2-2015-0049, as amended by Order No. R2-2019-0004 (MRP 2.0), incorporating the eastern portion of Contra Costa County within the requirements of the MRP.

On May 11, 2022, the SFBRWQCB adopted the third Municipal Regional Stormwater NPDES Permit (MRP 3.0) per Order No. R2-2022-0018. This permit became effective July 1, 2022, at the start of the fourth quarter of water year 2022. Because the water year 2022 monitoring was conducted according to MRP 2.0 protocols and was largely complete on the effective date of MRP 3.0, this report addresses the results of the water year 2022 monitoring according to the interpretive methods and reporting requirements specified in MRP 2.0, Provision C.8.

1.2 Regulatory Context

Contra Costa County lies within the jurisdictions of both the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB; Region 2) and the Central Valley Regional Water Quality Control Board (CVRWQCB; Region 5). Municipal stormwater discharges in Contra Costa County previously were regulated by the requirements of two NPDES stormwater permits: the MRP in Region 2 (Order No. R2-2015-0049[1]), and the East Contra Costa County Municipal NPDES Permit (Central Valley Permit) in Region 5 (Order No. R5-2010-0102[2]).

Prior to the reissuance of MRP 2.0 in 2015, the requirements of the two permits were effectively identical. With the reissued MRP 2.0, there were some differences between the MRP and the Central Valley Permit, although in most respects the creek status monitoring and reporting requirements remained similar. For this report, the creek status monitoring and reporting requirements specified in the reissued MRP 2.0 are considered the prevailing requirements. Sites in the Central Valley Region have

[1] The SFBRWQCB adopted the reissued Municipal Regional Stormwater NPDES Permit (Order No. R2-2015-0049) to 76 cities, counties, and flood control districts (i.e., permittees) in the Bay Area on Nov. 19, 2015 (SFBRWQCB 2015), effective Jan. 1, 2016. The BASMAA programs supporting MRP regional projects include all MRP permittees, plus the eastern Contra Costa County cities of Antioch, Brentwood, and Oakley, which have voluntarily elected to participate in the RMC. The RMC regional monitoring design was expanded to include the eastern portion of Contra Costa County, which is within the Central Valley Region (Region 5), to assist CCCWP in fulfilling parallel provisions in the Central Valley Permit.

[2] The CVRWQCB issued the East Contra Costa County Municipal NPDES Permit (Order No. R5-2010-0102) on Sept. 23, 2010 (CVRWQCB 2010). This Order was superseded by Order No. R2-2019-0004, incorporating the eastern portion of Contra Costa County within the requirements of the MRP (Order No. R2-2015-0049) on Feb. 13, 2019.

been monitored as part of the creek status monitoring required by both permits. Per agreement between the Central Valley and San Francisco Regional Water Quality Control Boards on Feb. 13, 2019, the SFBRWQCB adopted Order No. R2-2019-0004 (MRP 2.0), to include the eastern portion of Contra Costa County under the jurisdiction of MRP 2.0, rendering the Central Valley Permit obsolete for the purposes of this report.

1.3 Regional Monitoring Coalition (RMC) Overview

In 2010, members of the Bay Area Stormwater Management Agencies Association (BASMAA) formed the Regional Monitoring Coalition (RMC) to collaboratively implement the monitoring requirements found in Provision C.8 of the MRP. The participants of the RMC are listed in Table 1.1. The RMC developed a quality assurance project plan (QAPP) (BASMAA 2020), standard operating procedures (SOPs) (BASMAA 2016), data management tools, and reporting templates and guidelines for MRP monitoring compliance. Costs for these activities were shared among RMC members on a population-weighted basis by direct contributions and provision of in-kind services by RMC members to complete required tasks. Participation in the RMC was formerly facilitated through BASMAA, and as of June 2021 is now coordinated through the Bay Area Municipal Stormwater Collaborative (BAMSC) Monitoring and Pollutants of Concern Committee.

While BASMAA dissolved in June 2021, the Contra Costa Clean Water Program (CCCWP) continues to coordinate monitoring activities with the RMC through BAMSC and perform creek status monitoring and report results in accordance with the RMC study designs.

The goals of the RMC are to:

1. Assist RMC permittees in complying with requirements of the MRP.
2. Develop and implement regionally consistent creek monitoring approaches and designs in the Bay Area through improved coordination among RMC participants and other agencies (e.g., regional water quality control boards, Regions 2 and 5, and the Surface Water Ambient Monitoring Program) which share common goals,
3. Stabilize the costs of creek monitoring by reducing duplication of efforts and streamlining reporting.

The RMC divided the creek status monitoring requirements specified by permit provisions into those parameters which could reasonably be included within a regional/probabilistic design, and those which, for logistical and jurisdictional reasons, should be implemented locally using a targeted (non-probabilistic) design. The monitoring elements included in each design category are specified in Table 1.2.

Table 1.1 Regional Monitoring Coalition 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
Alameda Countywide Clean Water Program (ACCWP)	Cities of Alameda, Albany, Berkeley, Dublin, Emeryville, Fremont, Hayward, Livermore, Newark, Oakland, Piedmont, Pleasanton, San Leandro, and Union City; Alameda County; Alameda County Flood Control and Water Conservation District; and Zone 7
Contra Costa Clean Water Program (CCCWP)	Cities of Antioch, Brentwood, Clayton, Concord, Town of Danville, El Cerrito, Hercules, Lafayette, Martinez, Town of Moraga, Oakley, Orinda, Pinole, Pittsburg, Pleasant Hill, Richmond, San Pablo, San Ramon, Walnut Creek; Contra Costa County Flood Control and Water Conservation District; and Contra Costa County Watershed Program
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

Table 1.2 Creek Status Monitoring Parameter per MRP 2.0 Provision C.8.d. and C.8.g., Monitored as Either Regional/Probabilistic or Local/Targeted Design

Biological Response and Stressor Indicators	Monitoring Design	
	Regional (Probabilistic)	Local (Targeted)
Bioassessment, physical habitat assessment, CSCI	X	X[1]
Nutrients (and other water chemistry associated with bioassessment)	X	X[1]
Chlorine	X	X[2]
Water toxicity (wet and dry weather)	NA	NA
Water chemistry (pesticides, wet weather)	NA	NA
Sediment toxicity (dry weather)	NA	NA
Sediment chemistry (dry weather)	NA	NA
Continuous water quality (sondes data: temperature, dissolved oxygen, pH, specific conductance)		X
Continuous water temperature (data loggers)		X
Pathogen indicators (bacteria)[3]		X

1 MRP 2.0 Provision C.8.d.i.(6) allows for up to 20% of sample locations to be selected under a targeted monitoring design. This design change was made under MRP Order No. R2-2015-0049.

2 MRP 2.0 Provision C.8.d.ii.(2) provides options for probabilistic or targeted site selection. In water year 2020, chlorine was measured at probabilistic sites.

3 Not required in water year 2022

CSCI California Stream Condition Index

NA Not applicable; the monitoring parameter is not specific to either monitoring design

1.4 Report Organization

This report focuses on the creek status and long-term trends monitoring activities conducted to comply with MRP 2.0 Provision C.8.d using a targeted (non-probabilistic) monitoring design during water year 2022. Together with the creek status monitoring data reported in Regional/Probabilistic Creek Status Monitoring Report: Water Year 2022 (ARC 2023), this submittal fulfills creek status monitoring requirements specified in MRP 2.0 Provisions C.8.d and C.8.g and complies with reporting Provision C.8.h.iii of the MRP (SFBRWQCB 2015). The remainder of the report describes the study area and design (Section 2), monitoring methods (Section 3), results and discussion (Section 4), and next steps (Section 5). As the permit term reporting requirements in water year 2022 only apply up to June 30, data collected after June 30, 2022, are not included in this report. Creek status monitoring parameters historically collected in the fourth quarter of a water year under MRP 2.0 were not collected because MRP 3.0 (effective July 1, 2022) provisions do not include them as a requirement.

2 Study Area and Design

2.1 Regional Monitoring Coalition Area

The RMC area encompasses 3,407 square miles of land in the San Francisco Bay Area. This includes portions of five participating counties which fall within the jurisdiction of the SFBRWQCB. Figure 2.1 displays the RMC area and illustrates the boundary of the State Water Resources Control Board (Regions 2 and 5) within Contra Costa County. The eastern portion of Contra Costa County drains to the CVRWQCB region (Region 5), while the western, central, and southern portions of the county drain into Region 2. Creek status monitoring is conducted in flowing water bodies (i.e., creeks and rivers) interspersed among the RMC area, including perennial and non-perennial creeks and rivers running through both urban and non-urban areas.

Contra Costa County has 31 major watersheds and sub-watersheds containing more than 1,300 miles of creeks and drainages (CCCDD 2003). The county's creeks discharge into the Sacramento-San Joaquin River Delta in the east, along the series of bays to the north (including Suisun and San Pablo bays), and to the northern end of the San Francisco Bay in the west. In addition, two watersheds (Upper San Leandro and Upper Alameda Creek) originate in Contra Costa County and continue through Alameda County before reaching San Francisco Bay.

2.2 Contra Costa County Targeted Monitoring Areas and Siting Rationale

In water year 2022, two of the county's watersheds were the focus of targeted general water quality or water temperature monitoring. Located in Region 2, the Upper San Leandro Creek and Walnut Creek watersheds were selected for continuous general water quality and continuous water temperature monitoring. Details discussing the water year 2022 siting rationale and watershed overview are discussed below.

2.2.1 Upper San Leandro Creek Watershed – Moraga Creek Sub-watershed

Unlike most creeks in Contra Costa County, the 4.8-mile-long Moraga Creek is part of the Upper San Leandro Creek watershed that drains into Alameda County via the San Leandro Reservoir. Moraga Creek, Laguna Creek and Rimer Creek create the Moraga Creek sub-watershed coming together to flow into Upper San Leandro Creek and the northeast arm of the Upper San Leandro Reservoir. Managed by the East Bay Municipal Utility District (EBMUD), the reservoir spans the county line with its outlet in Alameda County. Water then flows through Alameda County to the San Francisco Bay (CCCDD 2003).

The channels of the creeks throughout the area are relatively unmodified, with 93.8% of the 50.47 miles of stream channel containing no obvious reinforcements. Within Contra Costa County, the southern extent of Orinda and a major portion of Moraga make up the local jurisdictions in the 13,059-acre watershed. Portions of Moraga Creek are routed underground, to accommodate urbanization and infrastructure-based development (CCCDD 2003).

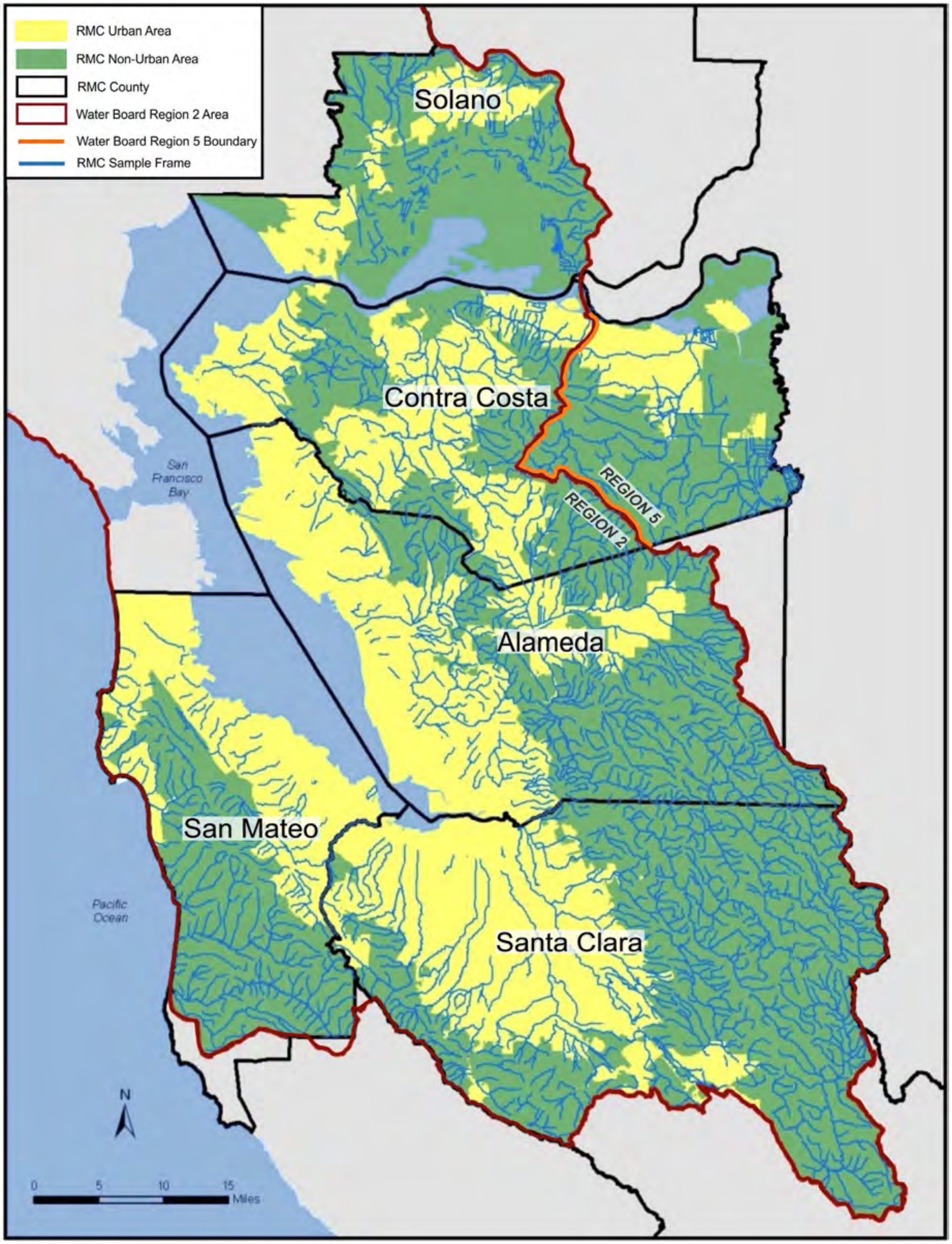

Figure 2.1 Map of RMC Area, County Boundaries and Major Creeks

In the Moraga Creek sub-watershed, unincorporated county lands, including portions of protected watershed managed by the EBMUD and East Bay Regional Parks District, keep the watershed area lightly developed at 25%. The developed area of the watershed consists mainly of small ranches and single-family homes, while impervious surface makes up only 15% of the total watershed area. Due to orographic lifting generated by the southern extent of the East Bay Hills, annual rainfall in this watershed is some of the highest in the county, ranging from 28 to 33 inches per year (CCCDD 2003).

In water year 2022, two locations were selected for targeted monitoring in the Moraga Creek sub-watershed. One location in Moraga Creek, downstream of the Moraga Country Club below the confluence with Laguna Creek in the City of Moraga, and one location in Rimer Creek, upstream of Camino Pablo adjacent to Sanders Ranch Road in the City of Moraga. Continuous water temperature monitoring in Moraga Creek and Rimer Creek were targeted to assess COLD habitat in a steelhead stream with documented rainbow trout populations (KEI 2022). Monitoring in Moraga Creek was also targeted following MRP 2.0 water temperature exceedances in water years 2020 (ADH 2021) and 2021 (KEI 2022).

2.2.2 Walnut Creek Watershed

The Walnut Creek watershed is in central Contra Costa County, with boundaries demarcated by the west side of Mount Diablo and the east side of the East Bay Hills. At 93,556 acres, it is the largest watershed in the county. The watershed has eight major tributaries which flow into the generally south-north trending direction of Walnut Creek. These tributaries include San Ramon Creek, Bollinger Canyon Creek, Las Trampas Creek, Lafayette Creek, Grayson Creek, Murderers Creek, Pine Creek, and Galindo Creek.

Due to steep slopes and land protection efforts, the upper watersheds along the perimeter of the Walnut Creek watershed generally remain undeveloped open space. The valleys of the watershed are densely urbanized and populated by the cities of Walnut Creek, Lafayette, Pleasant Hill, and Danville. The cities of Concord, Martinez, and small areas of Moraga and San Ramon also are partly within the watershed (Walkling 2013).

Walnut Creek has the second longest running stream length in the county at 28.74 miles. Its highest elevation lies at 3,849 feet, while the mouth joins sea level at Suisun Bay. An estimated 73% of its stream channel remains in a natural or earthen state, with the remaining portion contains hardened man-made reinforcements. Estimated impervious surfaces make up 30% of its watershed. Walnut Creek's estimated mean daily flow is 81.4 cubic feet per second (CCCDD 2003).

There were four locations targeted for continuous monitoring in the Walnut Creek watershed in water year 2022, one location each in Lafayette Creek, Las Trampas Creek, Bollinger Canyon Creek, and Walnut Creek. Lafayette Creek is a three-mile tributary to Las Trampas Creek, a 12.37-mile branch which eventually joins with San Ramon Creek to form Walnut Creek on the south side of the City of Walnut Creek. The 17,238-acre Las Trampas Creek sub-watershed is predominantly natural, with 79.1% of the 64.1 miles of channel containing no obvious reinforcements. Impervious surface in the Las Trampas Creek sub-watershed is calculated at 13.5% (CCCDD 2003). CCCWP monitored Lafayette Creek in water year 2016 and 2021 and discovered continuous water temperature exceedances. As data from previous years suggest water temperature in Lafayette Creek may be impacting its designated beneficial use, continuous water temperature and general water quality was targeted in water year 2022. Continuous water temperature was also targeted downstream at Las Trampas Creek, which experienced MRP 2.0 water temperature exceedances in water years 2017 and 2020.

Bollinger Canyon Creek, part of the San Ramon Creek subwatershed, is located in the southwest corner of the Walnut Creek watershed. Flowing southwest for five miles between Rocky Ridge and the Las Trampas Ridge, Bollinger Canyon Creek then leaves Bollinger Canyon and becomes San Ramon Creek flowing north into Walnut Creek at the City of Walnut Creek. The upper watershed of Bollinger Canyon is predominantly East Bay Regional Park District (EBRPD) land, with open space preserved for recreation and conservation. Continuous water temperature monitoring in Bollinger Canyon Creek was targeted to assess COLD habitat in a stream documented to support rainbow trout populations.

The fourth location targeted in the Walnut Creek watershed was located on Walnut Creek's main branch, downstream of the confluence with San Ramon Creek, in the City of Walnut Creek at Civic Park. Continuous general water quality was targeted to determine if this reach of Walnut Creek maintains its designated beneficial use for cold freshwater species, following MRP 2.0 water temperature exceedances in water year 2021.

2.3 Contra Costa Targeted Monitoring Design

In water year 2022, continuous water temperature and continuous water quality measurements were monitored at the targeted locations listed in Table 2.1. Monitoring locations are displayed in the overview map presented in Figure 2.2.

Site locations were identified using a targeted monitoring design based on a directed principle[3] to address the following management questions:

1. What is the range of continuous water quality measurements at targeted sites of interest?
2. Do continuous water quality measurements indicate potential impacts to aquatic life?
3. Are conditions in local receiving waters supportive of or likely supportive of beneficial uses?

Within Contra Costa County, the following targeted monitoring was conducted in water year 2022:

- Four continuous water temperature monitoring locations
- Two continuous water quality monitoring locations

Table 2.1 Targeted Sites and Local Reporting Parameters Monitored in Water Year 2022 in Contra Costa County

Site Code	Creek Name	Latitude	Longitude	Continuous Water Temperature	Continuous Water Quality
204R01519	Rimer Creek	37.81534	-122.11636	X	
204SLE204	Moraga Creek	37.83252	-122.13431	X	
207R02635	Las Trampas Creek	37.88925	-122.07336	X	
207R03780	Bollinger Canyon Creek	37.77100	-121.98966	X	
207R03403	Walnut Creek	37.90316	-122.05882		X
207LFC355	Lafayette Creek	37.89214	-122.11178		X

[3] 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."

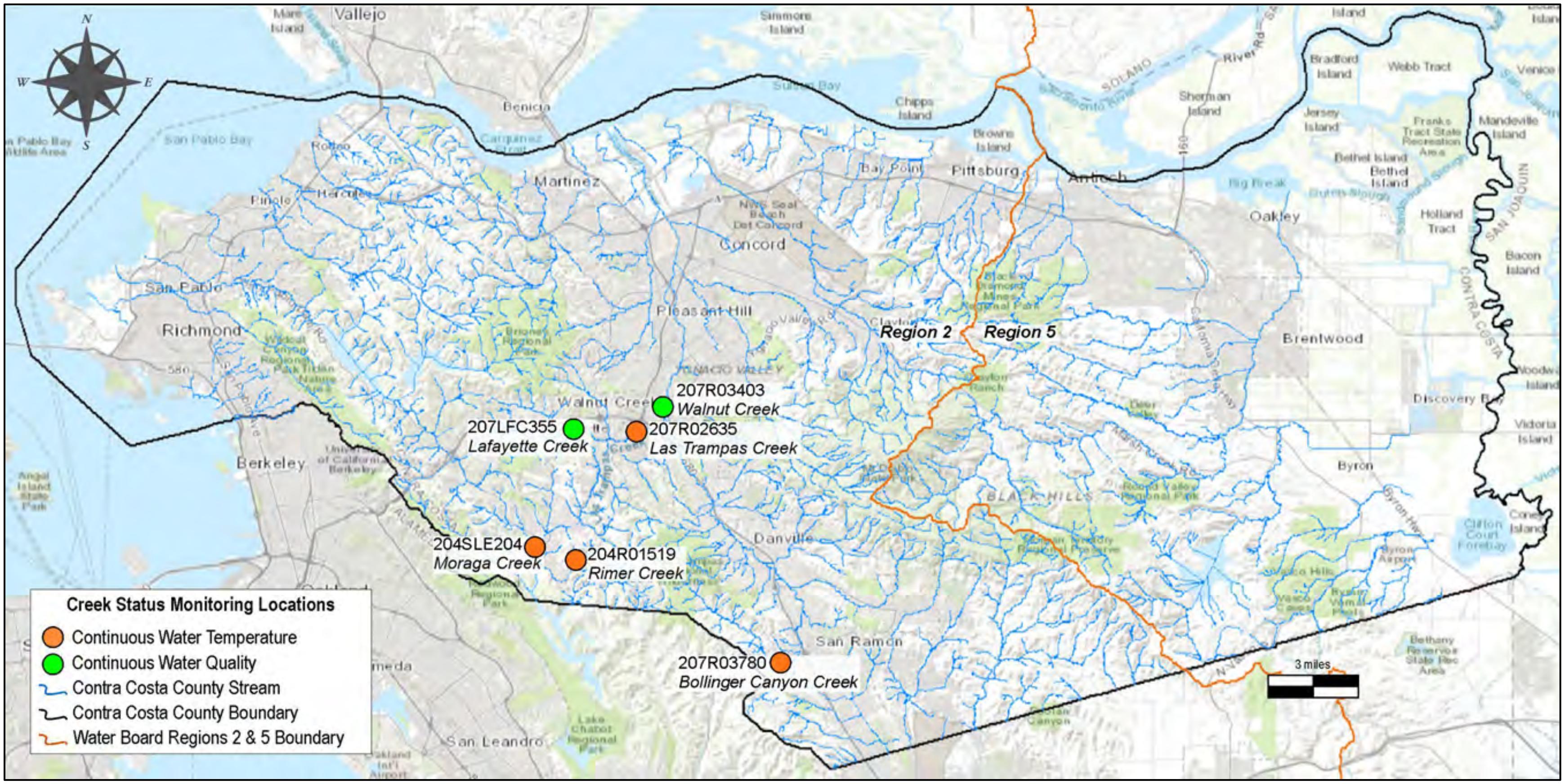

Figure 2.2 Overview of Targeted Sites Monitored by CCCWP in Water Year 2022

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3 Monitoring Methods

Targeted monitoring data were collected in accordance with the BASMAA RMC QAPP (BASMAA 2020) and BASMAA RMC SOP (BASMAA 2016). Where applicable, monitoring data were collected using methods comparable to those specified by the California Surface Water Ambient Monitoring Program (SWAMP) QAPP (SWAMP 2013) and were submitted in SWAMP-compatible format by CCCWP to the SFBRWQCB and the CVRWQCB on behalf of CCCWP permittees and pursuant to Provision C.8.h.

3.1 Data Collection Methods

Water quality data were collected in accordance with SWAMP-comparable methods and procedures described in the BASMAA RMC SOPs (BASMAA 2016) and associated QAPP (BASMAA 2020). These documents are updated as needed to maintain current and optimal applicability. The SOPs were developed using a standard format which describes health and safety precautions and considerations, relevant training, site selection, and sampling methods and procedures, (including pre-fieldwork mobilization activities to prepare equipment), sample collection, and demobilization activities to preserve and transport samples.

Monitoring frequency, timeframe, and number of site details for data evaluated are discussed below.

3.1.1 Continuous Water Quality Measurements

Continuous water quality monitoring equipment (YSI EXO 3) were deployed at two targeted locations during water year 2022. Continuous water quality parameters (water temperature, dissolved oxygen, pH, and specific conductance) were recorded every 10 minutes at two stations. The equipment was deployed as follows:

- Once during the spring over one to two weeks concurrent with bioassessment sampling (April-early June)

Procedures used for calibrating, deploying, programming, and downloading data are described in RMC SOP FS-4 (BASMAA 2016).

3.1.2 Continuous Water Temperature Monitoring

During water year 2022, continuous water temperature monitoring was conducted using digital temperature loggers (Onset® HOBO® Water Temp Pro V2) at four locations in the county. Locations were deployed at targeted sites from April-June in stream reaches that are documented to support cold water fisheries or where either past data or best professional judgment indicates that temperatures may negatively affect the designated beneficial use. Digital temperature loggers were set to record at 60-minute intervals over the course of the monitoring period.

Procedures used for calibrating, deploying, programming, and downloading data are described in RMC SOP FS-5 (BASMAA 2016).

3.2 Data Analysis and Interpretation Methods

Targeted monitoring data were evaluated against water quality objectives or other applicable thresholds, as described in Provision C.8.d of MRP 2.0. Table 3.1 defines thresholds used for selected targeted monitoring parameters as they apply to water year 2022. The following subsections provide details on MRP thresholds and the underlying rationale.

Table 3.1 Threshold Levels for Local/Targeted Creek Status Monitoring Constituents Per MRP 2.0 Provision C.8.d

Constituent	Threshold Level[1]	MRP 2 Provision	Provision Text
Water Temperature (continuous, HOBO)	≥2 weekly averages >17 °C (steelhead streams); or 20% of results >24 °C instantaneous maximum (per station)	C.8.d.iii.(4)	The temperature trigger is defined as when two or more weekly average temperatures exceed a WAT of 17 °C for a steelhead stream, or when 20% of the results at one sampling station exceed the instantaneous maximum of 24 °C. Permittees shall calculate the WAT by breaking the measurements into non-overlapping, 7-day periods.
Water Temperature (continuous, sondes)	A weekly average >17 °C (steelhead streams); or 20% of results >24 °C instantaneous maximum (per station)	C.8.d.iv.(4)a.	The Permittees shall calculate the WAT by separating the measurements into non-overlapping, 7-day periods. The temperature trigger is defined as any of the following: a single WAT exceeds 17 °C for a steelhead stream, or 20% of the instantaneous results exceed 24 °C.
pH (continuous, sondes)	≥20% results <6.5 or >8.5	C.8.d.iv.(4)b.	The pH trigger is defined as 20% of instantaneous pH results are <6.5 or >8.5.
Specific Conductance (continuous, sondes)	≥20% results >2000 µS	C.8.d.iv.(4)c.	The specific conductance trigger is defined as 20% of the instantaneous specific conductance results are >2000 µS, or there is a spike in readings with no obvious natural explanation.

1 Per MRP 2.0 Provision C.8.d., these are the data thresholds that trigger listings as candidate SSID projects per MRP 2.0 Provision C.8.e.
WAT weekly average temperature

3.2.1 Temperature

Temperature is one indicator of the ability of a water body to support a salmonid fisheries habitat (e.g., a steelhead stream). In California, the beneficial use of a steelhead stream is generally associated with suitable spawning habitat and passage for anadromous fish.

In Section C.8.d.iii.(4) of MRP 2.0, the temperature trigger threshold specification is defined as follows:

> "The permittees shall identify a site for which results at one sampling station exceed the applicable temperature trigger or demonstrate a spike in temperature with no obvious natural explanation as a candidate SSID project. The temperature trigger is defined as when two or more weekly average temperatures exceed … 17 °C for a steelhead stream, or when 20% of the results at one sampling station exceed the instantaneous maximum of 24 °C."

In Section C.8.d.iv.(4).a of MRP 2.0, which deals with continuous monitoring of dissolved oxygen, temperature and pH, the temperature trigger threshold specification is defined as follows:

> "…(the) maximum weekly average temperature (MWAT) exceeds 17 °C for a steelhead stream, or 20% of the instantaneous results exceed 24 °C."

The first cited section applies to temperature data recorded by the HOBO devices through the period of April-September. The second cited section applies to temperature data recorded by sonde devices during the two shorter deployment periods in spring and summer.

In either case, the weekly average temperature was calculated as the average of seven daily average temperatures in non-overlapping seven-day periods. The first day's data was not included in the weekly average temperature calculations to eliminate the probable high bias of the average daily temperature of that day, because the recording devices were deployed during daylight hours (the typically warmer part of a standard 24-hour day). As the weekly average temperatures were calculated over the disjunctive seven-day periods, the last periods not containing a full seven days of data were also excluded from the calculations.

In compliance with the cited sections of MRP 2.0, sites for which results exceeded the applicable temperature trigger can be identified as candidates for a stressor/source identification (SSID) project in the following three ways:

1. If a site had temperature recorded by a HOBO device and two or more weekly average temperatures calculated from the data were above 17 °C.
2. If a site had temperature recorded by a sonde device and one or more weekly average temperatures calculated from the data were above 17 °C (equivalent to determining the MWAT at one of the sites was above 17 °C for the period in question).
3. If a site had 20% of its instantaneous temperature results above 24 °C, regardless of the recording device.

3.2.2 Dissolved Oxygen (DO)

The Basin Plan (SFBRWQCB 2019) lists the applicable water quality objective for dissolved oxygen in non-tidal waters as follows: 7.0 mg/L minimum for waters designated as COLD (i.e., a steelhead stream) and 5.0 mg/L minimum for waters designated as WARM (i.e., a non-steelhead stream). Although this water quality objective is a suitable criterion for an initial evaluation of water quality impacts, further evaluation may be needed to determine the overall extent and degree to which cold or warm water beneficial uses are supported at a site. For example, further analyses may be necessary at sites in lower reaches of a water body which 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 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.

To evaluate the results against the relevant threshold in MRP 2.0 Provision C.8.d, dissolved oxygen data were evaluated against water quality objectives for steelhead streams to determine whether 20% or more of the measurements were below the 7.0 mg/L minimum for COLD designated beneficial use.

3.2.3 Hydrogen Ion Concentration (pH)

The applicable water quality objective for pH in surface waters is stated in the Basin Plan (SFBRWQCB 2019) as follows: the pH shall not be depressed below 6.5 nor raised above 8.5. This range was used in this report to evaluate the pH data collected from creeks.

To evaluate the results against the relevant threshold in MRP 2.0 Provision C.8.d, the pH data were evaluated to determine whether 20% or more of the measurements were outside of the water quality objectives.

3.2.4 Specific Conductance

The applicable water quality objective for specific conductance in surface waters is stated in MRP 2.0 Provision C.8.d. as follows: 20% of instantaneous specific conductance results should not exceed 2,000 µS/cm, or there should not be a spike in readings with no obvious natural explanation.

To evaluate the results against the relevant threshold in MRP 2.0 Provision C.8.d, the specific conductance data were evaluated to determine whether 20% or more of instantaneous measurements were outside of the water quality objectives, or if data was determined to have a spike in readings with no obvious natural explanation.

3.3 Quality Assurance/Quality Control Procedures

The RMC established a set of guidance and tools to help ensure data quality and consistency. Key BASMAA functions are now coordinated through BAMSC, and the RMC QAPP (BASMAA 2020) and SOPs (BASMAA 2016) are still considered to be the applicable references for implementation of monitoring required by the MRP.

Data quality assurance and quality control procedures are described in detail in the BASMAA RMC QAPP (BASMAA 2020). Data quality objectives were established to ensure data collected are of adequate quality and sufficient for the intended uses. Data quality objectives 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. Data were collected according to the procedures described in the relevant BASMAA RMC SOPs (BASMAA 2016), including appropriate documentation of data sheets.

3.4 Data Quality Assessment Procedures

Following completion of the field work, the field data sheets were reviewed by the local quality assurance officer and compared against the methods and protocols specified in the RMC SOPs and QAPP. The findings and results were then evaluated against the relevant data quality objectives 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 3.2. The data quality assessment consisted of the following elements:

- Conformance with field methods, as specified in RMC SOPs and QAPP.
- Numbers of measurements completed versus planned, and identification of reasons for any missed measurements.
- Temperature data were checked for accuracy by comparing measurements taken by HOBOs with National Institute of Standards Technology thermometer readings in room temperature water and ice water.
- Continuous water quality data were checked for accuracy by comparing measurements taken before and after deployment with measurements taken in standard solutions to evaluate potential drift in readings.

Table 3.2 Data Quality Steps Implemented for Temperature and Continuous Water Quality Monitoring

Step	Temperature (HOBOs)	Continuous 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
Post-sampling event report completed	X	X
Post-event calibration conducted		X
Data review-compare drift against SWAMP measurement quality objectives		X
Data review-check for outliers / out of water measurements	X	X

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4 Results

4.1 Statement of Data Quality

Field data sheets and data files were reviewed by the local quality assurance officer and results were evaluated against relevant data quality objectives. Results were compiled for qualitative metrics (representativeness and comparability) and quantitative metrics (completeness, precision, and accuracy) in accordance with the BASMAA RMC QAPP (BASMAA 2020). Results summarizing the water year 2022 data quality assessment are discussed below:

- Hourly water temperature data were recorded at 60-minute intervals from digital data loggers deployed in four creeks: one location each in Rimer Creek, Moraga Creek, Las Trampas Creek, and Bollinger Canyon Creek. Data loggers were deployed on April 11, 2022, and remained deployed until the pickup date of Aug. 12, 2022. As the permit term reporting requirements in water year 2022 apply only up to June 30, data collected after June 30, 2022, were not included in this report. One hundred percent of the expected data were collected at all four locations.
- Continuous water quality data (water temperature, dissolved oxygen, pH, and specific conductance) were continuously monitored at 10-minute intervals by sonde devices during one time period (April 28-May 11) in two creeks: one location in Walnut Creek and one location in Lafayette Creek. One hundred percent of the expected data were collected at both locations.
- An assessment of the continuous water quality data related to data quality objectives for accuracy in water year 2022 is presented in Table 4.1. Accuracy measurements for all monitoring parameters at both locations met data quality objectives in water year 2022.

Table 4.1 Accuracy[1] Measurements Taken for Dissolved Oxygen, pH, and Specific Conductance

Parameter	Measurement Quality Objectives	207R03403 Walnut Creek	207LFC355 Lafayette Creek
		April-May	April-May
Dissolved oxygen (mg/l)	± 0.5 or 10%	-0.9%	0.07%
pH 7.0	± 0.2	-0.08	-0.07
pH 10.0	± 0.2	0.02	-0.03
Specific conductance (µS/cm)	± 10%	8.9%	7.4%

1 Accuracy of the water quality measurements were determined by calculating the difference between sonde readings using a calibration standard versus the actual concentration of the calibration standard. The results displayed are those taken following measurements within the stream, defined as "post calibration", as opposed to the "pre calibration values", where all the sonde probes were offset to match the calibration standard prior to deployment.

4.2 Water Quality Monitoring Results

All targeted water quality monitoring data were evaluated against numeric trigger thresholds, as described in MRP 2.0 Provision C.8.d. These thresholds, which include applicable numeric water quality objectives or other criteria, indicate levels at which additional follow-up may be required under the MRP. Targeted monitoring locations for water year 2022 were located within SFBRWQCB Region 2 boundaries. The results are presented below.

4.2.1 Continuous Water Temperature (HOBO)

Summary statistics for continuous water temperature data collected at the four monitoring locations from April through June 2022 are shown in Table 4.2. At Rimer Creek, Moraga Creek, Las Trampas Creek, and Bollinger Canyon Creek, approximately 80 days of hourly temperature data were collected. All data were collected successfully with no device issues or equipment movement, resulting in 100% capture of targeted data.

The minimum and maximum temperature for all four stations was 7.99 °C and 24.05 °C, respectively. The median temperature range for all four stations was 14.75 °C to 17.46 °C, and the MWAT range was 17.96 °C to 21.63 °C.

Continuous water temperature data measured at each station are presented in Figure 4.1. The WAT data, WAT threshold of 17 °C and acute threshold of 24 °C for juvenile salmonid rearing (steelhead streams), are illustrated in Figure 4.2.

Over the course of the monitoring period, weekly average temperatures measured at Rimer Creek, Moraga Creek, Las Trampas Creek and Bollinger Canyon Creek locations exceeded the threshold for steelhead streams (Table 4.3). The number of exceedances ranged from two to six instances. Therefore, all four stations exceeded the MRP trigger threshold for continuous (HOBO) water temperature (two or more weekly average temperatures over the 17 °C threshold).

Table 4.2 Descriptive Statistics for Continuous Water Temperature Measured at Four Sites in Contra Costa County (Rimer Creek, Moraga Creek, Las Trampas Creek, and Bollinger Canyon Creek) – April 11-June 30, 2022

Site Temperature	204R01519 Rimer Creek (°C)	204SLE204 Moraga Creek (°C)	207R02635 Las Trampas Creek (°C)	207R03780 Bollinger Canyon Creek (°C)
Minimum	7.99	10.76	10.39	8.57
Median	14.75	16.01	17.46	15.15
Mean	14.92	15.83	17.27	14.95
Maximum	22.44	20.56	24.05	21.01
MWAT[1]	18.36	19.04	21.63	17.96
Number of Measurements	7,692	7,722	7,725	7,727

1 The maximum of the 7-day average of the daily average temperatures

Table 4.3 Water Temperature Data Measured at Four Sites in Comparison to MRP 2.0 WAT Trigger Threshold for Steelhead Streams

Site ID	Creek Name	Monitoring Period	Number of Results Where WAT > 17 °C
204R01519	Rimer Creek	04/11/2022-06/30/2022	2 of 11
204SLE204	Moraga Creek	04/11/2022-06/30/2022	3 of 11
207R02635	Las Trampas Creek	04/11/2022-06/30/2022	6 of 11
207R03780	Bollinger Canyon Creek	04/11/2022-06/30/2022	2 of 11

WAT weekly average temperature
Values in **bold** exceed MRP criterion

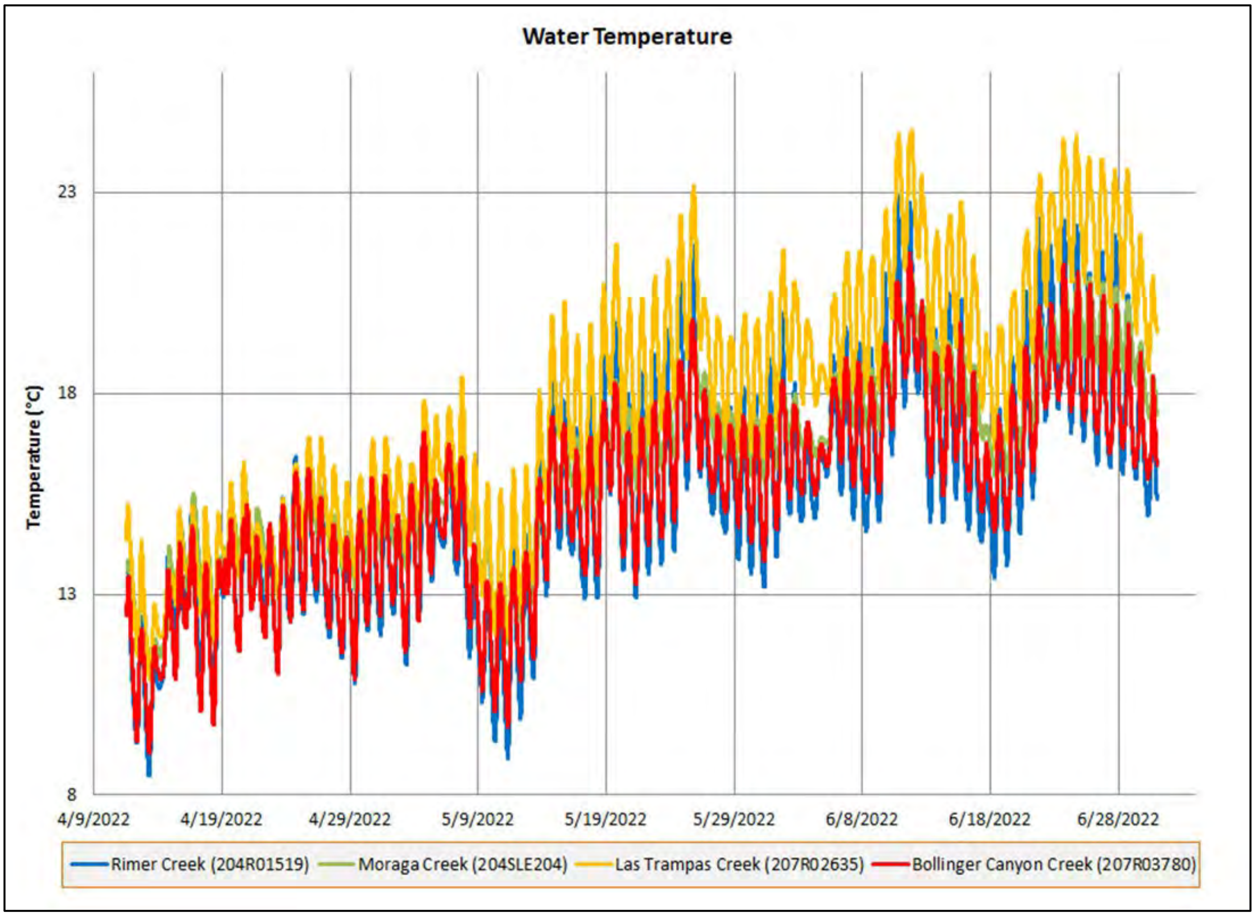

Figure 4.1 Hourly Water Temperature Data Collected at Four Sites in Contra Costa County (Rimer Creek, Moraga Creek, Las Trampas Creek, and Bollinger Canyon Creek) – April 11-June 30, 2022

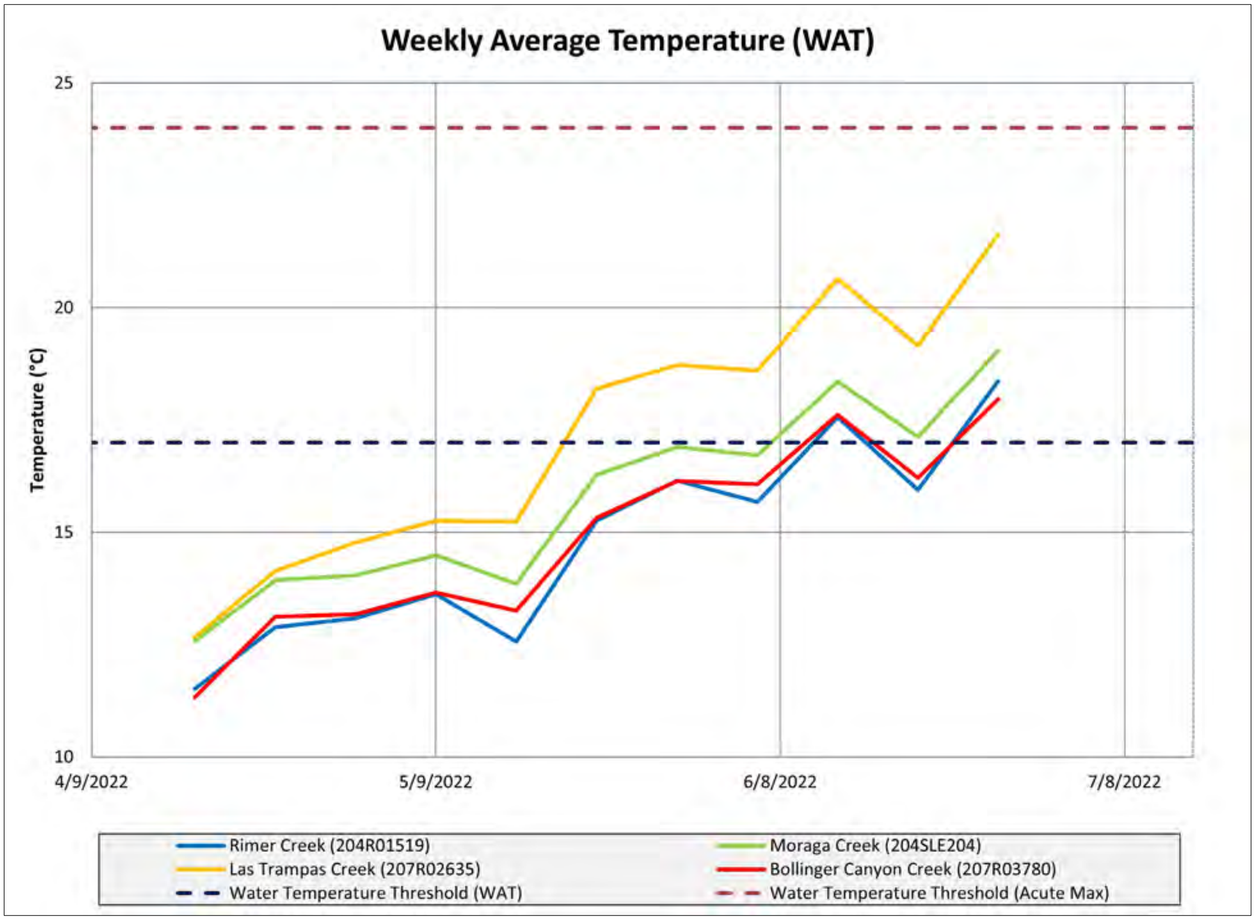

Figure 4.2 Weekly Average Water Temperature Data Collected at Four Sites in Contra Costa County (Rimer Creek, Moraga Creek, Las Trampas Creek, and Bollinger Canyon Creek) – April 11-June 30, 2022

4.2.2 Continuous Water Quality

Summary statistics for continuous water quality measurements collected at the Walnut Creek and Lafayette Creek locations during the spring deployment period (April 28-May 11) are shown in Table 4.4. WAT and MWAT for both stations over the same monitoring period are displayed in Table 4.5. Data collected during the spring deployment period, along with the required thresholds, are plotted in Figures 4.3 through 4.6.

Table 4.4 Descriptive Statistics for Continuous Water Quality Parameters (Temperature, Dissolved Oxygen, pH, and Specific Conductance) Measured in Contra Costa County (Walnut Creek and Lafayette Creek) – April 28-May 11, 2022

Parameter		207R03403 Walnut Creek	207LFC355 Lafayette Creek
		April-May	April-May
Temperature (°C)	Minimum	12.48	10.16
	Median	15.35	13.42
	Mean	15.38	13.37
	Maximum	18.11	16.19
Dissolved oxygen (mg/l)	Minimum	8.28	8.31
	Median	9.05	9.62
	Mean	9.11	9.68
	Maximum	10.69	12.54
pH	Minimum	8.08	8.05
	Median	8.21	8.21
	Mean	8.22	8.21
	Maximum	8.40	8.33
Specific conductance (µS/cm)	Minimum	696	204
	Median	854	752
	Mean	847	745
	Maximum	945	806

Table 4.5 Weekly Average Temperatures and MWAT Measured at Walnut Creek and Lafayette Creek – April 28-May 11, 2022

Site Name	Creek Name	Monitoring Period	WAT (°C)	MWAT (°C)
207R03403	Walnut Creek	04/28/22-05/11/22	15.46, 15.30	15.46
207R4819	Lafayette Creek	04/28/22-05/11/22	13.58, 13.17	13.58

MWAT maximum of recorded weekly average temperatures
WAT weekly average temperature
Values in **bold** exceed MRP criterion of 17 °C for steelhead streams

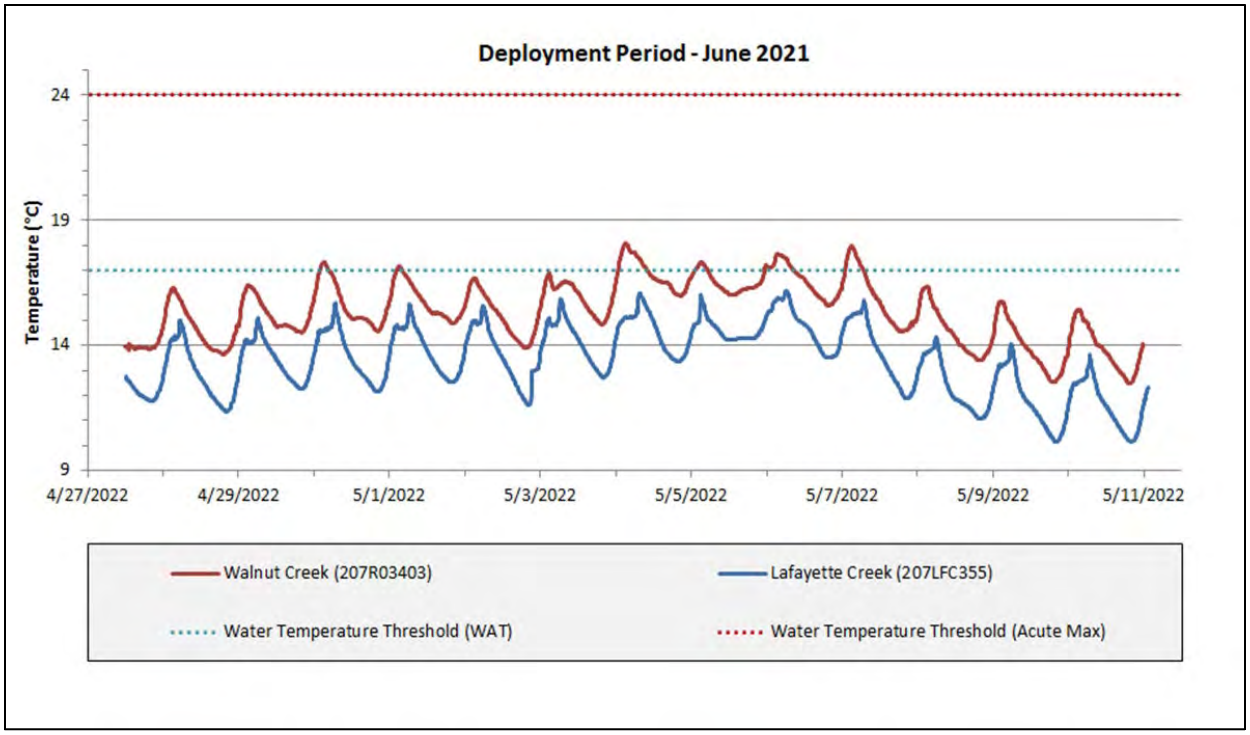

Figure 4.3 Continuous Water Quality Data (Temperature) Measured in Walnut Creek and Lafayette Creek – April 28-May 11, 2022

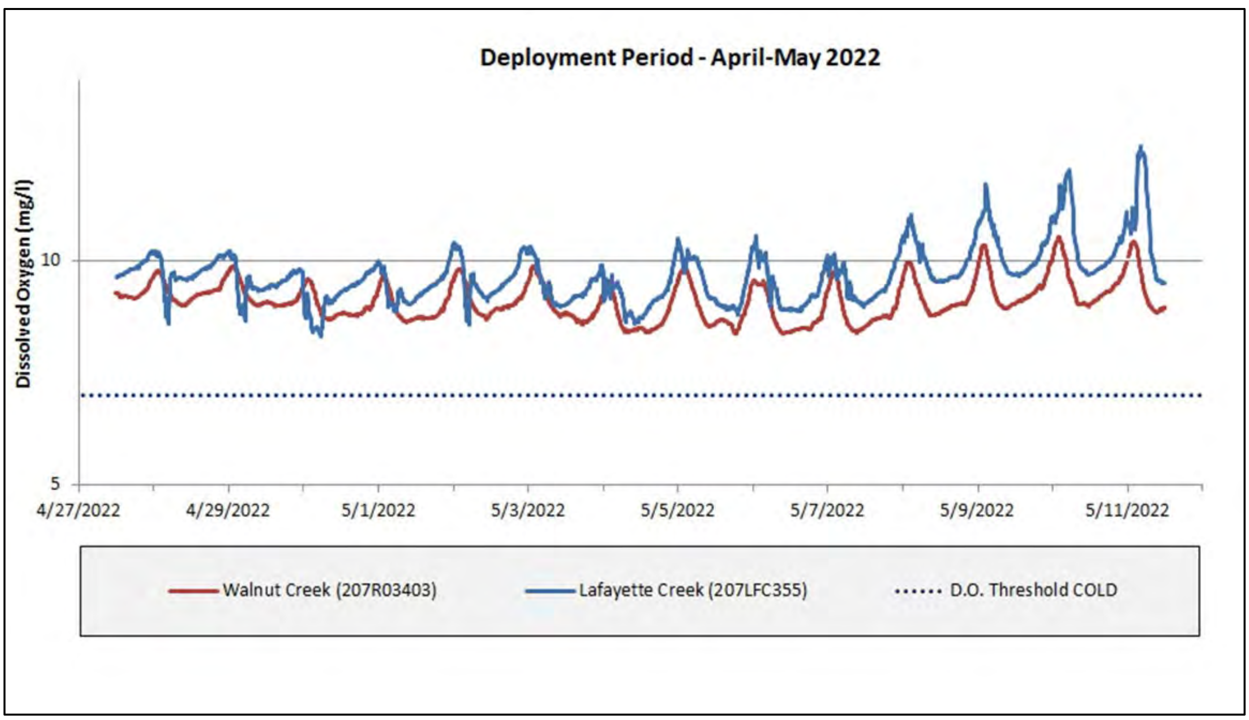

Figure 4.4 Continuous Water Quality Data (Dissolved Oxygen) Measured in Walnut Creek and Lafayette Creek – April 28-May 11, 2022

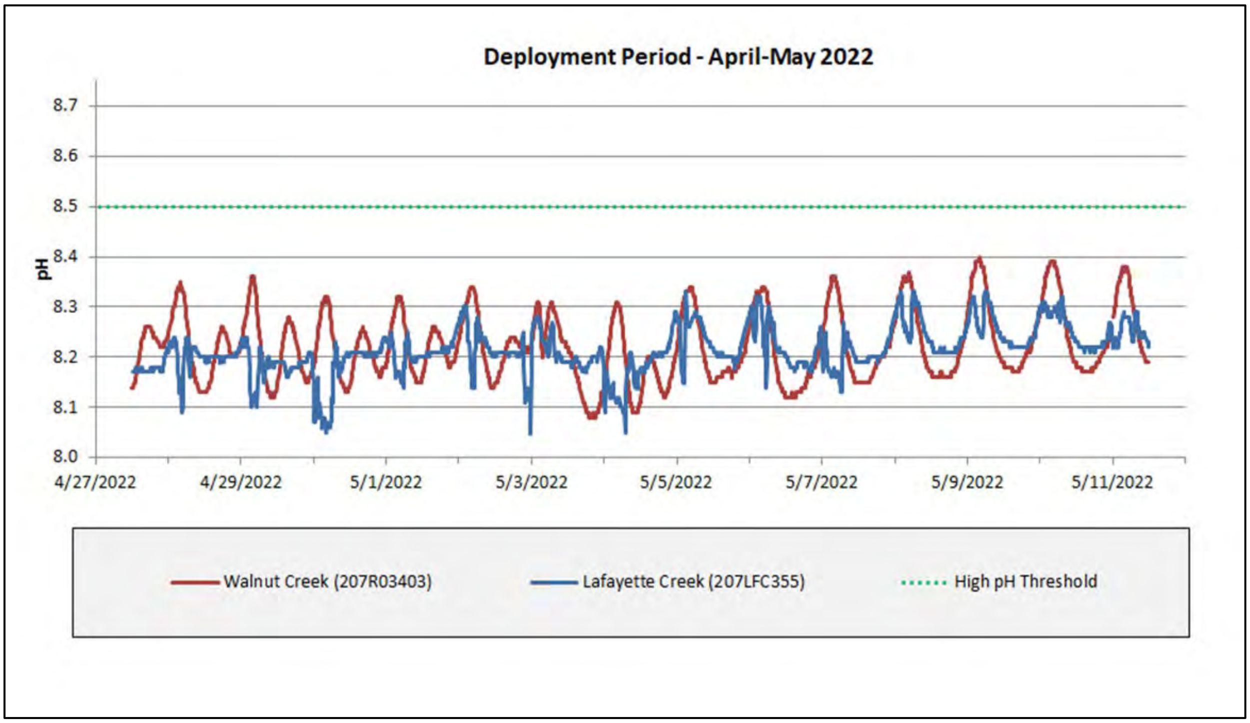

Figure 4.5 Continuous Water Quality Data (pH) Measured in Walnut Creek and Lafayette Creek – April 28-May 11, 2022

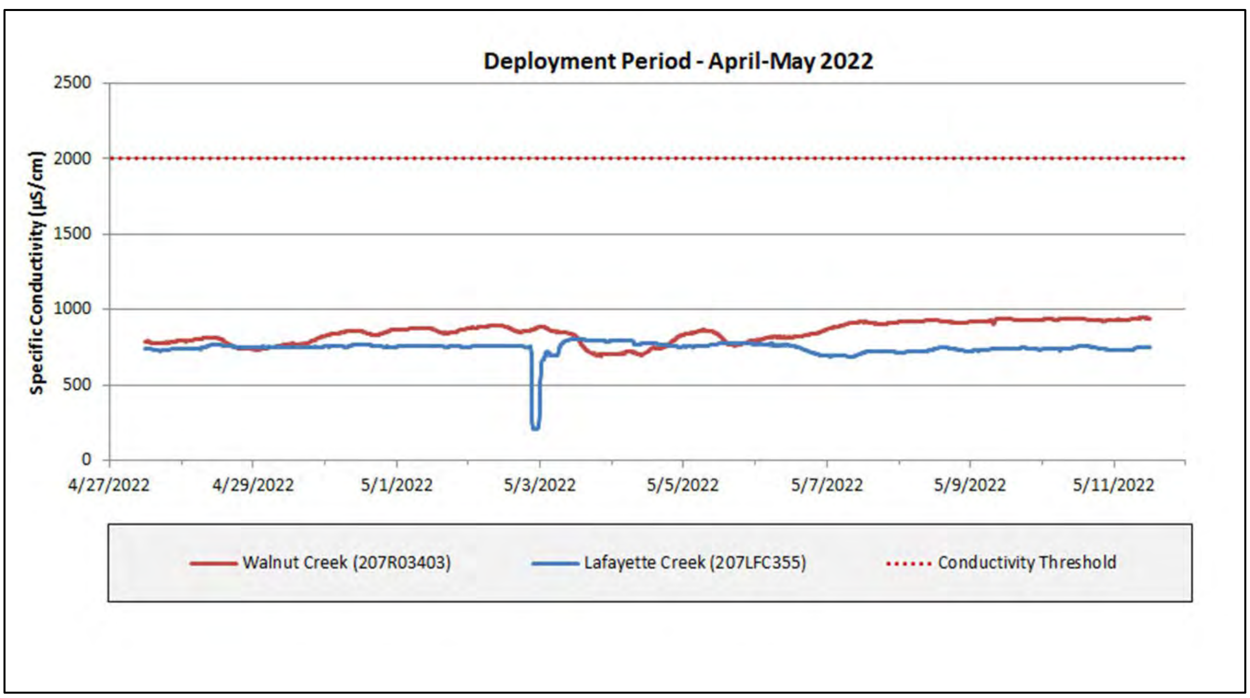

Figure 4.6 Continuous Water Quality Data (Specific Conductance) Measured in Walnut Creek and Lafayette Creek – April 28-May 11, 2022

At the Walnut Creek and Lafayette Creek monitoring stations, continuous water temperature data during the April-May deployment period display a diurnal cycle typical of the region. (Figure 4.3). During the April-May deployment period, weekly average temperatures measured at both stations were recorded below MRP 2.0 threshold criterion for steelhead streams (see Table 4.5).

The lowest dissolved oxygen concentration (8.28 mg/l) at the Walnut Creek monitoring station occurred in May 2022. The lowest dissolved oxygen concentration (8.31 mg/l) at the Lafayette Creek monitoring station occurred in April 2022. Dissolved oxygen measurements never fell below Basin Plan criteria for a steelhead stream (7.0 mg/L) at either location during the monitoring period. The minimum and maximum pH measurements for the Walnut Creek monitoring station were 8.08 and 8.40, respectively. The minimum and maximum pH measurements at the Lafayette Creek monitoring station were 8.05 and 8.33, respectively (see Table 4.4). Therefore, the minimum and maximum pH measurements at both stations never fell outside MRP 2.0 trigger threshold range of 6.5 to 8.5.

During the April-May deployment period, the Walnut Creek and Lafayette Creek monitoring stations show diurnal fluctuations of dissolved oxygen and pH (Figures 4.4 and 4.5). This cycle is typically a result of instream primary production, as during the late spring and early summer month monitoring periods, longer periods of daylight increase algae production, thus increasing the production and concentration of dissolved oxygen during the day. As the sun sets and during night hours, algae and aquatic plants switch from sunlight-induced photosynthesis to respiration and the consumption of dissolved oxygen. The consumption of dissolved oxygen in the stream through plant respiration and by decomposing plants and algae biomass contribute to decreased dissolved oxygen levels resulting in the falling limb of the diurnal curve.

Continuous conductivity data at both the Walnut Creek and Lafayette Creek monitoring stations display readings typical of the region (Figure 4.6). The median concentration of specific conductance at the Walnut Creek and Lafayette Creek monitoring stations was 854 µS/cm and 752 µS/cm, respectively. During both the April-May deployment period, neither the Walnut Creek nor Lafayette Creek station exceeded the MRP 2.0 specific conductance threshold of 2,000 µS/cm. On the morning of May 3 at the Lafayette Creek station, conductivity levels dropped from 750 µS/cm to 204 µS/cm over the course of 90 minutes, returning to baseline conductivity levels at this station by the early afternoon. As this decrease in conductivity is not considered a spike, and the increase on the afternoon of May 3 returns values to their baseline levels, this anomaly is not considered an exceedance. As the station at Lafayette Creek is located downstream of the Lafayette Reservoir, it is possible this decrease was the result of a small release of freshwater upstream.

Table 4.6 presents the percentages of continuous water quality data exceeding the water quality evaluation criteria specified in Provision C.8.d of MRP 2.0 (see Table 3.1) for dissolved oxygen, pH, and specific conductance, as measured at the Walnut Creek and Lafayette Creek stations during both monitoring periods.

Table 4.6 Percent of Dissolved Oxygen, pH, and Specific Conductance Data Measured at Two Sites in Contra Costa County (Walnut Creek and Lafayette Creek) Exceeding Water Quality Evaluation Criteria Identified in Table 3.1

Site Name	Creek Name	Monitoring Period	Dissolved Oxygen Percent Results < 5.0 mg/L	pH Percent Results < 6.5 or > 8.5	Specific Conductance Percent Results >2,000 µS/cm
207R03403	Walnut Creek	04/28/22-05/11/22	0%	0%	0%
207LFC355	Lafayette Creek	04/28/22-05/11/22	0%	0%	0%

Values in **bold** exceed MRP 2.0 criterion

Following is a summary of water quality evaluation criteria exceedances occurring at either creek location

4.2.2.1 Walnut Creek (Station 207R03403)

During the April-May 2022 deployment period, no water quality parameters exceeded MRP 2.0 trigger thresholds at the Walnut Creek station.

4.2.2.2 Lafayette Creek (Station 207LFC355)

During the April-May 2022 deployment period, no water quality parameters exceeded MRP 2.0 trigger thresholds at the Lafayette Creek station.

4.2.3 Continuous Water Quality Data Evaluation for Steelhead Suitability

The analysis of continuous water temperature and water quality data as it relates to fish habitat in Rimer Creek, Moraga Creek, Las Trampas Creek, Bollinger Canyon Creek, Walnut Creek, and Lafayette Creek is discussed below.

4.2.3.1 Rimer Creek – 204R01519

Water Temperature

The 2022 continuous water temperature monitoring station at Rimer Creek recorded a median temperature of 14.75 °C and an MWAT of 18.36 °C (see Table. 4.2). The 17 °C WAT criterion was exceeded on two occasions, once during the monitoring period of June 7-13, 2022, and once more during the period of June 21-27, 2022. There were no exceedances of the acute instantaneous water temperature criterion of 24 °C, as the maximum recorded temperature was 22.44 °C.

Steelhead Suitability

Rimer Creek is a relatively short creek (3.1 miles in length) that enters Moraga Creek about 1,550 feet before the latter flows into Upper San Leandro Reservoir on San Leandro Creek. Historically, steelhead migrated up San Leandro Creek to its headwater tributaries, including Rimer Creek (Leidy 2005). There are presently three reservoirs on San Leandro Creek located between Rimer Creek and the San Francisco Bay: Upper San Leandro Reservoir, Lower San Leandro Reservoir, and Lake Chabot, located 6.2 miles above San Francisco Bay. The construction of Chabot Reservoir in 1875 blocked the historical run of steelhead to the upstream portions of San Leandro Creek and its tributaries, but a remnant population of anadromous steelhead still spawn downstream of Lake Chabot when rains and runoff are suitable (Leidy 2005).

San Leandro Creek's tributaries flowing into Upper San Leandro Reservoir mostly all support populations of resident rainbow trout. Redwood Creek, hydrologically connected to Rimer Creek, has one of the larger populations of rainbow trout in the watershed. In 1984, the EBRPD obtained 53 yearling trout from Redwood Creek and had genetic analysis performed on them. The results showed that these fish were non-hybridized descendants of the coastal anadromous steelhead that once spawned throughout the San Leandro Creek watershed and were trapped in the upper watershed when the dams were built. So, although the upper watershed's rainbow trout are presently resident fish, their genetic stock appears to be that of San Leandro Creek's original population of anadromous steelhead un-hybridized with stocked rainbow trout from hatcheries (Leidy 2005).

EBMUD fisheries biologists report electrofishing Rimer Creek in 2020 and confirming the presence of rainbow trout in Rimer Creek. Fisheries biologists with EBMUD believe that during all but very low water conditions in the Upper San Leandro Reservoir, rainbow trout from the reservoir migrate up Rimer Creek to spawn, as suggested by the large spawning redds in Rimer Creek (personal communication, Bert Mulchaey 2022).

In water year 2022, Rimer Creek did not experience any acute instantaneous temperature exceedances of 24 °C. During two weeks of the 11-week deployment period, continuous water temperatures failed to meet the 17 °C WAT criterion, resulting in an MRP 2.0 exceedance. When discussing steelhead and resident rainbow trout in Contra Costa County streams, EBMUD fisheries biologists noted that warmer waters in the southern range of steelhead streams (e.g., Rimer Creek in Contra Costa County) do not prohibit a local rainbow trout fishery, as the upper water temperature criterion of 17 °C is more suitable for Pacific Northwest fisheries. Summer water temperatures in southern steelhead streams have been observed to consistently maintain water temperatures in the 19-20 °C range, with juvenile rainbow trout showing no signs of stress (personal communication, Bert Mulchaey 2022). Information available suggests Rimer Creek in the area of Camino Pablo by Sanders Ranch Road in the City of Moraga provides a suitable spawning and rearing habitat for juvenile resident rainbow trout during the spring and early summer months despite a 17 °C WAT exceedance per MRP 2.0 criterion.

4.2.3.2 Moraga Creek – 204SLE204

Water Temperature

At the Moraga Creek continuous water temperature monitoring station, the median water temperature was 16.01 °C and the MWAT was 19.04 °C (see Table 4.2). The WAT failed to meet the 17 °C threshold criterion on three occasions, with all instances occurring during the monitoring period of June 7-June 27, 2022. There were no exceedances of the acute instantaneous water temperature criterion of 24 °C, as the maximum recorded temperature was 20.56 °C.

Steelhead Suitability

As discussed in section 4.2.3.1, there are presently three reservoirs on San Leandro Creek located between Moraga Creek and the San Francisco Bay: Upper San Leandro Reservoir, Lower San Leandro Reservoir, and Lake Chabot, located 6.2 miles above San Francisco Bay. The construction of Chabot Reservoir in 1875 blocked the historical run of steelhead to the upstream portions of San Leandro Creek and its tributaries, but a remnant population of anadromous steelhead still spawn downstream of Lake Chabot when rains and runoff are suitable (Leidy 2005).

Leidy et al. (2005) reports that Moraga Creek is depicted as having a definite run or population of rainbow trout. More recently, fishery biologist Bert Mulchaey of EBMUD confirmed that rainbow trout from Upper San Leandro Reservoir migrate up the tributary streams to spawn and the resulting juvenile fish rear in these streams (personal communication, Bert Mulchaey 2022). Based on this information, it is assumed that Moraga Creek continues to support a resident rainbow trout population.

In water year 2022, Moraga Creek did not experience any acute instantaneous temperature exceedances of 24 °C. During three weeks of the 11-week deployment period, continuous water temperatures failed to meet the 17 °C WAT criterion, resulting in an MRP 2.0 exceedance. The failure to meet the 17 °C WAT criterion during three weeks of the 11-week deployment period suggest Moraga Creek in the area immediately downstream of the Laguna Creek confluence may not be suitable for rearing habitat or juvenile resident rainbow trout during the summer months. However, when discussing steelhead and resident rainbow trout in Contra Costa County streams, EBMUD fisheries biologists noted a healthy run of migrating rainbow trout and resident rainbow trout currently inhabit Moraga Creek, despite continuous water temperature exceedances per MRP 2.0 criterion in water years 2021 and 2022 (personal communication, Bert Mulchaey 2022).

4.2.3.3 Las Trampas Creek – 207R02635

Water Temperature

At the Las Trampas Creek water temperature monitoring station, the median water temperature was 17.46 °C and the MWAT was 21.62 °C (see Table 4.2). The 17 °C WAT criterion was exceeded on six occasions, with all instances occurring during the monitoring period from May 17-June 27, 2022. The highest instantaneous water temperature recorded was 24.05 °C, however this single occurrence accounted for less than one percent of total recordings, well below the twenty percent threshold that would constitute an exceedance per MRP 2.0 criterion; therefore, there were no exceedances of this criterion.

Steelhead Suitability

The Walnut Creek watershed supported a population of steelhead and coho salmon until the mid-1960s; however, the construction of drop structures on Walnut Creek downstream of the City of Walnut Creek prevent steelhead access to the watershed at present. Historically, steelhead and coho salmon formerly occupied the Walnut Creek watershed, migrating up Walnut Creek to enter the San Ramon Creek and Las Trampas Creek drainage systems to access spawning and rearing habitat. Recent studies on Las Trampas Creek and Walnut Creek determined that no steelhead reside in the Walnut Creek watershed at present, and it is likely the extensive modification of streams within the basin for flood control purposes has eliminated suitable habitat (Leidy 2005). Should the construction of effective fish ladders allow steelhead and other anadromous fish to pass over drop structures on Walnut Creek, the fish could use Walnut Creek as passage habitat to reach spawning and rearing habitat higher in the San Ramon and Las Trampas Creek sub-watersheds. U.S. Fish and Wildlife Surveys concluded that the lower end of Las Trampas Creek was unsuitable for steelhead restoration, but that upper Las Trampas Creek had the greatest potential for reestablishing steelhead (Leidy 2005).

In water year 2022, the Las Trampas Creek location at Bridge Road experienced acute instantaneous water temperature exceedances of 24 °C for less than 1% of instantaneous measurements. As this is less than 20% of instantaneous readings, this does not constitute an exceedance per MRP 2.0 criterion (see Table 3.1). As the 17 °C WAT criterion was exceeded during six weeks of the 11-week deployment period, it suggests this section of Las Trampas Creek may not be suitable for juvenile steelhead or rearing habitat, and may only act as a corridor for upstream migration to more suitable spawning and rearing habitat in the upper Las Trampas Creek sub-watershed per MRP 2.0 criterion.

4.2.3.4 Bollinger Canyon Creek – 207R03780

Water Temperature

At the Bollinger Canyon Creek continuous water temperature monitoring station (207R03780), the median water temperature was 15.15 °C and the MWAT was 17.96 °C (see Table 4.2). The WAT failed to meet the 17 °C threshold criterion on two occasions, once during the monitoring period of June 7-June 13, and once during the monitoring period of June 21-June 27, 2022. There were no exceedances of the acute instantaneous water temperature criterion of 24 °C, as the maximum recorded temperature was 21.01 °C.

Steelhead Suitability

Bollinger Canyon Creek is in the upper San Ramon Creek sub-watershed, within the Walnut Creek watershed. While no longer supporting steelhead or salmonids, the upper tributaries of San Ramon Creek are reported to support resident rainbow trout. EBMUD staff have observed rainbow trout in Bollinger Canyon Creek but speculate that these may be hatchery trout that have escaped from man-made impoundments in the area. The presence of rainbow trout fingerlings observed by EBMUD staff in the creek indicate some spawning is likely occurring in Bollinger Canyon Creek (Leidy 2005). Electrofishing in Bollinger Canyon Creek yielded rainbow trout in an EBRPD study; however, no electrofishing has occurred in the area since 1996 (personal communication, Joe Sullivan 2022).

In water year 2022, Bollinger Canyon Creek did not experience any acute instantaneous temperature exceedances of 24 °C. During two weeks of the 11-week deployment period, continuous water temperatures failed to meet the 17 °C WAT criterion, resulting in an MRP 2.0 exceedance. The failure to meet the 17 °C WAT criterion during two weeks of the 11-week deployment period suggest Bollinger Canyon Creek may not provide rearing habitat for juvenile resident rainbow trout in the early summer months according to MRP 2.0 criterion but does not prohibit the existence of a rainbow trout fishery in Bollinger Canyon Creek.

4.2.3.5 Walnut Creek – 207R03403

Water Temperature

The 2019 edition of the Basin Plan for the San Francisco Bay Basin designates Walnut Creek as having a COLD beneficial use. The water year 2022 sonde monitoring site in Walnut Creek was located in Civic Park, downstream of the San Ramon Creek confluence in the City of Walnut Creek. Continuous water temperature measurements were recorded at this site for the 2-week period of April 28-May 11. During this period, Walnut Creek's median temperature was 15.35 °C and its minimum and maximum temperature readings were 12.48 °C and 18.11 °C, respectively (see Table 4.4). The WAT recordings at this station during the 2-week monitoring period were 15.46 °C and 15.30 °C (see Table 4.5). No temperature criterion was exceeded during the monitoring period.

Dissolved Oxygen

During the April-May deployment period in Walnut Creek, dissolved oxygen levels never dropped below the minimum steelhead stream criterion (see Table 4.6).

pH

The pH of Walnut Creek at station 207R03403 always met Basin Plan criteria during the April-May deployment period (see Table 4.6).

Specific Conductance

The median specific conductance in Walnut Creek during the April-May deployment period was 854 µS/cm (see Table 4.4). The maximum recorded specific conductance was 945 µS/cm. Therefore, the specific conductance in Walnut Creek during the spring monitoring period met MRP 2.0 criterion (<20% of results >2,000 µS/cm).

Steelhead Suitability

Steelhead suitability within the Walnut Creek watershed is discussed in section 4.2.3.3.

In water year 2022, the Walnut Creek location at Civic Park did not experience any acute instantaneous temperature exceedances of 24 °C. The 17 °C WAT criterion was not exceeded during the two-week spring deployment period, suggesting this location of Walnut Creek would provide suitable rearing habitat or passage habitat for juvenile rainbow trout to upstream waters during the spring months.

4.2.3.6 Lafayette Creek – 207LFC355

Water Temperature

The monitoring site in Lafayette Creek was located in Leigh Creekside Park in the City of Lafayette at the mouth of Lafayette Creek, upstream of the confluence with Las Trampas Creek. The Lafayette Creek site recorded a median temperature of 13.42 °C and the minimum and maximum water temperature readings were 10.16 °C and 16.19 °C, respectively (see Table 4.4). The WAT recordings at this station during the 2-week monitoring period were 13.58 °C and 13.17 °C (see Table 4.5). No temperature criteria were exceeded during the monitoring period.

Dissolved Oxygen (DO)

During the April-May deployment period in Lafayette Creek, dissolved oxygen levels never dropped below the minimum steelhead stream criterion (see Table 4.6).

pH

The pH of Lafayette Creek at station 207LFC355 always met Basin Plan criteria during the April-May deployment period (see Table 4.6).

Specific Conductance

The median specific conductance in Lafayette Creek during the April-May deployment period was 752 µS/cm (see Table 4.4). The maximum recorded specific conductance was 806 µS/cm. Therefore, the specific conductance in Lafayette Creek during the spring monitoring period always met MRP 2.0 criterion (<20% of results >2,000 µS/cm).

Steelhead Suitability

Historically, Lafayette Creek likely had a population of steelhead, but steelhead are not present in this creek today (Leidy 2005). Leidy found no salmonids in Lafayette Creek in 1980 and 1999 and EBMUD fisheries biologists report finding no resident rainbow trout during recent electrofishing studies (personal communication, Bert Mulchaey 2022). The 2019 Basin Plan designates Lafayette Creek as having both COLD and WARM beneficial uses. This indicates the upstream portion of this creek has year-round water temperatures suitably cold to support salmonids, but the lower portions of the creek are too warm to support salmonids through the summer. The location of targeted general water quality monitoring for water year 2022 within Lafayette Creek was selected to monitor the potential to support cold water fisheries.

In water year 2022, Lafayette Creek did not experience any acute instantaneous temperature exceedances of 24 °C. The 17 °C WAT criterion was not exceeded during the two-week deployment period, constituting no exceedance per MRP 2.0 criterion. Water temperatures at this location of Lafayette Creek below the Lafayette Reservoir may be cool enough to support juvenile rainbow trout and rearing habitat during the spring months, however multiple upstream migratory barriers would make passage to upstream spawning habitat difficult and this area of Lafayette Creek is not likely to sustain a population (personal communication, Bert Mulchaey 2022).

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Appendix 5

Pollutants of Concern Monitoring Report: Water Year 2022

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Contra Costa Clean Water Program

Pollutants of Concern Monitoring Report

Submitted to the San Francisco Bay and Central Valley Regional Water Quality Control Boards

In Compliance with NPDES Permit Provision C.8.h.iv.(1)
Municipal Regional Stormwater Permit (Order No. R2-2022-0018)

March 31, 2023

Prepared for

Contra Costa Clean Water Program
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Contra Costa Clean Water Program

Pollutants of Concern Monitoring Report

March 31, 2023

Prepared for

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Contra Costa Clean Water Program Participants

- Cities of: Antioch, Brentwood, Clayton, Concord, Danville (Town), El Cerrito, Hercules, Lafayette, Martinez, Moraga (Town), Oakley, Orinda, Pinole, Pittsburg, Pleasant Hill, Richmond, San Pablo, San Ramon, and Walnut Creek
- Contra Costa County
- Contra Costa County Flood Control & Water Conservation District

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Acronyms and Abbreviations

Bay	San Francisco Bay
CCCWP	Contra Costa Clean Water Program
CVRWQCB	Central Valley Regional Water Quality Control Board
Delta	Sacramento-San Joaquin River Delta
MeHg	methylmercury
mg/kg	milligrams per kilogram
MRL	method reporting limit
MRP	municipal regional stormwater permit
MS4	municipal separate storm sewer system
NPDES	National Pollutant Discharge Elimination System
PCBs	polychlorinated biphenyl congeners
POC	pollutants of concern
ppm	parts per million
PSD	particle size distribution
RL	reporting limit
RMP	Regional Monitoring Program for Water Quality in San Francisco Bay
RPD	relative percent difference
RWL	Receiving Water Limitations
SFBRWQCB	San Francisco Bay Regional Water Quality Control Board
SSC	suspended sediment concentration
SWAMP	Surface Water Ambient Monitoring Program
TMDL	total maximum daily load
TOC	total organic carbon
USEPA	U.S. Environmental Protection Agency
WWTP	wastewater treatment plant
WY	water year

1 Executive Summary

This report summarizes pollutants of concern (POC) monitoring conducted by Contra Costa Clean Water Program (CCCWP) during water year (WY) 2022 (Oct. 1, 2021-Sept. 30, 2022). This report fulfills Provision C.8.h.iv(1) of the Municipal Regional Stormwater Permit (MRP 3.0), Order R2-2022-0018, effective July1, 2022, issued by the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB 2022).

POC monitoring is intended to assess inputs of POCs to San Francisco Bay (the Bay) from local tributaries and urban runoff, assess compliance with receiving waters limitations, assess progress toward achieving wasteload allocations for TMDLs, and to help resolve uncertainties associated with loading estimates for these pollutants.

Under MRP 3.0 Provision C.8.f., POC monitoring addresses six priority information management needs:

1. *Source Identification – identifying or confirming which sources or watershed source areas provide the greatest opportunities for reductions of POCs in urban stormwater runoff*
2. *Contributions to Bay Impairment – identifying which watershed source areas contribute most to the impairment of San Francisco Bay beneficial uses (due to source intensity and sensitivity of discharge location)*
3. *Management Action Effectiveness – evaluating the effectiveness or impacts of existing management actions, including compliance with TMDLs and other POC requirements and providing support for planning future management actions*
4. *Loads and Status – providing information on POC loads, concentrations, and presence in local tributaries or urban stormwater discharges*
5. *Trends – evaluating trends in POC loading to the Bay and POC concentrations in urban stormwater discharges or local tributaries over time*
6. *Compliance with Receiving Water Limitations – providing information to assess whether receiving water limitations (RWLs) are achieved*

Not all the above information need apply to all POCs; MRP 3.0 Tables 8.1 and 8.2 specify the minimum monitoring types (corresponding to the above information needs), methods, and frequencies of monitoring for each countywide stormwater program for the following POCs or POC groups:

- Polychlorinated biphenyls (PCBs) and total mercury, for Monitoring Types 1-5
- Copper, for Monitoring Type 4
- Emerging contaminants, for Monitoring Type 4
- Ancillary parameters as necessary for each sample to address management questions for the above POCs (e.g., total organic carbon (TOC) concurrent with PCBs where normalizing concentrations in water or sediment; suspended sediment concentration (SSC) for water samples analyzed for PCBs or mercury for Monitoring Types 3, 4 or 5; and hardness in conjunction with copper samples from fresh water)

- Copper, zinc, fecal indicator bacteria, and additional analytes selected for RWLs assessment for Monitoring Type 6

CCCWP Permittees prioritize monitoring pollutants of concern with the goal of identifying reasonable and foreseeable means of achieving load reductions of pollutants required by total maximum daily loads (TMDLs). TMDLs are watershed plans to attain water quality goals developed and established by the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB). The two most prominent TMDLs in driving stormwater monitoring, source control, and treatment control projects under MRP 3.0 are the mercury TMDL and the polychlorinated biphenyl congeners (PCBs) TMDL. In the interest of protecting the beneficial uses of the surface waters for people and wildlife dependent on the Bay for food, these regulatory plans are intended to reduce concentrations of mercury and PCBs in fish within the Bay.

Mercury and PCBs tend to bind to sediments. The principal means of transport from watersheds is via sediments washed into the Municipal Separate Storm Sewer System (MS4); therefore, an important focus of POC monitoring is identifying the most significant sources of contaminated sediments to the MS4. An additional focus is quantifying the effectiveness of control measures. The highest POC monitoring priorities for Permittees are answering these two basic TMDL implementation questions: where are the most significant sources of pollutants of concern, and what can be done to control them?

During WY 2022, the following monitoring activities were completed:

- PCBs and mercury sediment screening – sampling of street dirt and/or storm drain drop inlet sediment at ten locations adjacent to suspected source properties in old industrial areas throughout the county

Monitoring activities were performed in accordance with CCCWP's Pollutants of Concern Sampling and Analysis Plan and Quality Assurance Project Plan (ADH and AMS 2020a; ADH and AMS 2020b).

The WY 2022 monitoring effort and results are described in Section 2. Section 3 describes the allocation of sampling effort for POC monitoring for the forthcoming water year (WY 2024; Oct. 1, 2023-Sept. 30, 2024).

As discussed in Section 2.3, monitoring and assessment activities relevant to the Delta Methylmercury TMDL for East County Permittees will be reported in a separate section of the POCs report in WY 2023, per Provision C.19.d.iii.(3).

2 Monitoring Accomplished in Water Year 2022

During WY 2022, monitoring activities were performed with respect to MRP 2.0 and the newly promulgated MRP 3.0, to the extent practicable. The following subsections summarize the monitoring efforts and analytical results.

2.1 PCBs and Mercury Sediment Screening – Street Dirt and Storm Drain Drop Inlet Sampling

Ten composite samples of street dirt and storm drain drop inlet sediment were collected in September 2022. Sampling sites were selected based on 1) follow-up to WY 2021 elevated results, and 2) a GIS layer prepared by CCCWP's contractor, Geosyntec Consultants. The GIS layer identifies remaining old industrial properties throughout the county that may not have been thoroughly investigated in the past, and that may have the potential to contribute PCBs to the public right-of-way and the MS4. In generating the old industrial property database, careful consideration was given to the historic land use of each property and to results of previous monitoring efforts.

Table 1 provides site IDs, sampling dates, position coordinates and sampling notes for each location. Table 2 provides analytical test methods, reporting limits and holding times. Table 3 provides results of PCBs, mercury, total organic carbon (TOC), and particle size distribution (PSD) testing. Refer to Figure 1 for the general locations of the sampling sites.

The concentration of PCBs and mercury were nominal in seven of 10 sampling locations selected from the old industrial property database (i.e., Sample IDs KCrk1, LawRav1-LawRav3 MtzCrk1, SanFeCh10, and SanFeCh11). Test results from these seven samples ranged from 0.008 to 0.125 milligram per kilogram (mg/kg) or parts per million (ppm) for total PCBs, and from 0.081 to 0.265 ppm for total mercury (Table 3). Per MRP 3.0 Provisions C.11.c and C.12,c, moderate to high mercury and PCBs soil/sediment concentrations are generally greater than 0.3 ppm mercury and 0.2 ppm PCBs.

Three of 10 sampling locations were selected for follow-up investigation based on a single elevated result in WY 2021 sampling (1.1 ppm total PCBs for Site SanFeCh2) (CCCWP 2022a). The suspected source property on the northeast corner of S 8th Street and Ohio Avenue in Richmond was targeted for WY 2022 confirmatory sampling. Sample SanFeCh2A targeted the entrance to and exit from the property on S 8th Street; Sample SanFeCh2B targeted the perimeter of the property along Ohio Avenue; and Sample SanFeCh9 targeted the property across S 8th Street from the suspected source property (Table 1).

Follow-up sampling and analysis indicated that PCBs and mercury were highly elevated at the property entrance/exit (4.6 ppm PCBs and 1.2 ppm mercury for sample SanFeCh2A) (Table 3). Sample SanFeCh2A from the property perimeter along Ohio Avenue was also elevated (0.69 ppm PCBs and 1.0 ppm mercury). Results for Sample SanFeCh9 across S 8th Street were moderately elevated for PCBs but not mercury (0.250 ppm for PCBs and 0.173 ppm for mercury). These results seem to indicate that the source of POCs is confined to the east side of S 8th Street.

The intended follow-up action to these findings is to work with the City of Richmond to draft a source property referral form for submittal to the SFBRWQCB.

Table 1. Sediment Screening Sampling Locations and Sampling Notes – Water Year 2022

Site ID [1]	Date Sampled	Latitude[2]	Longitude[2]	City/Town	Sampling Notes	Monitoring Types
KCrk1	09/22/22	38.01513	-121.88796	Pittsburg	Sampled adjacent to vacant lot on Bliss Avenue, remainder of block along Bliss Avenue, and backside of block along Clark Avenue; the composite sample comprises 16 discrete sampling points.	Type 2
LawRav1	09/22/22	38.03002	-121.94336	Bay Point	Five discrete sampling points compose the composite sample collected along fence line of property; loose soil and gopher mounds present.	Type 1
LawRav2	09/23/22	38.03237	-121.94477	Bay Point	Composite sample comprises 12 discrete points along roadway; samples generally taken from areas where sediment accumulated around drop inlet grates where street sweepers appear to be less effective.	Type 2
LawRav3	09/23/22	38.02728	-121.94360	Martinez	Composite sample comprises 7 discrete points along fence line of property. Accessed a portion of fence line from adjacent parking lot.	Type 1
MtzCrk1	09/23/22	38.00087	-122.06725	Richmond	Composite sample comprises swept areas around drop inlets and driveways; sampled both sides of Imhoff Drive.	Type 2
SanFeCh2A	09/27/22	37.93100	-122.36184	Richmond	Composite sample comprises swept areas of the curb and gutter and sediment grabbed from broken portions of the drive apron; 4 sampling points compose the composite sample at the ingress/egress point to the property; site was selected for follow-up sampling based on WY 2021 elevated results.	Type 1, Type 5
SanFeCh2B	09/27/22	37.93093	-122.36180	Richmond	Collected 4 samples along fence line of property on Ohio Avenue. and 3 samples around rock structure on corner of S 8th Street and Ohio Avenue to compose this composite sample; site was selected for follow-up sampling based on WY 2021 elevated results.	Type 1, Type 5
SanFeCh9	09/27022	37.93106	-122.36216	Richmond	Composite sample comprises 9 sampling locations along fence line and on parcel at NW corner of S 8th Street and Ohio Avenue; this site is across the street from Site SanFeCh2A; site was selected for follow-up sampling based on WY 2021 elevated results.	Type 1
SanFeCh10	09/27/22	37.96892	-122.37140	Richmond	Three points of ingress/egress to/from the parcel were sampled along Parr Boulevard to compose this composite sample.	Type 1
SanFeCh11	09/27/22	37.96828	-122.36704	Richmond	Composite sample comprises 8 sampling locations along perimeter of property along Parr Boulevard and Goodrick Avenue.	Type 1

1 Site ID Key: KCrk = Kirker Creek, LawRav = Lawlor Ravine, MtzCrk = Martinez Creek, SanFeCh = Santa Fe Channel

2 Referenced to North American Datum of 1983

Table 2. Sediment Screening Analytical Tests, Methods, Reporting Limits, and Holding Times

Sediment Analytical Test	Method	Target Reporting Limit	Holding Time
Total PCBs (RMP 40 congeners)[1]	USEPA 8082A	0.5 µg/kg	1 year
Total Mercury	USEPA 7471B	5 µg/kg	1 year
Total Organic Carbon	ASTM D4129-05M	0.05%	28 days
Particle Size Distribution[2]	ASTM D422M	0.01%	28 days

1 San Francisco Bay RMP 40 PCB congeners include PCB-8, 18, 28, 31, 33, 44, 49, 52, 56, 60, 66, 70, 74, 87, 95, 97, 99, 101, 105, 110, 118, 128, 132, 138, 141, 149, 151, 153, 156, 158, 170, 174, 177, 180, 183, 187, 194, 195, 201, and 203.

2 Particle size distribution by the Wentworth scale; percent fines (slit and clay) are less than 62.5 microns.

Table 3. Sediment Screening Sampling Results – Water Year 2022

Sample ID	Total PCBs (mg/Kg or ppm) [1,2]	Total Hg (mg/Kg or ppm)[3]	TOC (%)	Particle Size Distribution[4]			
				Clay (%)	Silt (%)	Sand (%)	Gravel (%)
KCrk1	0.125	0.105	2.48	1.58	12.07	55.46	30.88
LawRav1	0.052	0.158	2.61	4.19	29.03	57.05	9.74
LawRav2	0.053	0.185	5.70	2.29	22.51	61.97	13.22
LawRav3	0.076	0.081	4.44	5.52	31.79	51.58	11.11
MtzCrk1	0.008	***0.318***	3.07	3.60	23.66	49.63	23.11
SanFeCh2A	***4.650***	***1.240***	5.93	2.81	20.55	45.26	31.38
SanFeCh2B	***0.687***	***1.010***	4.51	2.72	19.50	56.66	21.12
SanFeCh9	0.250	0.173	3.92	1.99	30.10	44.84	23.08
SanFeCh10	0.037	0.217	1.53	2.97	16.69	58.98	21.36
SanFeCh11	0.010	0.265	1.34	2.00	11.04	62.16	24.80

1 Sum of RMP 40 congeners

2 Values in ***bold italics*** indicate a moderate to high source area for PCBs (>0.2 ppm)

3 Values in ***bold italics*** indicate a moderate to high source area for mercury (>0.3 ppm)

ppm parts per million

Normalized to 100 percent

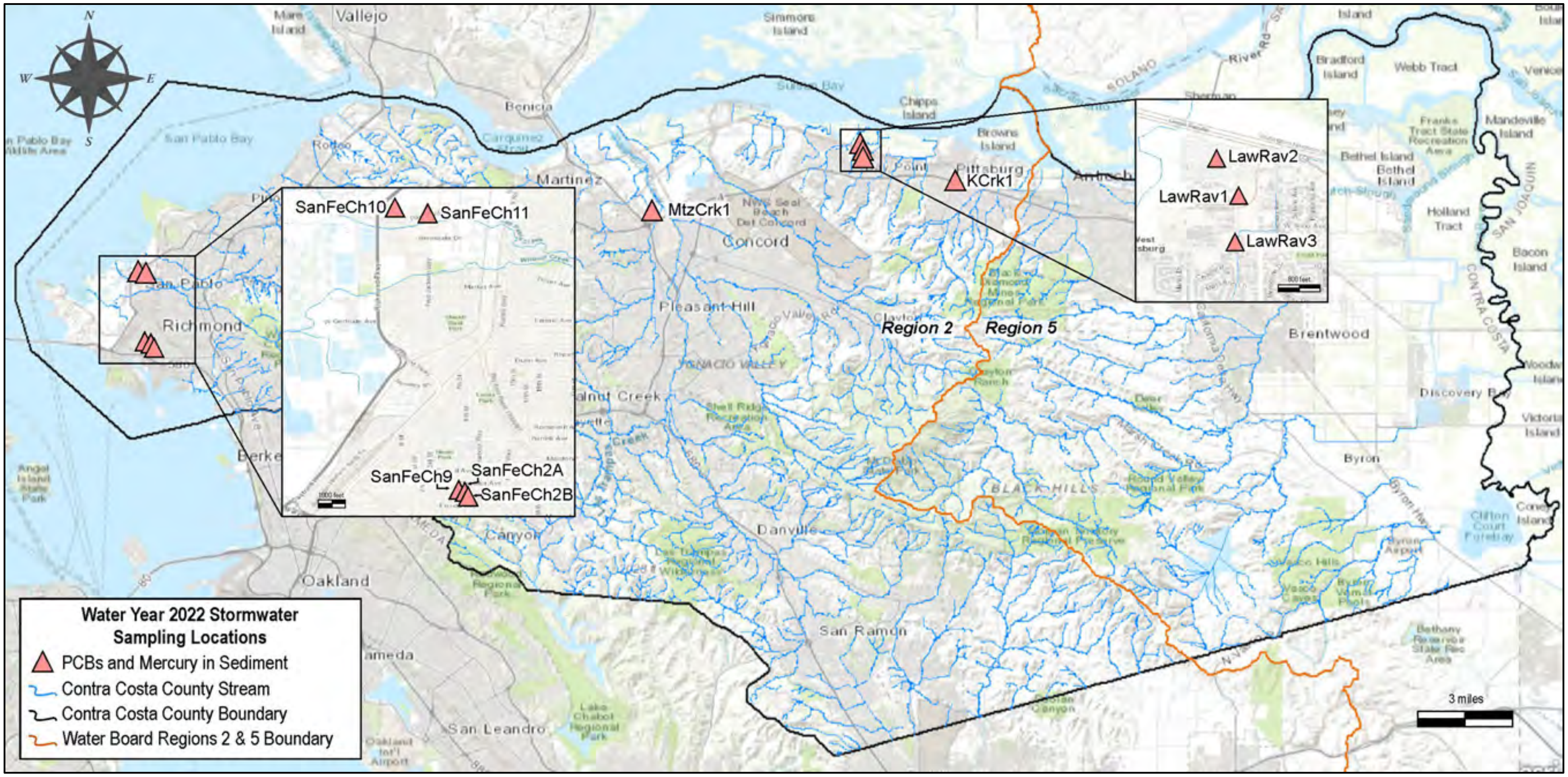

Figure 1. **Location of Water Year 2022 Monitoring Activities – County Overview**

2.2 Quality Assurance / Quality Control Analysis

Project staff performed verification and validation of laboratory data per the project quality assurance project plan (ADH and AMS 2020b) and consistent with California Surface Water Ambient Monitoring Program measurement quality objectives (SWAMP 2022).

Samples for all analyses met laboratory quality control objectives, except for minor instances detailed in Table 4 below. Given that the quality control issues described in Table 4 show the issues were of relatively minor consequence, 100% of the data from these samples are of acceptable quality and are included in the dataset for this report.

Table 4. Quality Control Issues and Analysis in the Water Year 2022 Project Data Set

Sample ID / Type	Issue	Analysis
KCrk1/Mercury laboratory duplicate	RPD of lab duplicate was 54%, well beyond the control limit of 20%. The original sample was 0.105 mg/Kg and the replicate result of 0.182 mg/Kg.	The variability in the result was attributed to the heterogeneous character of the sample; standard mixing techniques were used but were not sufficient for complete homogenization of this sample.
KCrk1/PCB matrix spike/matrix spike duplicate	For two PCB congeners (PCB 138 and 194), the RPD of the MS/MSD was greater than the 40% control limit (43% and 85%, respectively).	PCB 194 was not detected in the original sample; since the MS/MSD recoveries both indicated a high bias, the data quality was not greatly affected. PCB 138 MS/MDS RPD was only slighted elevated above the 40% limit; since the MSD recovery that led to the elevated RPD indicated a high bias, the data quality was not greatly affected.
Method 8082A, PCB congeners	On 11/16/22, the upper control criterion was exceeded for some analytes in the continuing calibration verification (CCV).	The field samples analyzed in this sequence did not contain the analytes in question; since the apparent problem indicated a high bias, the data quality was not affected, and no further corrective action was required.
Method 8082A, PCB congeners	On 10/19/22, the upper control criterion was exceeded for PCB 151, 194, 201, and 203 in the CCV.	The field samples analyzed in this sequence did not contain the analytes in question at concentrations above the MRL; since the apparent problem indicated a high bias, the data quality was not affected.
Particle size distribution field duplicate	RPD of field duplicate for coarse gravel was outside of precision control limits (40%)	Precision outside of control limits for gravel is not uncommon in field duplicate samples due to sample heterogeneity.
Method 8082A, PCB congeners	Several of the PCB congers from Method 8082A were "P" qualified, indicating the GC or HPLC confirmation criteria was exceeded and the RPD was greater than 40% between the two results.	Exceedance of this type are common with results that are only slightly above the RL. Since the "P" qualified data represent low detections, the sum of the RMP 40 congeners is acceptable for screening purposes.

CCV Continuing Calibration Verification
GC gas chromatography
HPLC high pressure liquid chromatography
MS matrix spike
MSD matrix spike duplicate
MRL method reporting limit
RMP Regional Monitoring Program for Water Quality in San Francisco Bay
RPD relative percent difference

2.3 Summary of Monitoring Completed in Water Year 2022

WY 2022 monitoring is summarized in Table 5. The table lists the total number of tests completed for each pollutant class, the monitoring types that were addressed, and the corresponding targets outlined in MRP 3.0.

Except for aqueous methylmercury, the number of samples collected and analyzed in WY 2022 met the minimum annual requirements of MRP 3.0 in all pollutant categories. Aqueous methylmercury sampling that was required annually by MRP 2.0 was customarily conducted late in each water year (i.e., after July 1 of each year). MRP 3.0 became effective on July 1, 2022, which included the following directive in Provision C.19.d.ii.(2).e:

> "*By January 1, 2024, address whether eutrophication and low dissolved oxygen concentrations increase methylmercury in ponded areas of Marsh Creek during low flow periods (depending on the year, low flow periods can range between mid-March and Mid-November), and, if so:*
>
> *i. Under what hydrologic or seasonal circumstances do increased methylmercury concentrations reach the Delta?*
>
> *ii. Are there reasonable and foreseeable management actions to ameliorate increased methylmercury concentrations?*"

Because of this directive, sampling was re-prioritized and was focused on attending to this requirement and its questions. Monitoring and assessment activities relevant to this directive and the Delta Methylmercury TMDL for East County Permittees will be reported in a separate section of the POCs report in WY 2023 per Provision C.19.d.iii.(3). Refer to Section 3 for a discussion of methylmercury sampling planned for WY 2024.

Table 5. Summary of Monitoring Completed in Water Year 2022 by Pollutant Class, Analyte, Management Information Need, and MRP Targets

Pollutant Class / Type of Monitoring	Analyte									Monitoring Types						Samples Collected and Analyzed in WY 2022	Cumulative Samples Collected and Analyzed Under MRP 3	Total Samples Required by MRP 3 (and Annual Minimum Requirement)
	PCBs	Mercury	Methylmercury	SSC	PSD	TOC	Copper [1]	Hardness	RWL Analytes[2]	(1) Source ID	(2) Bay Impairment	(3) Management Action	(4) Loads & Status	(5) Trends	(6) Receiving Water Limits			
PCBs - sediment	✓				✓	✓				✓	✓			✓		10[a]	10	65 (8)
PCBs - water																0		
Mercury – sediment		✓			✓					✓	✓			✓		10[a]	10	50 (8)
Mercury – water																0		
Methylmercury[3] – aqueous																0	0	50 (8)
Copper[1] - water																0	0	5
Emerging Contaminants[4]																NA	NA	NA
Receiving Water Limitations[2]																0	0	5

1 Total and dissolved fractions of copper
2 Receiving water limitations analytes include: dissolved copper, zinc, and lead, hardness, *E. coli*, total nitrogen, total phosphorus, ammonia, temperature, pH, and specific conductance
3 Methylmercury monitoring requirements per MRP 3 Provision C.19.d.ii.(2).
4 CCCWP is satisfying this permit requirement through augmentation of the RMP Emerging Contaminates Monitoring Strategy
a Sediment screening adjacent to old industrial source properties in high opportunity areas
SSC suspended sediment concentration
PSD particle size distribution
TOC total organic carbon
RWL receiving water limitations
NA Not applicable

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..

3 Monitoring Planned for Water Year 2024

POC monitoring conducted by CCCWP in WY 2024 will meet or exceed the minimum number of samples required each year for PCBs and mercury (eight). Monitoring Types 1 through 6 will be addressed for PCBs and mercury.

Monitoring efforts in WY 2024 will continue to include identifying mercury and PCBs source properties and areas, as required by MRP Provision C.11.b/C.12.b (Monitoring Types 1 and 2). Sediment investigation of the remaining old industrial source areas for PCBs and mercury will take place at locations identified through ongoing desktop research and field surveys. Sites which may be added to the sampling list include locations of interest due to historic or present-day land use, lack of adequate source control, and reoccurring accumulation of sediment within the right-of-way.

WY 2024 will also include sampling at the bottom of the watershed in Old Industrial areas that are expected to have few source properties to confirm this assumption (Monitoring Type 4).

A few additional previous monitoring locations will be revisited to evaluate trends in POC loading to the Bay and POC concentrations in urban stormwater discharges or local tributaries over time (Monitoring Type 5).

Receiving Water Limitations Monitoring (Type 6) will be conducted per the Receiving Water Limitations Monitoring Plan (see Urban Creeks Monitoring Report, Appendix 7).

Mercury and methylmercury monitoring in Marsh Creek will be conducted to address MRP 3.0 Provision C.19.d.ii.(2).e, as detailed in the Annual Mercury Monitoring Plan prepared for the CVRWQCB (see Urban Creeks Monitoring Report, Appendix 6). Methylmercury monitoring in Marsh Creek will be conducted at Stations M0, M1, and M2.

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Appendix 6

East County Annual Mercury Monitoring Plan: Water Year 2024

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Contra Costa Clean Water Program

East County Annual Mercury Monitoring Plan: Water Year 2024

Submitted to the San Francisco Bay and Central Valley Regional Water Quality Control Boards

In Compliance with NPDES Permit Provision C.19.d.iii.(1)
Municipal Regional Stormwater Permit (Order No. R2-2022-0018)

March 31, 2023

Contra Costa Clean Water Program
255 Glacier Drive
Martinez, California 94553

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Contra Costa Clean Water Program

East County Annual Mercury Monitoring Plan: Water Year 2024

March 31, 2023

Submitted to

San Francisco Bay and Central Valley Regional Water Quality Control Boards
in Compliance with NPDES Permit Provision C.19.d.iii.(1)
Municipal Regional Stormwater Permit (Order No. R2-2022-0018)

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Acronyms and Abbreviations

CCCWP	Contra Costa Clean Water Program
CCCDD	Contra Costa County Community Development Department
CVRWQCB	Central Valley Regional Water Quality Control Board
Delta	Sacramento-San Joaquin River Delta
MRP	Municipal Regional Stormwater Permit
Monitoring Plan	Annual Mercury Monitoring Plan
ng/L	nanograms per liter
NPDES	National Pollutant Discharge Elimination System
QA/QC	quality assurance/quality control
SFBRWQCB	San Francisco Bay Regional Water Quality Control Board
SWAMP	Surface Water Ambient Monitoring Program
TMDL	Total Maximum Daily Load

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1 Introduction

The Municipal Regional Stormwater National Pollutant Discharge Elimination System (NPDES) Permit (MRP) (SFBRWQCB 2022) requires East County Permittees of the Contra Costa Clean Water Program (CCCWP) to prepare an annual mercury monitoring plan to propose strategies, methodologies, and sampling locations for methylmercury monitoring required under Provision C.19.d.ii.(2). This East County Annual Mercury Monitoring Plan (Monitoring Plan) defines monitoring to be implemented in water year 2024.

1.1 MRP Provision

Contra Costa County lies within the jurisdictions of both the San Francisco Bay (Region 2) and Central Valley (Region 5) Regional Water Quality Control Boards (SFBRWQCB and CVRWQCB, respectively). Municipal stormwater discharges in Contra Costa County are regulated by the requirements of MRP 3.0 for urban stormwater in Region 2 (Order No. R2-2022-0018), which incorporates the eastern portion of Contra Costa County within the requirements of the Region 2 MRP. This Monitoring Plan complies with the reporting requirements specified in Provision C.19.d.iii.(1) of MRP 3.0, as issued by SFBRWQCB Order No. R2-2022-0018.

1.2 Project Background

In 2010, the CVRWQCB established methylmercury wasteload allocations for all dischargers to the Sacramento-San Joaquin River Delta (Delta) through the Delta Methylmercury Total Maximum Daily Load (Delta Mercury TMDL). The intended goal of the Delta Mercury TMDL is to bring methylmercury concentrations in fish down to levels considered to be protective of people and wildlife who consume fish from the Delta. The Delta Mercury TMDL translates desired levels of mercury in fish to a water column target of 0.06 ng unfiltered methylmercury per liter of water (0.06 ng/L). The concept behind this TMDL policy is that if all waters of the Delta were to attain a concentration of 0.06 ng/L, fish within the Delta would then attain desired levels of methylmercury (CVRWQCB 2010).

Motivation and objectives for methylmercury monitoring are driven by determination from the CVRWQCB that mercury concentrations in fish species found in the Delta exceed acceptable levels for protection of human health and wildlife that depend on fish for food (CVRWQCB 2010). The root causes of elevated levels of mercury are legacy mining and old industrial sources, along with global atmospheric sources and smaller contributions from urban stormwater sources (CCCWP 2013). Methylmercury is a form of mercury of heightened environmental concern because it binds to proteins and, therefore, bioaccumulates in organisms and biomagnifies at successively higher levels of the food chain.

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2 Study Area

The Delta Methylmercury TMDL identifies eight geographic sub-areas for monitoring (Figure 1). Of these eight geographic sub-areas, the West Delta, Central Delta, and Marsh Creek sub-areas are located within Contra Costa County. Discharges into these sub-areas are regulated by Provision C.19.d of MRP 3.0, in accordance with the Delta Methylmercury TMDL. In water year 2024, CCCWP will target two of the three Delta sub-areas for methylmercury monitoring: the West Delta sub-area and the Central Delta sub-area.

2.1 West Delta Sub-area

The West Delta sub-area includes the watersheds of West Antioch Creek and East Antioch Creek (Figure 2). Both watersheds are located in the northeastern part of Contra Costa County in part of a creek system that drains from the hills south of Antioch to the Sacramento-San Joaquin River Delta. The main stem of West Antioch Creek flows from its headwaters on East Bay Regional Parks District Land, toward its confluence with Markley Canyon Creek just north of Highway 4. While channelized in much of its lower half, the main stem of West Antioch Creek remains natural for most of its length. Many of the tributaries that make up the watershed are routed underground to provide flood protection and drainage through the more developed areas. Flowing for 6.24 miles, West Antioch Creek joins these tributaries in a channelized section of stream surrounded by urban development in the City of Antioch before passing through the Dow Wetlands Preserve and discharging into the Delta (CCCDD 2003).

The East Antioch Creek watershed begins at low elevation headwaters near Lone Tree Way in the City of Antioch by the border with the City of Brentwood. The watershed contains one primary stream branch (East Antioch Creek) and no tributaries. Trending in a northwest direction, East Antioch Creek flows 7.87 miles prior to joining the Delta. With the exception of a 1-mile underground stretch south of Highway 4, much of the creek is an aboveground earthen channel. Several detention basins and levees have been constructed along East Antioch Creek to contain storm flows. Prior to discharging into the Delta, water from East Antioch Creek flows into Lake Alhambra, a manmade impoundment constructed to contain storm flows (CCCDD 2003).

Water year 2024 sampling locations for the West Delta sub-area are located in the West Antioch Creek and East Antioch Creek watersheds. A discussion on site details for these locations are provided in Sections 2.3.1 – 2.3.3.

2.2 Central Delta Sub-area

The Central Delta sub-area includes the Kellogg Creek and Brushy Creek watersheds (Figure 3), and the East County Delta drainages (Figure 4). The Kellogg Creek and Brushy Creek watersheds are located in the southeastern portion of Contra Costa County, bordering Alameda and San Joaquin Counties. Due to the rain shadow effect of Mt. Diablo, average rainfall in the upper watershed averages approximately 20 inches per year, and falls to 10 inches or less in the lower parts of the watershed. Developed areas remain at a minimum in the Kellogg Creek and Brushy Creek watersheds, with all the land part of unincorporated Contra Costa County. The 32.6 square mile Kellogg Creek watershed includes the Los Vaqueros Reservoir, a reservoir that can store up to 100,000 acre-feet of water, pumped to the facility from an intake near Old River Road by Discovery Bay (CCCDD 2003). The Brushy Creek watershed is approximately 37.1 square miles, predominantly characterized by agriculture and undeveloped open space, with the longest stream branch being Brushy Creek at 12.5 miles. Trending eastward, Brushy Creek flows into Old River and the Clifton Court Forebay, eventually draining into the Sacramento-San Joaquin River Delta (CCCDD 2003).

The East County Delta Drainages of Contra Costa County are a series of bays and meandering tidally influenced waterways. Many of the islands that constitute the land area of the East County Delta Drainages are below sea level, as soils reclaimed from surrounding marshes have oxidized, resulting in subsiding land masses which are kept dry by peripheral levees. Major levee breaks in the area have occurred, creating new water bodies such as Franks Tract and the aptly named Big Break (CCCDD 2003). The highest elevation in the watershed is 100 feet, with the lowest elevation in the watershed at 20 feet below sea level. Surface water in the area is characterized by crisscrossing irrigation canals, channelized through flood control and agricultural infrastructure bringing water from the low-lying interior eastward to the Sacramento-San Joaquin River Delta.

Characterized by low gradient, predominantly tidally influenced waterways with lack of public access, sampling locations in the East County Delta Drainages will not be targeted in water year 2024. Sampling locations above tidal boundaries may be targeted in this portion of the Central Delta sub-area in subsequent water years.

In water year 2024, sampling locations for the Central Delta sub-area are located in the Brushy Creek and Kellogg Creek watersheds. Additional site details of these locations are discussed in Sections 2.3.4 and 2.3.5.

2.3 Sampling Locations and Schedule

The proposed MRP 3.0 monitoring schedule for Delta sub-areas in Contra Costa County is presented in Table 1. In water year 2024, the West Delta sub-area and Central Delta sub-area will be targeted for methylmercury monitoring.

Table 1. Proposed Monitoring Schedule for Delta Sub-areas in Contra Costa County

Monitoring Year (WY)	Delta Subarea		
	West Delta	Marsh Creek	Central Delta
2023		X	
2024	X		X
2025	TBD	TBD	TBD
2026	TBD	TBD	TBD
2027	TBD	TBD	TBD

WY water year
TBD Sampling schedule in these sub-areas to be determined based on the outcome of monitoring conducted in water years 2023 and 2024.

Sample location detail for water year 2024, including site ID, site coordinates, and a brief site description for selected locations are presented in Table 2.

Table 2. Sample Location, Site Coordinates, and Location Description for the West Delta and Central Delta Sub-areas

Delta Sub-area	Creek Name	Site ID	Latitude	Longitude	Site Description
West Delta	West Antioch	A1	38.00994	-121.82362	Bottom of watershed, above tidal influence
	East Antioch	A2	38.01054	-121.79682	Discharge from Lake Alhambra flap gate valve
		A3	38.00644	-121.78748	East Antioch Creek, upstream of Lake Alhambra
Central Delta	Brushy Creek	B1	37.84003	-121.62312	Bottom of watershed, above tidal influence
	Kellogg Creek	K1	37.88907	-121.62879	Bottom of watershed, above tidal influence

Sampling at locations in the two sub-areas will be conducted during both the dry season and wet season, with a minimum of eight samples collected over the course of water year 2024. Dry weather samples will be collected during baseflow conditions in the late spring or early summer, depending upon hydrologic conditions. One dry season event will be targeted, with one sample being collected at each of the five sampling locations. Wet season samples will be collected during elevated stream stages, where flow conditions have been influenced by stormwater runoff. One wet season event will be targeted, with one sample being collected at each of the five sampling locations. A total of ten samples are projected for collection over the course of water year 2024.

2.3.1 West Antioch Creek Monitoring Station A1

Monitoring Station A1 is on the main stem of West Antioch Creek. The site is located downstream of the confluence with the Markley Canyon Creek tributary near the bottom of the watershed. Located above tidal influence, below all major tributaries, this section of West Antioch Creek was selected to build upon baseline monitoring results collected by CCCWP in water year 2015 and to determine methylmercury concentrations in West Antioch Creek prior to discharging into the Delta.

2.3.2 East Antioch Creek Monitoring Station A2

Monitoring Station A2 is located downstream of Lake Alhambra at the Lake's discharge point into a tidally influenced section of East Antioch Creek. Samples will be collected near or from the discharge point flap gate prior to any tidal influence on the sample. Monitoring at this section of East Antioch Creek was selected to investigate if methylating conditions are present in Lake Alhambra, to build upon baseline monitoring data collected by CCCWP in water year 2015, and to determine methylmercury concentrations in East Antioch Creek prior to discharging into the Delta.

2.3.3 East Antioch Creek Monitoring Station A3

Monitoring Station A3 is located upstream of Station A2 on the upstream end of Lake Alhambra on the main branch of East Antioch Creek. Monitoring at this station on East Antioch Creek was selected to provide data for methylmercury ratio comparison with data from samples collected below Lake Alhambra and to build upon baseline monitoring data collected by CCCWP in water year 2015.

2.3.4 Brushy Creek Monitoring Station B1

The monitoring station at Brushy Creek is located at the bottom of the Brushy Creek watershed below major tributary confluences and above tidal influence from the Delta. As CCCWP has not previously monitored methylmercury in the Brushy Creek watershed, this monitoring station was selected to investigate hydrologic and seasonal conditions during which methylmercury concentrations might discharge to the Delta.

2.3.5 Kellogg Creek Monitoring Station K1

As with the Brushy Creek watershed monitoring station, this location at Kellogg Creek is located at the bottom of the Kellogg Creek watershed below all major tributary confluences and above tidal influence with the Delta. As CCCWP has not previously monitored methylmercury in the Kellogg Creek watershed, this monitoring station was selected to investigate hydrologic and seasonal conditions during which methylmercury concentrations might discharge to the Delta.

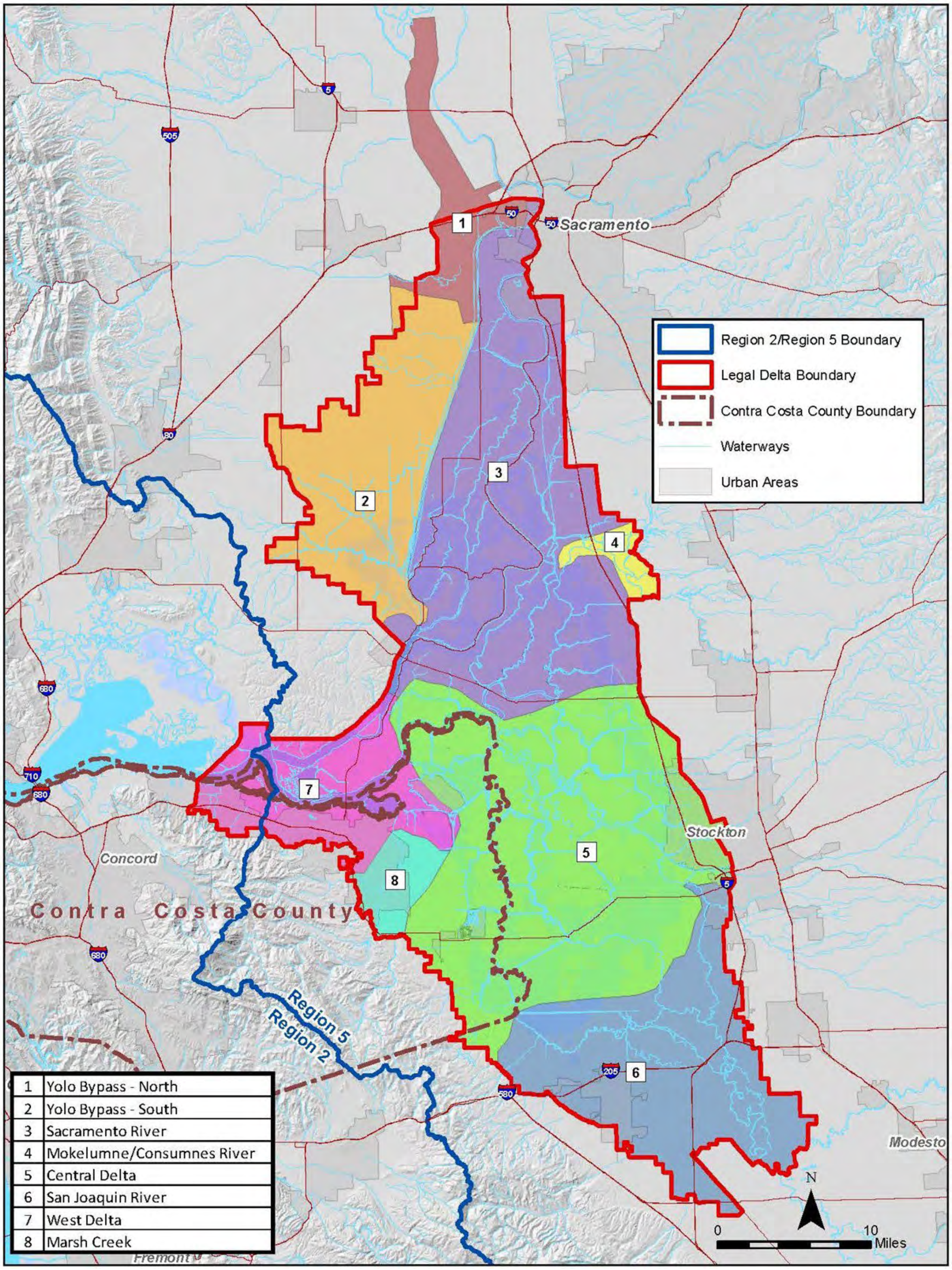

Figure 1. Delta Sub-areas Defined in the Methylmercury TMDL

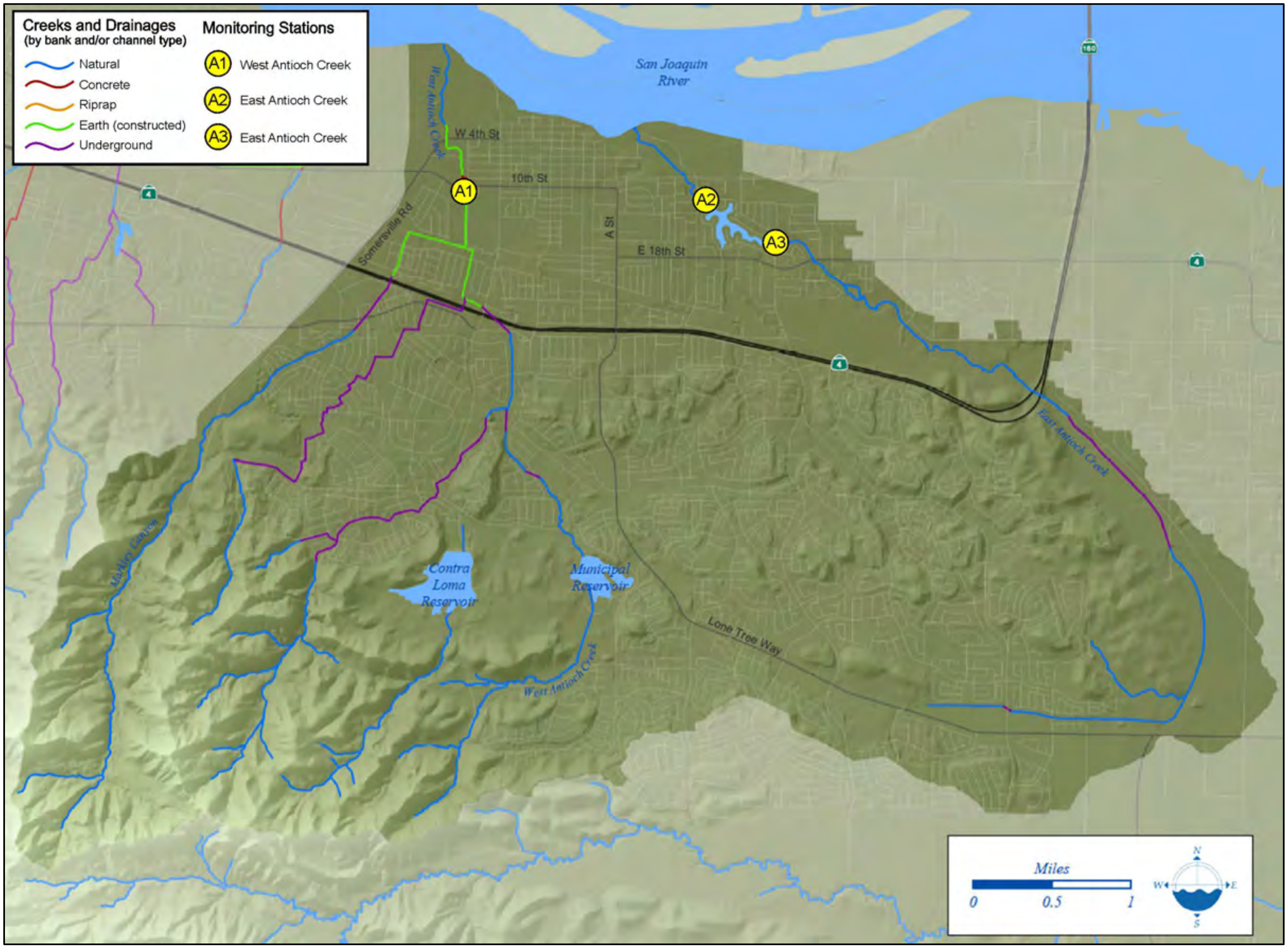

Figure 2. Overview of West Antioch Creek and East Antioch Creek Watersheds – West Delta Sub-area Monitoring Stations

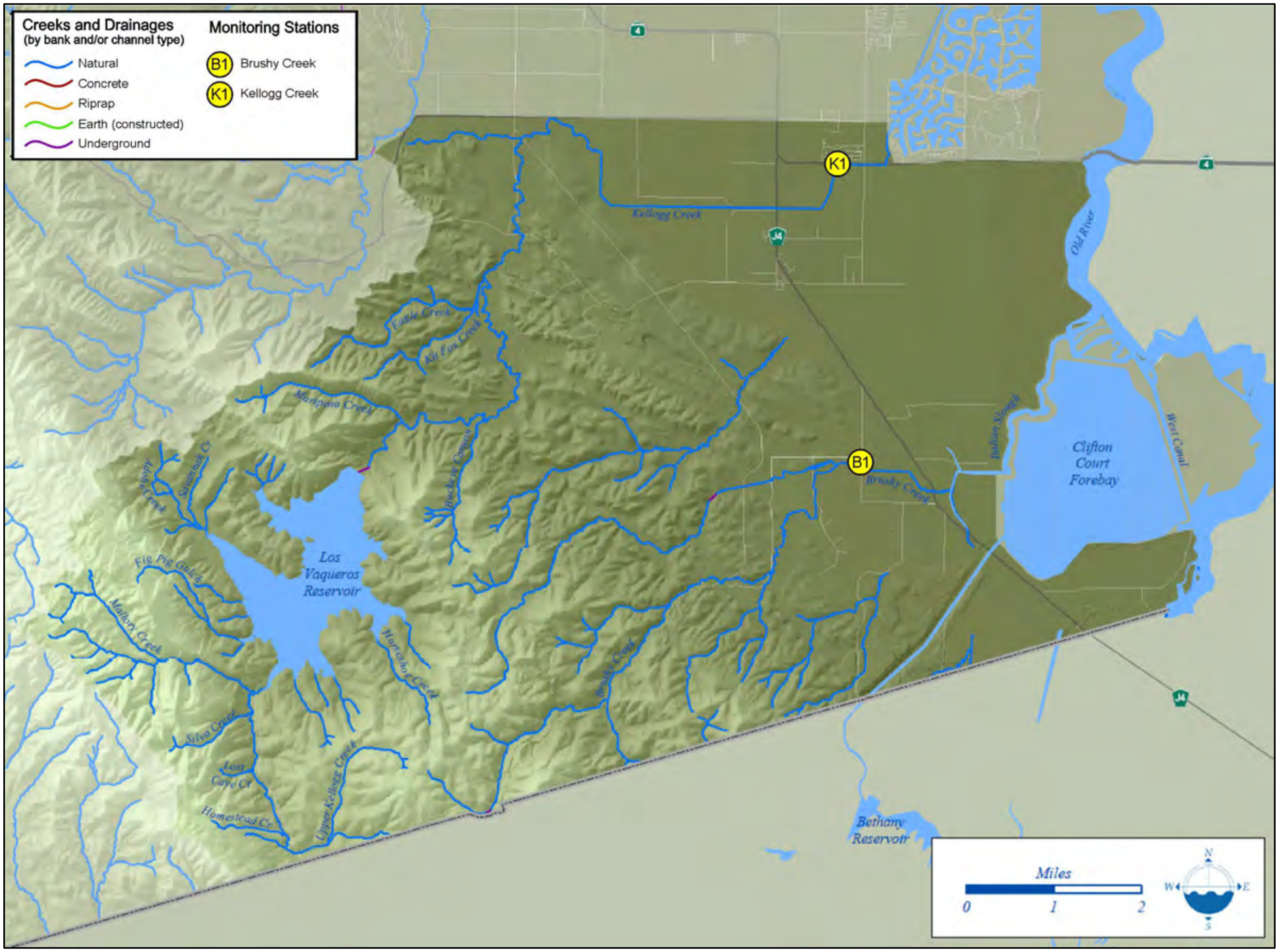

Figure 3. **Overview of Brushy Creek and Kellogg Creek Watersheds – Central Delta Sub-area Monitoring Stations**

Figure 4. Overview of East County Delta Drainages – Central Delta Sub-area

3 Monitoring Design

Target sample events and locations selected in water year 2024 are intended to address monitoring questions posed in MRP 3.0 Provision C.19.d.ii(2)(a)-(d):

a) *What are the annual methylmercury loads from the MS4 discharge to the Central Delta, Marsh Creek, and West Delta subareas?*

b) *Do the methylmercury loads to each subarea meet the assigned methylmercury wasteload allocations?*

c) *Are there any MS4 design features that increase mercury methylation in the discharge?*

d) *What MS4 water quality controls have been implemented or are planned to be implemented to reduce methylmercury production and transport in the MS4 discharge?*

The following subsections describe the field and laboratory methods that will be used in the implementation of this Monitoring Plan. A discussion providing past data collected relevant to identifying trends as part of the study approach are discussed in further detail in Section 4.

3.1 Field Sampling, Measurements, and Laboratory Methods

Sampling will be performed following clean hands/dirty hands grab sampling protocols (EPA Method 1669) for low-level mercury (EPA Method 1631E) and low-level methylmercury analysis (EPA Method 1630). At the time of grab sample collection, field measurements and observations will be made by the field crew, including dissolved oxygen concentration, pH, and water temperature. Photos will be taken to document field conditions.

Analytes, methods, reporting limits and holding times for analytes to be collected as part of this Monitoring Plan are presented in Table 3. Samples will be analyzed by Caltest Analytical Laboratory in Napa, California. Note that total mercury and total methylmercury are analyzed together (from the same sample). This is done so that methylation ratios can be calculated to indicate if samples were collected from an environment where enhanced methylation is present. Samples for suspended sediment concentration are collected and analyzed concurrent with mercury samples. This is done so that mercury results can be normalized by suspended sediment concentrations to provide an estimate of particle ratios (i.e., mercury to sediment expressed in parts per billion).

Table 3. Analytes, Methods, Reporting Limits, and Holding Times

Analyte	Method	Reporting Limit	Holding Time
Total (Unfiltered) Mercury	EPA 1631E	0.5 ng/L	90 days
Total (Unfiltered) Methylmercury	EPA 1630	0.05 ng/L	90 days
Suspended Sediment Concentration	ASTM D3977-97B	3 mg/L	7 days

3.2 Quality Assurance/Quality Control

California's Surface Water Ambient Monitoring Program (SWAMP) provides timely and high-quality data to evaluate the condition of all waters throughout the state. This is accomplished through carefully designed, externally reviewed monitoring programs and assistance to other entities state-wide in the generation of comparable data through integrated assessments. This project will use SWAMP-specified methods related to sample handling, data review, verification and validation, and measurement quality objectives as the basis for evaluating project data with the goal of it being comparable to the standard of known and documented quality that has been set by SWAMP (SWAMP 2022).

Following SWAMP guidelines, adherence to proper sample collection, sample handling, and analytical methods will ensure water samples are collected and analyzed without the inadvertent introduction of contamination from an exterior source and that they are representative of their sampling locations. These methods and procedures include clean sample collection and handling protocols for field and field quality assurance/quality control (QA/QC) samples, use of appropriate sample containers and preservation, accurate and complete field logs and chain-of-custody forms, oversight by a qualified quality assurance officer, and the internal QA/QC procedures performed by the laboratories.

For more details about sample collection and handling and other related issues, refer to the Project Sampling and Analysis Plan (ADH and AMS 2020a). For more details regarding the Monitoring Plan's quality assurance and quality control measures, refer to the project Quality Assurance Project Plan (ADH and AMS 2020b).

4 Study Design

As discussed in *Annual Mercury Monitoring Plan: Water Year 2023* (CCCWP 2022), the conceptual model for methylmercury monitoring in Delta sub-areas starts with the knowledge that methylmercury is formed from total mercury. Total mercury loads in watersheds are transported into waterbodies via stormwater. Potential sources of total mercury in stormwater include mobilization from legacy mercury mines, improper disposal of mercury-containing consumer products (batteries and fluorescent lights), to atmospheric deposition. The methylation process from total mercury to methylmercury occurs primarily and most efficiently, in slow moving or stagnant waterbodies, where metabolic activity by methylating bacteria is relatively high, either in the waterbody itself or in the bottom sediments of ponds, reservoirs, and slow-moving streams.

With this conceptual model as a guiding framework, sample locations where methylating conditions may be present can be targeted, such as Lake Alhambra on East Antioch Creek. Percent methylation is an indicator for methylation efficiency, or net methylation rates (Krabbenhoft 1999). Almost any uncontaminated soil-water system could be expected to have 1 to 3 percent methyl-total ratios. Moderately high methylation efficiency is indicated by methyl-total ratios of around 5 percent. Waters with methyl-total ratios exceeding 10 percent are considered to have high methylation efficiencies (i.e., are highly methylating).

By targeting monitoring events at strategic locations, samples collected will help determine whether methylating conditions are present and in which watersheds and will help determine methylmercury concentrations that may be reaching Delta receiving waters.

Data collected in water year 2024 will be used to help establish trends, adding to previous years monitoring data presented below in Table 4.

Table 4. Methylmercury monitoring results in West Antioch Creek and East Antioch Creek

Site ID	Wet or Dry Weather	Date	Time	SSC (mg/L)	Total Hg (ng/L)	Total MeHg (ng/L)	MeHg to Hg Ratio (%)
A1	Dry	01/14/15	1300	3.3	2.1	***0.06***	2.9
A1	Wet	02/08/15	1200	164	27	***0.21***	0.8
A1	Dry	02/26/15	1350	12	2.2	***0.07***	3.2
A1	Wet	04/07/15	1000	104	24	***0.47***	2.0
A2	Dry	01/14/15	1245	4	2	0.05	2.5
A2	Wet	02/08/15	1145	41	22	***0.11***	0.5
A2	Dry	02/26/15	1330	7.1	1.6	0.05	3.1
A2	Wet	04/07/15	0935	22	8.6	***0.11***	1.3
A2	Wet	04/25/15	0705	10	5.5	***0.13***	2.4
A2	Dry	06/09/15	1530	16	3.0	***0.08***	2.7
A3	Dry	01/14/15	1215	38	9.8	***0.24***	2.4
A3	Wet	02/08/15	1115	42	12	***0.08***	0.7
A3	Dry	02/26/15	1300	77	13	***0.12***	0.9
A3	Wet	04/07/15	0915	32	7.4	***0.08***	1.1
A3	Wet	04/25/15	0650	16	2.9	0.05	1.7
A3	Dry	06/09/15	1600	7.6	2.7	***0.13***	4.8

A1 West Antioch Creek
A2 East Antioch Creek, downstream of Lake Alhambra
A3 East Antioch Creek, upstream of Lake Alhambra
SSC suspended sediment concentration
Hg mercury
MeHg methylmercury
Values in ***bold italics*** exceed the Delta TMDL of 0.06 mg/L for methylmercury

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Appendix 7

Pollutants of Concern (POCs) Receiving Water Limitations Assessment Report

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Receiving Water Limitations Assessment Report

Receiving Water Limitations Monitoring Plan

Submitted in compliance with Provision C.8.h.iv of National Pollutant Discharge Elimination System (NPDES) Permit No. CAS612008, Order No. R2-2022-0018

Submitted by

Alameda Countywide Clean Water Program (ACCWP)
Contra Costa Clean Water Program (CCCWP)
Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP)
San Mateo Countywide Water Pollution Prevention Program (SMCWPPP)

March 14, 2023

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ACRONYMS AND ABBREVIATIONS

ACCWP	Alameda Countywide Clean Water Program
BAMSC	Bay Area Municipal Stormwater Collaboration
BASMAA	Bay Area Stormwater Management Agencies Association
Basin Plan	Water Quality Control Plan for the San Francisco Basin
CCCWP	Contra Costa Clean Water Program
CEDEN	California Environmental Data Exchange Network
CTR	California Toxics Rule
DPR	California Department of Pesticide Regulation
EB	Equipment blank
FIB	Fecal indicator bacteria
FD	Field duplicate
FB	Field blank
MP	Monitoring plan
MQO	Measurement quality objectives
MRP	Municipal Regional Stormwater Permit
NPDES	National Pollutant Discharge Elimination System
NTR	National Toxics Rule
PAH	Polycyclic aromatic hydrocarbon
PBDE	Polybrominated diphenyl ether
PCBs	Polychlorinated biphenyls
P&T	Pesticides and toxicity
QA/QC	Quality assurance and quality control
QAPP	Quality Assurance Project Plan
RMP	Regional Monitoring Program for Water Quality in San Francisco Bay
RWL	Receiving water limitations
RWL MP	Receiving Water Limitations Monitoring Plan
SFBRWQCB	San Francisco Bay Regional Water Quality Control Board
SCVURPPP	Santa Clara Valley Urban Runoff Pollution Prevention Program
SMCWPPP	San Mateo Countywide Water Pollution Prevention Program

SPoT	Stream Pollution Trends
STLS	Small Tributaries Loading Strategy
SWAMP	California Surface Water Ambient Monitoring Program
TMDL	Total Maximum Daily Load
USEPA	United States Environmental Protection Agency
Water Board	San Francisco Bay Regional Water Quality Control Board
WQAS	Water Quality Attainment Strategy
WQO	Water quality objective

1. INTRODUCTION

This Receiving Water Limitations Assessment Report was prepared collaboratively by the Alameda Countywide Clean Water Program (ACCWP), the Contra Costa Clean Water Program (CCCWP), the Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP), and the San Mateo Countywide Water Pollution Prevention Program (SMCWPPP) per the Municipal Regional Permit (MRP) for urban stormwater issued by the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB; Order No. R2-2022-0018). This report fulfills the requirements of MRP Provision C.8.h.iv.(2)(a) for providing a Receiving Water Limitations Assessment Report.

MRP Permittees are required to develop and implement a plan for monitoring receiving waters (creeks and rivers that flow to San Francisco Bay) to provide information to assess whether receiving water limitations (RWLs) are achieved. Per MRP 3.0 Provisions C.8.f and C.8.h.iv, the monitoring program should assess "the potential that discharges of these analytes may result in levels in receiving waters approaching or exceeding water quality objectives and the basis of the determination." The RWL monitoring methods must include the following attributes (SFBRWQCB 2022):

- Collection and analysis of analytes during the wet season in receiving waters (i.e., creeks and rivers that flow to San Francisco Bay) influenced by urban stormwater runoff.
- Collection and analysis of analytes during the dry season in receiving waters (i.e., creeks and rivers that flow to San Francisco Bay) influenced by dry season urban runoff.
- Sampling locations for RWLs assessment monitoring shall be spatially and temporally representative of the sampled waterbody. Sampled waterbodies shall be representative of the range of receiving waterbody types.

Permittees are to develop a Receiving Water Limitations Assessment Report, herein referred to as the RWL Monitoring Plan (MP or RWL MP), no later than March 31, 2023. The MP must provide the following information:

- Relevant water quality objectives against which to compare monitoring data;
- Analytes in addition to those listed in MRP Table 8.2 to monitor based on assessment of the potential that discharges of these analytes may result in levels in receiving waters approaching or exceeding water quality objectives and the basis of the determination; and
- Identification of waterbodies to be sampled, sampling locations within those waterbodies, and sampling schedule consistent with the requirements in MRP Tables 8.1 and 8.2.

The RWL MP is subject to approval by the SFBRWQCB Executive Officer for compliance and technical adequacy. Upon approval by the Executive Officer, Permittees will augment the RWLs assessment monitoring required in Tables 8.1 with the analytes identified in the report. By no later than March 31, 2026, or as part of the Integrated Monitoring Report, Permittees will submit an updated Receiving Water Limitations Assessment Report with proposed monitoring to be conducted during the next permit term.

This MP addresses sampling and analysis activities related to the implementation of the RWL monitoring that will be conducted by the ACCWP, CCCWP, SMCWPPP and SCVURPPP (i.e., the collaborating Programs).

The sampling and analytical methods described in this MP will be implemented by the collaborating Programs. The Programs will employ common laboratories using the same methods for all analyses and will incorporate protocols to ensure consistency in quality assurance and data management efforts.

2. BACKGROUND

MRP Provision C.8.f.ii specifies the analytes to be included in the MP as copper, zinc and fecal indicator bacteria (MRP Table 8.2). The MRP also states that additional analytes should be monitored "based on assessment of the potential that discharges of these analytes may result in levels in receiving waters approaching or exceeding water quality objectives." The following subsections describe the analyte selection process and provide the water quality objectives by which exceedances will be assessed.

2.1 Evaluation of Analytes

A summary of the process used to evaluate potential analytes is provided below. A more detailed description of the process is provided in Appendix A. The analyte evaluation was conducted in two steps: 1) compilation of water quality data collected in non-tidal receiving water locations within the four counties; and 2) an assessment of analyte concentrations which included comparison of concentrations with existing and draft proposed water quality objectives (WQOs) and criteria.

2.1.1 Data Compilation

The collaborating Programs accessed and compiled relevant water quality data from the California Environmental Data Exchange Network (CEDEN) from the last decade (2010-2021). The Programs then reviewed the compiled data on a county-by-county basis to eliminate non-relevant data points (e.g., monitoring at treatment facilities, collected in subtidal areas, associated with "field measurements", and uncertain data quality). The resulting dataset comprised approximately 26,000 data points. These data points represented many analyte types, including fecal indicator bacteria (FIB) and organic, inorganic, and conventional water quality parameters. Four primary monitoring efforts generated approximately 93% of these data points:

1. Regional Monitoring Program for Water Quality in San Francisco Bay (RMP) Small Tributaries Loading Strategy (STLS, 55%),
2. Bay Area Stormwater Management Agencies Association Regional Monitoring Coalition (RMC, 23%),
3. California Surface Water Ambient Monitoring Program (SWAMP, 13%), and
4. Department of Pesticide Regulation Surface Water Monitoring Project (DPR, 2%).

2.1.2 Analyte Selection

To evaluate which analytes to include in the monitoring program, the maximum concentration of each of the analyte was compared to the most stringent of existing water quality thresholds developed and used by federal and state regulatory agencies. This data review process was modeled after the Reasonable Potential Analysis method used by NPDES permit writers to determine if pollutants require effluent limits in NPDES wastewater permits. The water quality thresholds used in the analysis include:

- California Toxics Rule (CTR) and National Toxics Rule (NTR) Water Quality Criteria/Criterion, which were developed based on USEPA protocols and are protective of aquatic life exposed to those concentrations in the receiving water, or where applicable, protection of human health for consumption of organisms.
- Numeric WQOs listed in the Water Quality Control Plan for the San Francisco Basin (Basin Plan; RWQCB 2019) for the protection of aquatic life beneficial uses in freshwater surface waters.
- WQOs in Basin Plan Amendment R2-2021-0002, which amends the 2019 Basin Plan WQOs for bacteria.
- EPA National Recommended Water Quality Criteria, Aquatic Life and Human Health Criteria.
- Other water quality thresholds provided by SFBRWQCB staff.

The regional dataset was organized into several analyte groups for evaluation. The analyte groups include FIB, trace metals (including mercury), polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbon (PAHs), polybrominated diphenyl ethers (PBDEs), pesticides, and nutrients. No individual constituent was eliminated from consideration due to lack of a numeric WQO or criterion. Rather, individual constituents were evaluated as part of their larger group. A detailed description of the evaluation for each data group is provided in Appendix A.

Based on the analysis of readily available data collected over the last decade in Bay Area creeks and channels (i.e., receiving waters), the following analytes will be included in the RWL monitoring program:

- *E. coli* – applicable FIB, required by MRP Provision C.8.f.

- Dissolved copper – required by MRP Provision C.8.f.
- Dissolved zinc - required by MRP Provision C.8.f.
- Dissolved lead – based on the comparison of data to Basin Plan WQOs.
- Hardness – ancillary parameter to calculate site-specific metals WQOs.
- Total Mercury – based on the comparison of data to Basin Plan WQOs.
- PCBs (RMP 40)[1] – based on the comparison of data to CTR criteria.
- Total Phosphorus – based on anticipation of new statewide criteria.
- Total Nitrogen – based on anticipation of new statewide criteria.
- Unionized Ammonia – based on Regional Water Board staff recommendation.
- Ammonia, pH, specific conductance, temperature – ancillary parameters to calculate unionized ammonia.

Additionally, pesticides and toxicity (P&T) are also included in the RWL monitoring program, consistent with the monitoring being conducted in compliance with MRP Provision C.8.g – Pesticides and Toxicity Monitoring. Descriptions of the analytes, methods, timing, and sampling locations for pesticides and toxicity monitoring are included in Section 4. These descriptions explain the rationale for the monitoring conducted under provision C.8.g achieving the objectives of C.8.f RWL monitoring requirements.

2.2 Water Quality Objectives and Thresholds

The Water Quality Objectives that will be used to evaluate observed chemical concentrations are listed in Table 2-1. Pesticide and toxicity monitoring data will be evaluated consistent with MRP3 C.8.g permit requirements.

Table 2-1. Water Quality Objectives/Criteria for the Analytes Measured for the RWL MP

Analytes	Units	Applicable Objective/Criteria (Freshwater)	
		1-hr	4-day
Copper, Dissolved	ug/L	13	9.0
Lead, Dissolved		65	2.5
Zinc, Dissolved		117	118
E. coli	MPN/100mL	STV = 320	GM = 100
Total Mercury	ug/L	2.4	NA
PCBs (RMP 40)	ug/L	NA	NA
Total Nitrogen	mg/L	TBD	TBD

[1] The RMP 40 congener list was developed by the San Francisco Estuary Institute during the early years of RMP implementation and has been used by a variety of monitoring projects in the Bay Area over the last several decades, including stormwater programs subject to MRP for a variety of efforts. A list of these 40 congeners is available at https://www.sfei.org/sites/default/files/project/Updated_DMMO_PCB_Congener_and_PAH_Analyte_Lists.pdf

Analytes	Units	Applicable Objective/Criteria (Freshwater)	
		1-hr	4-day
Total Phosphorus	mg/L	TBD	TBD
Unionized Ammonia (as N)	mg/L	Annual Median = 0.025	

Notes: STV – statistical threshold value. GM – geometric mean.

For pesticides, applicable water quality thresholds provided by SFBRWQCB staff will be compared to the monitoring results.

3. PROJECT AND DATA QUALITY OBJECTIVES

The monitoring program will implement a comprehensive data quality assurance and quality control (QA/QC) program, covering all aspects of RWL monitoring. QA/QC for data the collected will be performed according to procedures detailed in both the BASMAA RMC Quality Assurance Project Plan (QAPP) (BASMAA 2020)[2] and the Clean Watersheds for a Clean Bay (CW4CB) QAPP (BASMAA 2013)[3], which between them address all proposed Project monitoring and analytical aspects. Data quality protocols incorporated into both QAPPs reference SWAMP measurement quality objectives (MQOs), so there is no expected conflict between the two. These combined QAPPs are herein referred to as the RWL MP QAPPs.

4. SAMPLING DESIGN

This section describes the sampling locations and sample frequencies for those parameters not subject to MRP Provision C.8.g permit requirements. Sampling locations, frequency, and timing for pesticides and toxicity are addressed in Section 4.3 below.

4.1 Sampling Locations

Each of the four Countywide Stormwater Programs selected a single sampling location for RWL monitoring within their respective county, for a total of four sites. Sampling stations are listed in Table 4-1 and mapped in Figure 1. Sampling stations were selected to represent a range of receiving waterbody types present in the San Francisco Bay Area. Criteria used to select waterbody types include:

- Watershed size
- Percent impervious watershed area
- Existing upstream impoundment (or not)
- Channel type

[2] https://basmaa.org/wp-content/uploads/2023/03/BASMAA_RMC_QAPP_v4_Final_2020_signed.pdf

[3] https://basmaa.org/wp-content/uploads/2021/01/final_cw4cb-qapp_r1_081513.pdf.

- Availability of previous water quality monitoring data

All sampling locations are above tidally influenced areas near the bottom of their respective watershed and are influenced by urban runoff. Selected watersheds range from 6 to 117 square miles in size and 6 to 46 percent impervious area. San Mateo Creek and Walnut Creek both have impoundments; approximately 85% of the watershed area is upstream of Crystal Springs Reservoir at San Mateo Creek, compared to one percent of the watershed area upstream of Lafayette Reservoir at Walnut Creek. All four sampling locations have been part of previous monitoring data collection efforts. There is a stream gage at the sampling station in Castro Valley Creek; the remaining stations have stream gages further upstream.

Table 4-1. Sampling Locations and Associated Watershed Characteristics for RWL Monitoring

County	Location	Latitude	Longitude	Watershed Size (sq miles)	% Impervious Area	Upstream Impoundments (Area upstream dam)	Existing Monitoring Data Collection
Alameda	Castro Valley Creek at N 3rd St (Japanese Gardens)	37.68016	-122.08059	6	46	None	Previous monitoring for ACCWP and USGS. USGS gaging station
Santa Clara	Saratoga Creek at Cabrillo Av (Bowers Park)	37.35973	-121.97336	17	21	None	Previous monitoring for SCVURPPP; stream gage further upstream
San Mateo	San Mateo Creek at 3rd Ave (Gateway Park)	37.56981	-122.31780	33	6	Crystal Springs Reservoir (28 sq mi)	Long term P&T monitoring site (SPoT); stream gage further upstream
Contra Costa	Walnut Creek at Concord Ave	37.97990	-122.05176	117	16	Lafayette Reservoir (1.2 sq mi)	FCD property; previous monitoring for CCCWP; stream gage further upstream

A summary of watershed characteristics for each of the RWL sampling watersheds is provided below.

4.1.1 Castro Valley Creek

Castro Valley Creek drains a 6-square mile watershed that encompasses portions of unincorporated Alameda County. Castro Valley Creek is a major tributary to one of the larger watersheds within Alameda County, the 48-square mile San Lorenzo Creek watershed. The proposed monitoring location is located near a long-term USGS gauging station just below the confluence of Castro Valley Creek with Chabot Creek. Land use is largely suburban throughout these two catchments. Together these two catchments are nearly full developed with mostly high density residential land uses, with approximately 10% open space in the area of upper Castro Valley Creek. The drainage of the two creek systems is approximately 60% underground segments, with a near even split between engineered channel and more natural channel segments, which are largely represented within the upper sections of the Castro Valley Creek catchment.

4.1.2 Saratoga Creek

Saratoga Creek drains a 17-square mile watershed including parts of unincorporated Santa Clara County, the Town of Saratoga, and the Cities of Santa Clara and San Jose. Saratoga Creek is a major tributary to San Tomas Aquino Creek that 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 eight 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.

4.1.3 San Mateo Creek

San Mateo Creek drains a 33-square mile watershed including parts of unincorporated San Mateo County, the City of San Mateo, and the Town of Hillsborough. The upper 88 percent of the watershed is characterized by the northwest/southeast trending ridges and valleys of the San Andreas Rift Zone and the Santa Cruz Mountains. Runoff from this undeveloped 28-square mile area drains to a system of reservoirs which were constructed in the late 1800s and are now owned and operated by the San Francisco Public Utilities Commission (SFPUC). These include the San Andreas Reservoir, Upper Crystal Springs Reservoir, and Lower Crystal Springs Reservoir, all of which are oriented along the northwest trending San Andreas Rift Zone.

Below the Lower Crystal Springs reservoir dam, the watershed encompasses approximately five square miles and is mostly urbanized with an overall imperviousness of approximately 38 percent (STOPPP 2002). Low and medium density residential land uses characterize the area upstream of El Camino Real, and high density residential and commercial land uses characterize the watershed downstream of El Camino Real. San Mateo Creek below the Lower Crystal Spring reservoir dam is approximately 5.5 miles in length and is nearly 50 percent modified (STOPPP 2002). There are several engineered reaches, including a 2,000-foot culvert that begins downstream of El Camino Real. There is one main tributary in this reach, Polhemus Creek which enters San Mateo Creek approximately 0.75 mile downstream of the dam. San Mateo Creek flows to San Francisco Bay at Ryder Park, just south of Coyote Point and is tidally influenced downstream of Highway 101.

4.1.4 Walnut Creek

The Walnut Creek watershed is the largest watershed in Contra Costa County totaling 146 square miles, or 96,000 acres, in size. The Walnut Creek watershed has 309 miles of creek channels accounting for almost a quarter of all mapped creek channels in Contra Costa County. The watershed extends from San Ramon to the south, Martinez to the north, Moraga and Orinda to the west, and Concord to the east.

The Walnut Creek watershed encompasses the Grayson-Murderers, Concord, Pine-Galindo, San Ramon, and Las Trampas sub-watersheds. Draining the west side of Mount Diablo and the east side of the East Bay hills, Walnut Creek's major tributaries include San Ramon Creek, Bollinger Creek, Las Trampas Creek, Lafayette Creek, Grayson Creek, Murderer's Creek, Pine Creek, Tice Creek, and Galindo Creek. The Cities of Walnut Creek, Lafayette, Pleasant Hill and Danville lie completely within the boundaries of the Walnut Creek watershed, while the Cities of Concord, Martinez, and small areas of Moraga and San Ramon are partly within the watershed.

Agriculture and livestock were previously important industries in the valleys of the Walnut Creek watershed. An increase in housing and commercial development along the creek created the need for improved flood control measures. Today, a stormwater drainage system reroutes surface waters from their original path through the valley. Land use and other physical factors have also affected the way surface and groundwater reach the creek channel. Land uses in the Walnut Creek watershed consist of 13% agricultural lands; 58% urban lands; and 29% open space, parks and recreation areas, and water.

4.2 Sampling Frequency and Timing

The Project will include a total of four wet season sample events and one dry season sample event at each of the four sampling locations over the permit term. SFBRWQCB staff indicated that wet season sample events do not need to occur during storm events (Richard Looker, SFBRWQCB, personal communication). However, Programs will target wet season sampling events within one to two days following a storm event to better assess water quality in receiving water that is influenced by urban stormwater runoff. Provision C.8.h.iv requires that an updated RWL "Assessment Report with proposed monitoring to be conducted during the next permit term" is submitted by March 31, 2026. Therefore, the collaborating Programs will attempt to complete all required RWL monitoring by the end of Water Year 2025 (i.e., September 30, 2025) so that all RWL monitoring data is available for review and interpretation in the March 31, 2026 report.

Figure 1. RWL Monitoring Sites and Watershed Areas

4.3 Pesticide and Toxicity Monitoring

MRP Provision C.9 implements the Total Maximum Daily Load (TMDL) and Water Quality Attainment Strategy (WQAS) for diazinon and pesticide-related toxicity for all Bay Area urban creeks. The TMDL/WQAS amendments to the Basin Plan were adopted by the Water Board in 2005. MRP Provision C.9 requires Permittees to implement comprehensive control programs to eliminate pesticide-related toxicity associated with stormwater discharges. The TMDL/WQAS was designed to address all current and future toxicity associated with current and future use pesticides.

The TMDL/WQAS also requires that the MRP include pesticides and toxicity monitoring; this monitoring is described in MRP Provision C.8.g. The MRP factsheet provides perspective on the intent of the monitoring required in Provision C.8.g:

> *Toxicity testing provides a tool for assessing toxic effects (acute and chronic) of all the chemicals in samples of stormwater, receiving waters or sediments and allows the cumulative effect of the pollutants present in the sample to be evaluated, rather than the toxic responses to individual chemicals. Toxicity in water and on sediment also are monitored in order to determine whether the numeric targets in the TMDL/WQAS are being achieved, and to help provide evidence on whether pesticide-related toxicity is decreasing in urban creek waters.*
>
> *This subprovision [C.8.g] combines all the pesticide and toxicity monitoring into one place. This format is intended to provide for more thoughtful dry weather and wet weather sampling designs that may provide more meaningful data for the region and potentially for statewide studies.*

In collaboration with Water Board staff, Permittees designed and, in 2009, began implementing a comprehensive pesticide and toxicity monitoring program, which is contained in MRP Provision C.8.g. This monitoring program has evolved over time based on new information about the types of pesticides that may be a risk to urban creek water quality. As such, the Provision C.8.g pesticides and toxicity monitoring program satisfies both the TMDL/WQAS and RWL monitoring needs.

4.3.1 Sampling Locations

Pesticide and toxicity sampling locations are selected to represent mixed land use in urban watersheds that are not already being monitored for toxicity or pesticides by other programs, such as the SWAMP Stream Pollution Trends (SPoT) Program. Specific monitoring locations within the identified creeks are based on the likelihood that they will contain fine depositional sediments during the dry season and are safe to access during wet weather sampling, if relevant.

Consistent with the needs of the TMDL/WQAS, Programs may elect to revisit the same site over time to better understand temporal variation, select new sites annually to better understand spatial variation, or choose some combination of the two. Lists of potential sampling locations for pesticide and toxicity sampling are provided by countywide Program in the Tables 4-2 through 4-5. Watershed size and percent impervious statistics were calculated from USGS StreamStats[4].

4.3.2 Sampling Frequency and Timing

MRP Provision C.8.g requires Permittees to conduct pesticide and toxicity monitoring in receiving waters annually at the numbers of sampling sites listed in Table 4-2. Monitoring is conducted in both wet and dry seasons to best evaluate receiving water conditions. Dry season water column monitoring includes water column toxicity monitoring of test species described in Section 5. Wet season monitoring consists of monitoring both pesticides and toxicity in the water column. Pesticides monitored as part of Provision C.8.g monitoring are described Section 5 as well.

Table 4-2. Numbers of Sites Where Water Toxicity and Pesticides Monitoring are Required by MRP Provision C.8.g.

Permittees[1]	Minimum Number of Sample Sites	
	Dry Weather	Wet Weather
Alameda County Permittees	2 per year	10 collective samples over the Permit term, with at least 6 samples by the end of the third water year of the Permit
Contra Costa County Permittees	1 per year	
Santa Clara County Permittees	2 per year	
San Mateo County Permittees	1 per year	

[1] Solano County permittees are required to collect one dry weather Pesticides & Toxicity sample over the permit term, but they are not required to conduct RWL assessment monitoring.

[4] https://streamstats.usgs.gov/ss/.

Table 4-3. Existing and Potential Sampling Locations and Associated Watershed Characteristics for Pesticides and Toxicity Monitoring, ACCWP.

Site ID	Site Name	Latitude	Longitude	Watershed Size (sq miles)	% Impervious Area	Upstream Impoundments (Area upstream dam)	Existing Monitoring Data Collection
204CVY010	Castro Valley Cr above USGS gauging station	37.68016	-122.08059	6	46	None	Previous monitoring for ACCWP and USGS.
Z4LA	Zone 4, Line A--Hayward Industrial Storm Drain-Z4LA	37.64536	-122.13630	1.6	67	None	P&T WY2023
SANLORCRKUP	San Lorenzo Creek Upper-SANLORCRKUP	37.68197	-122.14305	46.2	12.4	20.7	P&T WY2023
204ACA200	South San Ramon Creek at Johnson Drive	37.70103	-121.91983	39	23	None	P&T WY2023
204SAU030	Sausal at E.22nd	37.78566	-122.22424	3.9	22	None	P&T WY2016
205R01198	Zone 6 Line G west of Grimmer-205R01198	37.50872	-121.96650	13.2	25	None	P&T WY2016
204WRD002	Ward Creek upstream of Ameron Pump Station	37.61729	-122.07366	8.4	38	None	P&T WY2017
204AVJ020	Arroyo Viejo Rec. Center	37.76253	-122.17539	0.2	51	None	P&T WY2018
204LME100	Glen Echo at 29th Street	37.81726	-122.26107	1.1	38	None	P&T WY2019
204ALP147	Arroyo Las Positas just upstream of 1st St	37.69985	-121.74141	16.3	15	None	P&T WY2020
204ALP180	channelized tributary to Arroyo Seco at Patterson directly d/s from Patterson Pass Rd.	37.696086	-121.71471	7.3	6	None	P&T WY2020
204SLE030	San Leandro Creek at Empire Road	37.72556	-122.18361	45.8	8	42.0	P&T WY2021
204SLO010	San Lorenzo Creek downstream of confluence with Castro Valley Creek	37.67757	-122.08204	45.5	29	19.8	P&T WY2021
204R01380	Arroyo de la Laguna 750m north of Bernal Ave	37.66228	-121.90612	222	13	None	P&T WY2022
204ADV010	Arroyo del Valle 130m upstream of the Arroyo de la Laguna confluence	37.66244	-121.90466	172	2.3	146	P&T WY2022

Table 4-4. Existing and Potential Sampling Locations and Associated Watershed Characteristics for Pesticides and Toxicity Monitoring, CCCWP

Site ID	Site Name	Latitude	Longitude	Watershed Size (sq miles)	% Impervious Area	Upstream Impoundments (Area upstream dam)	Existing Monitoring Data Collection
207R02615	Walnut Creek at Concord Ave	37.97990	-122.05176	146	30	Lafayette Reservoir (1.2 sq mi)	FCD property; previous monitoring for CCCWP and DPR; stream gage further upstream
207R04819	Las Trampas Creek near Gazebo Park	37.89270	-122.11037	146	30	Lafayette Reservoir (1.2 sq mi)	Previous monitoring for CCCWP
207ALH010	Alhambra Creek at Main Street	38.01691	-122.13619	16.75	15	None	Previous monitoring for CCCWP; stream gage further upstream
206R01319	San Pablo Creek at Fred Jackson Way	37.96744	-122.36554	43	20	Briones Reservoir (TBD) and San Pablo Reservoir (TBD)	Previous monitoring for CCCWP
543EAN015	East Antioch Creek	38.01042	-121.79691	11.35	60	Lake Alhambra (TBD)	Previous monitoring for CCCWP

Table 4-5. Existing and Potential Sampling Locations and Associated Watershed Characteristics for Pesticides and Toxicity Monitoring, SCVURPPP

Site ID	Site Name	Latitude	Longitude	Watershed Size (sq miles)	% Impervious Area	Upstream Impoundments (Area upstream dam)	Existing Monitoring Data Collection
205STQ010	San Tomas Aquino at Mission College Blvd	37.38888	-121.96872	26	34	None	Long term P&T monitoring site (SCVURPPP);
205STE021	Stevens Creek at Hwy 101	37.40895	-122.06904	24	9	Stevens Creek Reservoir (17 sq mi)	Long term P&T monitoring site (SCVURPPP);
205GUATRM	Guadalupe River at Trimble	37.38888	-121.96872	172	23	Lexington, Guadalupe Creek, Almaden, Calero (78 sq mi)	DPR P&T monitoring site

Table 4-6. Existing and Potential Sampling Locations and Associated Watershed Characteristics for Pesticides and Toxicity Monitoring, SMCWPPP

Site ID	Site Name	Latitude	Longitude	Watershed Size (sq miles)	% Impervious Area	Upstream Impoundments (Area upstream dam)	Existing Monitoring Data Collection
204SMA020	San Mateo Creek at 3rd Ave (Gateway Park)	37.56981	-122.31780	33	6	Crystal Springs Reservoir (28 sq mi)	Long term P&T monitoring site (SPoT); stream gage further upstream
204COL040	Colma Creek at Orange Ave	37.65333	-122.42582	11	39	None	Downstream of Orange Memorial Regional Treatment Facility
204COR005	Cordilleras Creek at Lenolt St	37.49677	-122.24313	3	16	None	New site
204RED010	Redwood Creek at Maple St	37.48196	-122.22640	6	30	None	Previous POC monitoring site (SMCWPPP)
202R01308	Pilarcitos Creek at Oak Ave	37.46833	-122.43647	27	1.7	Pilarcitos Lake (4 sq mi)	Previous bioassessment and P&T monitoring site (SMCWPPP)
202SPE005	San Pedro Creek at Hwy 1	37.59454	-122.50517	7.2	8	None	Previous POC monitoring site (SMCWPPP)

5. ANALYTICAL METHODS

Water samples will be analyzed for the parameters listed in Table 5-1 (RWL aquatic chemistry), Table 5-2 (P&T aquatic chemistry), and Table 5-3 (aquatic toxicity). Analytical methods and reporting units are also provided. The collaborating Programs have agreed to use common laboratories. Each Program may elect to use a different (and geographically closer) analytical laboratory for *E. coli* analysis in order to achieve the 8-hour hold time for these samples.

MQOs for laboratory analyses for metals, organics, nutrients, and *E. coli* were selected to match SWAMP (2022) requirements and are described in the Project QAPPs.

Table 5-1. RWL Monitoring Laboratory Analytical Methods

Analyte	Sampling Method	Recommended Analytical Method	Reporting Units
Pb, dissolved	Grab	EPA 200.8	ug/L
Cu, dissolved	Grab	EPA 200.8	ug/L
Zn, dissolved	Grab	EPA 200.8	ug/L
Hardness	Grab	EPA 1638M / SM 2340	mg/L
E. coli	Grab	SM 9223B (Quantitray)	MPN
Total Mercury	Grab	EPA 1631	ug/L
PCBs (RMP 40)	Grab	EPA 1668	ng/L
Nitrate as N	Grab	EPA 300.0	mg/L
Nitrite as N	Grab	SM 4500	mg/L
TKN	Grab	SM 4500	mg/L
Total Phosphorus	Grab	SM 4500-P B/F-11 (LL)	mg/L
Ammonia	Grab	SM 4500-NH3 B,C-11	mg/L

Table 5-2. Pesticides and Toxicity Monitoring Aquatic Chemistry Analytical Methods

Analyte	Sampling Method	Recommended Analytical Method	Reporting Units
Pyrethroids	Grab	EPA 625.1	ng/L
Imidacloprid	Grab	EPA 632	ug/L
Fipronil and degradates	Grab	EPA 625.1	ng/L

Table 5-3. Pesticides and Toxicity Monitoring Aquatic Toxicity Analytical Methods

Test Species	Test Endpoint	Recommended Analytical Method	Evaluation
Pimephales promelas	Larval survival and growth	EPA 821/R-02-013	Pass or Fail using TST, % effect
Ceriodaphnia dubia	Survival	EPA 821/R-02-013	Pass or Fail, % effect < 25% passes, % effect > 25% fails
Ceriodaphnia dubia	Reproduction	EPA 821/R-02-013	Pass or Fail using TST, % effect
Selenastrum capricornutum	Growth	EPA 821/R-02-013	Pass or Fail using TST, % effect
Hyalella azteca	Survival	EPA 821/R-02-012	Pass or Fail using TST, % effect

Test Species	Test Endpoint	Recommended Analytical Method	Evaluation
Chironomus dilutus	Survival	EPA 821/R-02-012	Pass or Fail using TST, % effect

6. FIELD METHODS AND PROCEDURES

Field crews will collect grab samples of water using protocols comparable to those specified by SWAMP. Sampling techniques will include direct filling of sterile sample containers for *E. coli* samples, collection of mercury samples using clean hands/dirty hands protocols, and direct immersion or use of pre-cleaned peristaltic pump and tubing assemblies for all other samples. Samples must be collected in a consistent manner that neither contaminates, loses, or changes the form of the analytes of interest. In addition, QA/QC measures should be performed according to the RWL MP QAPPs.

Sample collection methods were developed for the RWL MP based upon standard sampling protocols associated with the most restrictive analytes, FIB and trace metals. In order to achieve short hold time requirements associated with analysis of FIB samples, Programs will identify storms capable of being sampled and samples delivered to selected analytical laboratory within six hours of collection and with sufficient time remaining in standard laboratory work hours to receive and initiate testing (i.e., two hours). To address potential contamination issues associated with sampling and field filtration of dissolved trace metal samples (copper, lead, and zinc), clean-hands, dirty-hands protocols will be employed using appropriate sampling equipment, including use of inline filters for collection of dissolved fraction samples or capsule filters for manual filtering of bulk sample material within 15 minutes of sample collection.

Field personnel will also collect water quality measurements at time of sampling in order to calculate unionized ammonia from results for Ammonia as N analyses. These measurements will include, at a minimum, temperature, pH, and electrical conductivity. Other sampling details are summarized below.

6.1 Pre-Sampling Procedures

At least 72 hours prior to the sampling window, the analytical laboratories should be contacted to notify them of the sampling schedule and the number of samples to be delivered. Required sample containers will be ordered from the labs.

One or two days prior to collection of field data, the sample team should complete/assemble the following:

- Paperwork (Monitoring Plan, chain-of-custody forms, datasheets, maps, permits, gate keys).
- Sample containers and sterile sample collection containers.
- Labels and marker to write on labels.
- Cooler(s) with cube ice and zip-top bags for double-bagging the ice.
- Sampling and filtration devices:

    - Sampling extension pole with device to hold sample bottles, and screwdriver to loosen the band that holds the sample bottle to the pole.
    - Peristaltic pump with laboratory-clean tubing train and 0.45 µm trace-metal precleaned inline filter, or precleaned syringe connected directly to a precleaned capsule filter
- Water quality meter (calibrated within 24 hours of use).
- Ethanol solution 70 percent for field sterilization of sampling extension pole.
- Samples gloves (powder-free polyethylene, nitrile, or non-talc latex).
- Paper towels.
- Rubber boots or chest/hip waders for each person.
- Cell phone.
- Camera.
- Personal protective equipment (personal flotation device, reflective vest, eye protection, chemical resistant gloves)
- First aid kit.

6.2 Sample Collection

FIB and aquatic toxicity samples will be collected by direct immersion of the lab-provided sample container. All samples should be collected in the centroid of the stream if feasible. Except for sample containers that contain a chemical preservative or a dechlorinating compound, the sample containers should be opened, filled, and recapped below the water surface. Sample containers should be filled to the shoulder of the bottle. Samples should always be collected upstream of sampling personnel and equipment, and with the sample container pointed upstream when the container is opened for sample collection. Care must be taken not to sample water downstream of areas where sediments have been disturbed in any manner by field personnel.

- If the centroid of the stream cannot be sampled by wading, a sampling devices (e.g., a pole sampler) can be used to reach the sampling location. Such devices typically involve a means to extend the reach of the sampler, with the sample collection bottle attached to the end of the device for filling at the desired location. These methods do not allow opening of the sample container under water, so there is some potential for contamination when the container is opened prior to lowering the sample container into the stream. When sampling from a stream bank, the sample container or intermediate collection container is attached to a device which is attached in turn to the end of an extendable sampling pole. When no other option is available, sites may be accessed by bridge or through a field inlet and sampled with a sample container-suspending device, lowered into the stream at the end of a pole. Extreme care must be taken to avoid contaminating the sample with debris from the pole and bridge. For *E. coli* samples, care must also be taken to sterilize all sampling devices with a 70 percent ethanol solution between stations. Allow the pole to air-dry before the sample is taken.

- All remaining samples will be collected via direct immersion or use of a peristaltic pump with Teflon and Masterflex tubing chains. Filtering of dissolved fraction samples will either be performed using an inline filter during sample collection or with a capsule filter within fifteen minutes of collection of grab samples. In either case, blanking will be completed per QAPP requirements to assess any contamination caused by collection technique.

Proper gloves must be worn to both prevent contamination of the sample and to protect sampling personnel from environmental hazards. The user should wear at least one layer of gloves, but two layers help protect against leaks. All gloves must be powder-free. Disposable polyethylene, nitrile, or non-talc latex gloves are acceptable, with polyethylene the preferred outer layer for trace metals sampling.

7. SAMPLE CONTAINERS AND HANDLING

Standard sample container types and handling techniques for Project analytes are summarized in Table 7-1. These protocols will be adjusted consistent with project needs.

Table 7-1. SWAMP Sample Handling Protocols for Project Analytes in Surface Water

Analyte	Analyte Group	Sample Container Material & Property	Preservative	Holding Time (at 4 ± 2º C)
Dissolved Copper, Zinc, Lead	Inorganics	Polyethylene	Following field filtration, HNO3 to pH<2 within 48 of collection	Field filtered within 15 minutes of collection. 6 months at room temperature following acidification
Hardness (as $CaCO_3$)	Conventional	Polyethylene	Cool to ≤6 ºC; HNO3 or H2SO4 to pH<2	6 months
PCBs (RMP 40)	Synthetic Organics	1000-mL I-Chem 200- Series amber glass bottle, with Teflon lid-liner	Cool to ≤6º C in the dark.	1 year until extraction, 1 year after extraction
Total Mercury	Inorganics	250-mL glass or acid cleaned Teflon bottle	Cool to 6º C in the dark and acidify to 0.5% with pre-tested HCl within 48 hours	6 months at room temperature following acidification
Nitrate as N	Nutrients	Polyethylene	Cool to ≤6 ºC	48 hours
Nitrite as N	Nutrients	Polyethylene	Cool to ≤6 ºC	48 hours
TKN	Nutrients	Polyethylene	Cool to ≤6 ◦C; H2SO4 to pH<2	28 days
Total Phosphorus	Nutrients	Polyethylene	Cool to ≤6 ◦C; H2SO4 to pH<2	28 days

Analyte	Analyte Group	Sample Container Material & Property	Preservative	Holding Time (at 4 ± 2º C)
Ammonia as N	Nutrients	Polyethylene	Cool to ≤6 ◦C; H_2SO_4 to pH<2	28 days
E. coli	Bacteria	Sterile Polyethylene	Sodium Thiosulfate	8 hours (6 hours for transport to lab plus 2 hours for lab to initiate test)
Aquatic Toxicity	Toxicity	8 @ 4-L Amber glass	Cool to ≤6 ºC	36 hours
Pyrethroid pesticides, fipronil, and imidacloprid	Pesticides	Amber glass	Cool to ≤6 ºC and store in the dark	Samples must be extracted within 7 days of collection (3 days for cyfluthrin and permethrin)

Field crews should properly store and preserve samples as soon as possible after collection. Sample containers should be placed on crushed or cube ice in an insulated ice chest; ice should be placed into sealed, double-bagged zip-top bags prior to sampling to prevent any contamination of samples by melt water. Sufficient ice will be needed to lower the sample temperature to 4 ± 2 °C within 45 minutes after time of collection. Sample temperature should be maintained at 4 ± 2 °C until delivered to the laboratory.

Sample transport should be arranged so that samples arrive at the laboratory well within hold time requirements. The analytical laboratories should be informed in advance and reminded at time of sample delivery of the holding time requirements, so that required processing or analyses are initiated as soon as possible.

Each receiving laboratory has a sample custodian who examines the samples for correct documentation, proper preservation and holding times. The laboratory will follow sample custody procedures outlined in their QA plan.

8. SAMPLE DOCUMENTATION

Individual field crews are responsible for generating sample documentation in the field. Various methods of field documentation are described below.

8.1 Field Datasheets

All field data gathered by this project will be recorded on standardized field data entry forms. Given that sampling may be conducted during storm events, these forms should be printed on waterproof paper and all information should be recorded in pencil or waterproof pen. These forms are shown in Appendix B. Information will be photocopied/scanned and delivered to the Monitoring Coordinator for each Program. All entries should be legible and initialed / signed by the individual making the entries. Field data sheets shall include at a minimum:

- Date and time of sample collection, including arrival on site and time of departure
- Names of crew members
- Narrative description of the sampling site (general location)
- Summary of any meetings or discussions with property owner or agency personnel
- Other relevant information such as current and antecedent weather conditions
- Sample IDs
- Collection of QA/QC samples, if relevant (e.g., field duplicates, field blanks)
- Deviations from sampling plans, site safety plans, and QAPP procedures

8.2 Photographs

Photographic documentation is an important part of sampling procedures. An associated photo log will be maintained documenting sites and subjects associated with photographs. A copy of all photographs should be provided to the Monitoring Coordinator at the conclusion of sampling efforts.

8.3 Sample Labeling

All samples collected will be labeled in a clear and precise way for proper identification in the field and for tracking in the laboratory. At a minimum, the sample labels will contain the following information: station ID and date/time of collection. Site IDs are listed in Table 8-1.

Each sample collected for the Project will be labeled according to the following naming convention:

SITE-YYYYMMDD-HHMM

where:

SITE - Site ID (e.g., ACCV)

YYYYMMDD – Date

HHMM – hour and minute in 24-hour time (for example, if a sample was collected at 3:25 p.m. the HHMM would be “1525”)

Table 8-1. Site IDs for RWL Monitoring Stations

Site ID	County	Location	Latitude	Longitude
204CVY010	Alameda	Castro Valley Creek above USGS gauging station	37.68016	-122.08059
SCSC	Santa Clara	Saratoga Creek at Cabrillo Av (Bowers Park)	37.35973	-121.97336

Site ID	County	Location	Latitude	Longitude
SMSM	San Mateo	San Mateo Creek at 3rd Ave (Gateway Park)	37.56981	-122.31780
207R02615	Contra Costa	Walnut Creek at Concord Ave	37.97990	-122.05176

For pesticides and toxicity monitoring, the site IDs will be assigned based on the site included in Table 4-2.

8.4 Sample Chain of Custody Forms and Custody Seals

All sample shipments for analyses will be accompanied by a chain of custody record (COC). COCs will be completed and sent with the samples for each laboratory and each shipment (e.g., each event). If multiple coolers are sent to a single laboratory on a single day, COC forms will cover only samples within a given cooler.

The COC will identify the contents of each shipment and maintain the custodial integrity of the samples. Generally, a sample is considered to be in someone's custody if it is either in someone's physical possession, in someone's view, locked up, or kept in a secured area that is restricted to authorized personnel. Until the samples are shipped, the custody of the samples will be the responsibility of the field contractor. The sampling team leader or designee will sign the COC in the "relinquished by" box and note date and time.

A self-adhesive custody seal will be placed across the lid of each sample at a point of closure. The shipping / storage containers in which samples are stored (usually an ice chest) will be sealed with self-adhesive custody seals any time they are not in someone's possession or view before shipping. All custody seals will be signed and dated.

9. QUALITY CONTROL

Field personnel will strictly adhere to Project QAPPs to ensure the collection of representative, uncontaminated samples. To the extent possible, sampling methods are designed to be consistent with those employed for previous investigations while maintaining compliance with the MRP. The most important aspects of quality control associated with sample collection are as follows:

- Field personnel will be thoroughly trained in the proper use of sample collection equipment and will be able to distinguish acceptable versus unacceptable samples in accordance with pre-established criteria presented in this MP.
- Field personnel will be thoroughly trained to recognize and avoid potential sources of sample contamination (e.g., dirty hands, ice used for cooling, potentially contaminating materials).

- To the extent possible, sampling equipment that comes in direct contact with the sample will be made of non-contaminating materials and will be thoroughly cleaned between sampling events.
- Sample containers will be pre-cleaned and of the recommended type.

Aspects of particular relevance to the sampling program are described below.

9.1 Field Blanks

Field blank (FB) samples will be collected at a rate as described in the Project QAPPs.

FB samples are collected in the field by passing analyte-free deionized water supplied by the laboratory through the sampling equipment (tubing, bottles). They are identified as "blanks" and submitted to the contracted analytical laboratory for analysis. If target analytes are not found, or found in very low concentrations, then there can be some degree of confidence that sampling equipment, containers and techniques are not causing contamination. These samples are collected in addition to any bottle or tubing blank analyses that the laboratory may perform after cleaning and prior to transfer to the field.

After collection, field blanks are treated identically to samples. The label should be identical to the field sample collected associated with the blank, with "FB" inserted at the end of the standard sample ID. The time recorded for the blank should be the actual time of the blank sample collection.

9.2 Equipment Blanks

Equipment blank (EB) samples will be collected at a rate as described in the Project QAPPs.

Equipment blanks are generated by the personnel responsible for cleaning sampling equipment. Equipment blanks must be analyzed before the equipment is brought to the sampling site. To ensure that sampling equipment is contaminant-free, water known to be low in the target analyte(s) must be processed though the equipment as during sample collection. The water is collected, processed, and analyzed in the same way as a field sample. An equipment blank must be prepared for dissolved metals in water samples whenever a new lot of filters is used.

9.3 Field Duplicate Samples

Field duplicates (FDs) will be collected by each Program a minimum of once over the course of Project implementation. FD samples should be collected immediately following the collection of its associated field sample (i.e., the FD for mercury should be collected immediately following the field sample for mercury, then the field duplicate for PCBs should be collected immediately following the field sample for PCBs, and so on). FD samples should be submitted to the laboratory as blind samples, using the correct sample date and entering a sample time fifteen minutes before that reported for the field sample.

10. FIELD HEALTH AND SAFETY PROCEDURES

All field staff will be expected to abide by their employer's (i.e., the field contractor's) health and safety programs.

11. DATA EVALUATION

The data evaluation methods will employ a combination of graphical and descriptive statistics to evaluate if the monitoring data may be exceeding water quality objectives/criteria and thresholds.

12. REFERENCES

BASMAA (Bay Area Stormwater Management Agency Association) Regional Monitoring Coalition (RMC). 2020. Creek Status and Pesticides & Toxicity Monitoring Quality Assurance Project Plan, Final Version 4. 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. 79 pp plus appendices.

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STOPPP (San Mateo Countywide Stormwater Pollution Prevention Program). 2002. Characterization of Imperviousness and Creek Channel Modifications for Seventeen Watersheds in San Mateo County. January 2002.

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APPENDIX A

Process for Evaluation and Selection of Analytes

INTRODUCTION

MRP Provision C.8.f requires that the receiving water limitations (RWLs) monitoring program should assess "the potential that discharges of these analytes may result in levels in receiving waters approaching or exceeding water quality objectives and the basis of the determination."

Through the Bay Area Municipal Stormwater Collaboration (BAMSC), the countywide stormwater Programs in Alameda, Contra Costa, San Mateo, and Santa Clara counties collaboratively developed, on behalf of all applicable Permittees, a RWLs Monitoring Plan (MP). The RWL MP includes a uniform list of target analytes to be monitored regionally. This appendix describes the process used by the stormwater Programs to evaluate and select analytes for inclusion in the RWL MP.

ANALYTE LIST

To assist in determining the regional analyte list, stormwater Programs accessed and compiled relevant water quality data from the California Environmental Data Exchange Network (CEDEN) from the last decade (2010-2021). The regional data center at Moss Landing Marine Laboratories (MLML) assisted with this compilation. The initial data query provided analytical data in CEDEN identified as "samplewater" and collected at locations identified as either "bank," "midchannel," "reach," or "X." These data are assumed to have been collected in receiving waters (i.e., local creeks/channels). The Programs then reviewed the compiled data on a county-by-county basis to eliminate non-relevant data points (e.g., LID monitoring data and data collected in subtidal areas). The resulting dataset comprises over 47,000 data points. The compiled dataset was then reviewed to exclude non-relevant data and those of uncertain data quality. This review process resulted in the exclusion of some data points for one or more of the following reasons:

- Analytes classified as "field measurements," which removed approximately 20,000 data points.
- Additional non-relevant analytes (e.g., velocity, silt, sand), which removed approximately 700 data points.
- Data points with compliance codes indicating that the data were estimated, rejected, or of screening level quality only, which removed approximately 600 data points.
- Data points with one of the following CEDEN Quality Assurance (QA) codes, which removed approximately 50 data points.

QACode	Definition
BRK	Broken container
BT	Insufficient sample to perform the analysis
FIF	Probe / Instrument failure
LRGN	Data rejected - Surrogate recovery not within control limits, flagged by laboratory
LRIL	Data rejected - RPD exceeds laboratory control limit, flagged by laboratory

QACode	Definition
LRIP	Data rejected - Analyte detected in field or lab generated blank, flagged by laboratory
LRIU	Data rejected - Percent Recovery exceeds laboratory control limit, flagged by laboratory
LRJ	Data rejected - Estimated value - EPA Flag, flagged by laboratory
LRJA	Data rejected - Analyte positively identified, but quantitation is an estimate, flagged by laboratory
LRM	Data rejected - A matrix effect is present, flagged by laboratory
LRQ	Data rejected - Based on professional judgment, QA/QC protocols were not met, flagged by lab
LST	Sample was lost or destroyed
R	Rejected

Over 26,000 data points remained following the exclusions described above. These data points represent many analyte types, including fecal indicator bacteria (FIB) and organic, inorganic, and conventional water quality parameters. Four primary monitoring efforts generated approximately 93% of these data points:

1. Regional Monitoring Program for Water Quality in San Francisco Bay (RMP) Small Tributaries Loading Strategy (STLS, 55%),
2. Bay Area Stormwater Management Agencies Association Regional Monitoring Coalition (RMC, 23%),
3. California Surface Water Ambient Monitoring Program (SWAMP, 13%), and
4. Department of Pesticide Regulation Surface Water Monitoring Project (DPR, 2%).

Two pollutant categories falling into the synthetic organics category, PCBs and PBDEs, were reported on a congener basis, which required calculating a sum of individual congeners to use for comparison to Water Quality Objectives (WQOs). Given that a relatively large proportion of PCBs and PBDEs congeners were reported at non-detectable concentrations (NDs), it was necessary to quantify the NDs to generate summary statistics and box and whisker plots for these two analyte categories. The Programs' analyses incorporated a substitution of NDs with a value of 0, consistent with RMP data analyses and reporting for the Regional Monitoring Program (personal communication with Don Yee, SFEI, October 26, 2022).

A relatively small number of data points were reported with a Results Qualifier code of less than (<), greater than (>), less than or equal to (≤), or greater than or equal to (≥). This affected 102 data points (0.4%), primarily associated with FIB, and a few instances of nutrients were also affected. For generating summary statistics and box and whisker plots, these values were quantified as the reported concentration with the number of instances of using one of these Results Qualifier codes were also reported.

In conducting the data analysis, it was also necessary to pool data for some data points. In particular, those reported on the same fraction and using the same or similar methods but using slightly different analyte names were pooled. For example, in the case of hardness, data are reported using one of three names in the compiled database: (1) Hardness as CaCO3, (2) Hardness as CaCO3, total, and (3) Hardness as CaCO3, dissolved. As hardness is always analyzed as the dissolved fraction, these three analytes were pooled in the statistical analyses. Similar manipulations were conducted on other analytes where the reported information allowed this determination. Data for applicable analytes that did not have sufficient detail to support this type of pooling were excluded from the analysis.

Data were processed in MS Excel and R Studio. To replace non-detects with zero and calculate the replacement percentage, all non-detects (whether 0, NA, or a negative value) were replaced with NA for each analyte or analyte grouping and substituted with a value of “0”. The proportion of replaced values (i.e., results with ResQualCode = “ND” and reported alternatively as NA, 0, or the negative value of the method detection limit) was calculated as the percentage of the total number of NDs relative to the total number of analyses for a particular sampling event. The chosen congeners of PAHs, PCBs, and PBDEs were summed by event and collated into their own summed files to generate a sum of the individual compounds/congeners within that analyte group. These concentrations summed by the event were then used to create boxplot figures.

PAHs, fipronil, pesticides, and pyrethroids were converted from their reported units to µg/L in Excel to generate consistent units for displaying in the boxplots. Boxplot figures for all analytes or analyte groups (e.g., PAHs, PCBs, PBDEs) show the minimum and maximum values (whiskers) as well as the 25th percentile (1st quartile, bottom of box), the median, and the 75th percentile (3rd quartile, top of box) and outliers. Select boxplots that supported decision-making are presented below in relation to specific analytes.

ANALYTE SELECTION

To evaluate which analytes to include in the monitoring program, the maximum value for each of the analytes described above were compared to the most stringent of the existing water quality thresholds developed by federal and state regulatory agencies This data review process was modeled after the Reasonable Potential Analysis (RPA) method used by National Pollutant Discharge Elimination System (NPDES) permit writers to determine if pollutants require effluent limits. The water quality thresholds used in the analysis include:

- California Toxics Rule (CTR) and National Toxics Rule (NTR) Water Quality Criteria/Criterion, which were developed based on USEPA protocols and are protective of aquatic life exposed to those concentrations in the receiving water, or where applicable, protection of human health for consumption of organisms.
- Numeric WQOs listed in the Water Quality Control Plan for the San Francisco Basin (Basin Plan; RWQCB 2019) for the protection of aquatic life beneficial uses in freshwater surface waters.
- WQOs in Basin Plan Amendment R2-2021-0002, which amends the 2019 Basin Plan WQOs for bacteria.
- EPA recommended Water Quality Criteria for Aquatic Life and Human Health

The regional dataset is organized into several analyte groups for evaluation. No individual constituent was eliminated from consideration due to lack of a numeric WQO or criterion. Rather, individual constituents were evaluated as part of their larger group. The sections below describe data screening and review for each analyte group. The recommended list of RWL analytes is included at the end of this section.

FIB. Bacteria data were available for *E. coli* (n=405) and enterococcus (n=157). In freshwater, *E. coli* is the sole indicator, with two WQOs, a six-week rolling geometric mean (GM), and a statistical threshold value (STV), which approximates a single sample maximum. Per MRP Provision C.8.f Table 8.2, *E. coli* will be included in the RWL monitoring program. Because all RWL monitoring will be conducted in freshwater, samples will not be analyzed for enterococci, which is the indicator for marine or brackish/saline waters.

Metals. Metals data were available for total fraction arsenic (n=18), cadmium (n=18), chromium (n=30), copper (n=101), lead (n=13), nickel (n=30), and zinc (n=18). CTR WQOs for several metals included in the Basin Plan are hardness-dependent and are given for the dissolved fraction of the metal in water. The WQOs for metals are given for both 1-hour (acute) and 4-day (chronic) averages. For all metals, except zinc, the 4-day WQO was the lower concentration (most stringent) and thus, used for the analyses. Metals data were first screened using WQOs based on a conservative hardness of 100 mg/L as $CaCO_3$. A review of all hardness data in the censored dataset shows that actual hardness in the region is generally higher; the median and mean hardness are 255 and 290 mg/L as $CaCO_3$, respectively. The 5^{th}, 25^{th} and 75^{th} percentiles are 103, 170, and 496 mg/L as $CaCO_3$, respectively. Maximum metals concentrations in the dataset exceeded the lead, copper, and zinc WQOs based on a hardness of 100 mg/L as $CaCO_3$; boxplots for the four remaining analytes are shown in Figure A-1. No additional analysis of the copper and zinc data was conducted because these analytes must be included in the RWL monitoring program per MRP Provision C.8.f Table 8.2.

Of the 13 samples in the dataset with lead results, five had total lead concentrations that exceeded the chronic WQO (4-day). These samples were all collected during rain events in December 2014 as part of RMP STLS monitoring. One station was in Contra Costa, three in Alameda, and one in Santa Clara County. No results exceeded the acute WQO (1-hour) for lead, which is the more applicable criteria for storm event samples given the shorter duration of most storm events. Because the lead data were only available as the total recoverable metal in water, the WQO was calculated as a total recoverable criterion, by eliminating the conversion factor in the equation, instead of a dissolved criterion as the other metals were calculated. No hardness data were available for these samples; therefore, the criterion was not adjusted for hardness. However, if the median of all of the regional hardness data (i.e., 255 mg/L as $CaCO_3$) is used to calculate the criterion, three samples would exceed the WQO. Based on these findings, lead should be added to the list of analytes in the RWL monitoring program. It should be measured as the dissolved fraction to simplify comparison with the criterion.

Hardness should be included with the metals analysis so that the WQOs can be adjusted to site-specific conditions. In addition to RWL monitoring for copper, zinc, and lead, five additional copper samples will be collected by each Program per MRP Provision C.8.f to provide information on pollutants of concern (POC) loads, concentrations, and /or presence/absence. Furthermore, one or two annual sediment samples (depending on the Program population) will be analyzed for a suite of metals (arsenic, cadmium, chromium, copper, lead, nickel, zinc) per MRP 3.0 Provision C.8.g (Pesticides and Toxicity Monitoring).

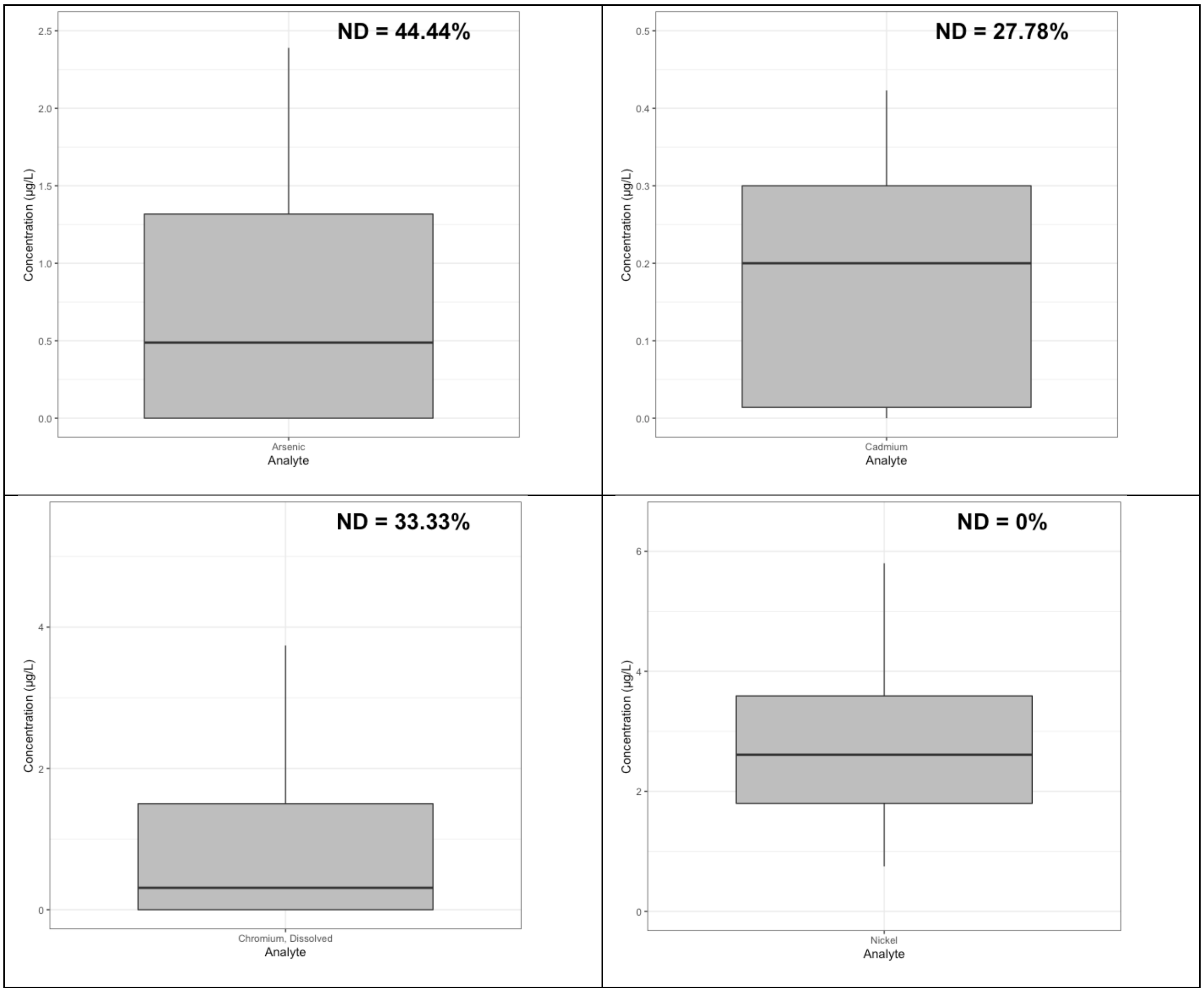

Figure A-1. Box plots generated from 4-county CEDEN data (2010-2021) for total fraction inorganic parameters not to be measured through RWL monitoring.

Mercury. Data were available for mercury (n=315) and were compared to WQOs from the Basin Plan (Figure A-2). Many of the data exceeded the acute and chronic WQOs. Mercury is already identified as a POC in the Bay Area, and there is a mercury Total Maximum Daily Load (TMDL) for San Francisco Bay with load reduction requirements for urban runoff sources. Although mercury is already being sampled by the stormwater Programs per MRP 3.0 Provision C.8.f (50 to 60 samples, depending on population, over the five-year permit term) to address several other information needs (i.e., identification of source areas, effectiveness of management actions, status of POC loads, and trends), it will be included in the RWL monitoring program.

PCBs. Data were available for PCBs (n=103 sum of RMP 40 PCB congeners) and were compared to the CTR criterion for Total PCBs (sum of 209 PCB congeners) (Figure A-2). Many of the data exceeded the CTR criterion. There is a PCBs TMDL for San Francisco Bay with load reduction requirements for urban runoff sources. Similar to mercury, PCBs will be included in the RWL monitoring program even though it is already being sampled by the stormwater Programs (65 to 75 samples, depending on population, over the five-year permit term) per MRP Provision C.8.f to address other information needs (i.e., identification of source areas, effectiveness of management actions, status of POC loads, and trends) that may overlap with RWLs assessment.

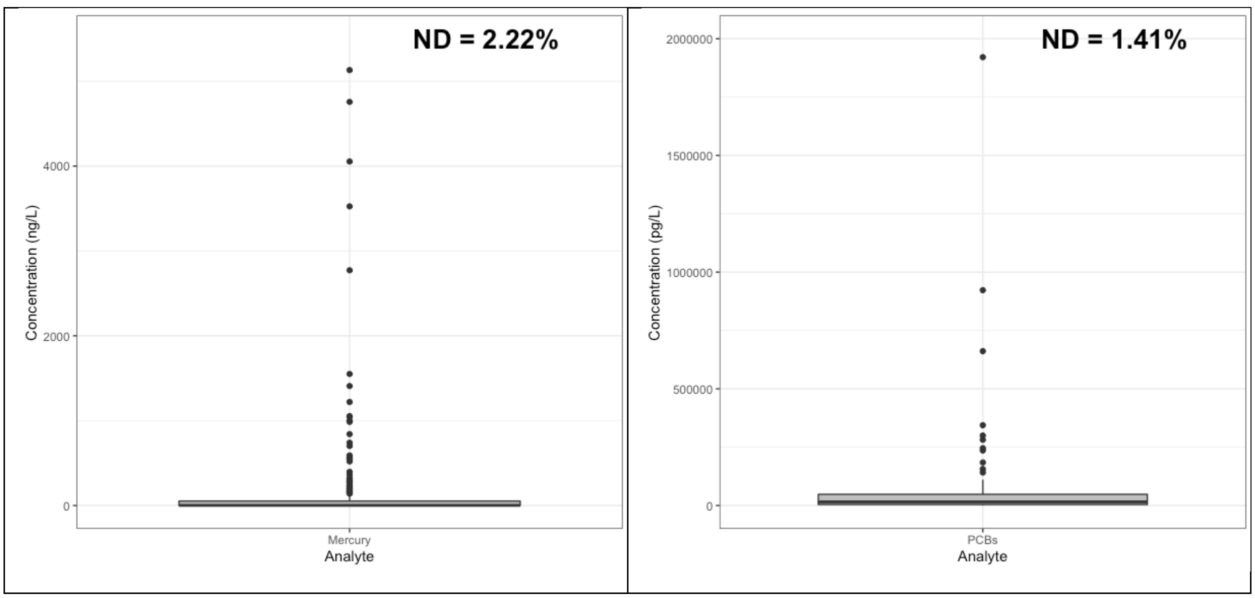

Figure A-2. Box plots generated from 4-county CEDEN data (2010-2021) for total fraction mercury (left) and sum of RMP 40 PCBs (right). The Basin Plan WQO for mercury is 0.025 ug/L (25 ng/L) and the CTR water quality criteria for PCBs for human health is 0.00017 ug/L (170 pg/L).

Selenium. Data were available for total selenium (n=63) and dissolved selenium (n=66). These data were collected from creeks throughout the Bay Area as part of RMP STLS monitoring (n=36 total, n=36 dissolved), SWAMP studies (n=7 total, n=28 dissolved), and Lehigh Permanente special studies (n=20 total, n=2 dissolved). Selenium data were compared to criteria from the National Toxics Rule (NTR) which are listed in the CTR (Figure A-3). While no samples had selenium concentrations exceeding the acute criterion, 11 of 63 total selenium results and two of 66 dissolved selenium results exceeded the chronic criterion, which is for the total recoverable fraction. All of the samples with exceedances were collected from Permanente Creek which has been identified as impaired for selenium and is being investigated by the

Lehigh Permanente Quarry through its NPDES permit. Because selenium does not exceed criteria elsewhere in the regional dataset, it will not be included in the RWL monitoring program.

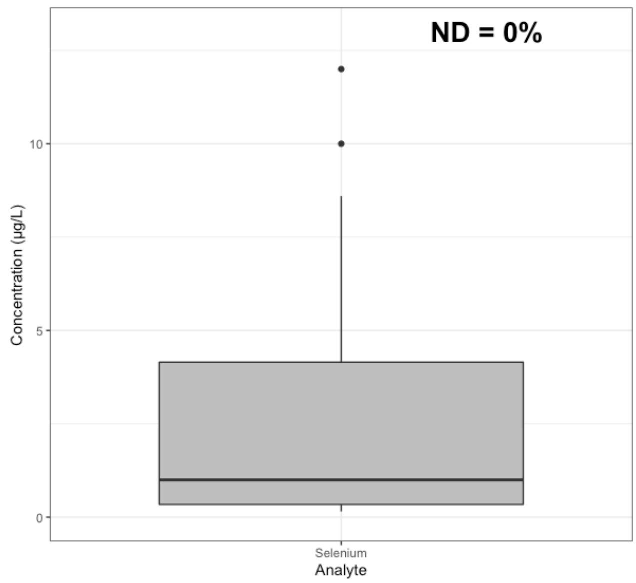

Figure A-3. Box plots generated from 4-county CEDEN data (2010-2021) for total fraction selenium. The Basin Plan WQO for selenium is 5 ug/L; all datapoints above the WQO are associated with Permanente Creek monitoring.

Pesticides. Pesticide data were available for fipronil and its degradates (n=13), pyrethroids (n=12 to 68 depending on constituent), carbaryl (n=33), chlorpyrifos (n=11), dicamba (n=18), imidacloprid (n=30), indoxacarb (n=10), malathion (n=10), and oxadiazon (n=10). There are no promulgated numeric criteria for pesticides in the CTR or WQOs in the Basin Plan except for chlorpyrifos and malathion. For the two pesticides with relevant criteria, malathion and chlorpyrifos, analytical results for Bay Area sampling efforts largely generated non-detects. For malathion, eight of ten samples collected by DPR over the study period were reported as NDs, with consistent MDLs of 0.001 and RLs of 0.02 ug/L associated with each analysis. For chlorpyrifos, each of the eleven samples collected by DPR and STLS resulted in NDs, with ten of the eleven samples exhibiting reporting limits below the 0.041 ug/L CCC.

However, pesticide-related toxicity is a known concern in Bay Area urban creeks. As such, a Water Quality Attainment Strategy and TMDL for Diazinon and Pesticide-related Toxicity in Urban Creeks was established by the SFBRWQCB. This comprehensive program is enforced through MRP Provision C.9 (Pesticides and Toxicity Control) and covers all existing and future issues related to pesticides in creeks. Furthermore, many pesticides (e.g., pyrethroids, imidacloprid, fipronil) are being monitored in receiving water (along with toxicity endpoints for several organisms) in dry and wet weather by the stormwater Programs as required by MRP Provision C.8.g (Pesticides and Toxicity) monitoring. Therefore, pesticides will not be included in the RWL monitoring program.

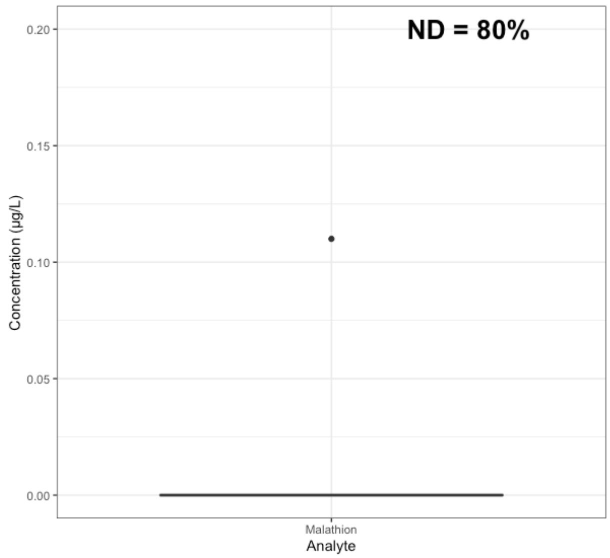

Figure A-4. Box plot generated from 4-county CEDEN data (2010-2021) for total fraction malathion. EPA Aquatic Life Criteria CCC for malathion is 0.1 ug/L.

PAHs. The regional dataset contains 846 data points in the PAH group. Data were available for 28 individual PAHs (n=16 to 34 depending on PAH), 16 of which have CTR objectives for human consumption of organisms. Maximum concentrations for these 16 PAHs were compared to the CTR objectives. Seven individual PAHs exceeded the CTR criteria: benzo(a)anthracene (9 of 34), benzo(a)pyrene (14 of 34), benzo(b)fluoranthene (17 of 34), benzo(k)fluoranthene (9 of 17), chrysene (18 of 34), dibenzo(a,h)anthracene (1 of 34), indeno(1,2,3-cd)pyrene) (13 of 34). These samples were collected at five stations throughout the counties of Alameda, Contra Costa, San Mateo, and Santa Clara as part of RMP STLS monitoring in Water Years 2011 through 2014. All samples with PAH concentrations that exceeded the CTR criteria were QA flagged as having some blank contamination with no blank correction (QA Code: NBC). Furthermore, all of the sample batches associated with these samples were flagged by the QA officer as having cursory verification/validation and minor deviations (VLC, VMD), some were also flagged as having incomplete QA (VQI), and some had "accuracy issues" noted in the Batch Comments. Finally, all results were reported without associated reporting limits (QA Code: NRL). Although the data were not rejected by the laboratory or QA officer, these issues suggest that there is uncertainty associated with these data. Therefore, inclusion of PAHs in the RWL monitoring program is not supported by these data. However, one or two annual sediment samples (depending on the Program population) will be analyzed for total PAHs per MRP Provision C.8.g (Pesticides and Toxicity Monitoring).

Nutrients. The regional dataset contains nutrient data for ammonia as N (n=778), nitrate as N (n=503), nitrite as N (n=494), total Kjeldahl nitrogen (n=689), orthophosphate as P (n=228) and phosphorus as P (n=860). There are currently no promulgated freshwater aquatic life WQOs against which to compare these data. Most of the nutrient data were collected synoptically with bioassessment monitoring conducted by the stormwater Programs and SWAMP, typically in the months of April, May and June. In addition, some of the nutrient data (over 250 records) were collected as part of MRP Provision C.8.f (POC) monitoring during the previous MRP permit term (i.e., MRP 2.0). Nutrients were included with MRP 2.0 POC monitoring to support SFBRWQCB efforts to develop nutrient numeric endpoints (NNE) for the San Francisco Bay Estuary, and prior data collected in freshwater tributaries to San Francisco Bay were used by the Nutrient Strategy Technical Team to develop and calibrate nutrient loading models. The "San Francisco Bay Nutrient Management Strategy" (NMS) is part of a statewide initiative to address nutrient over-enrichment in State waters (RWQCB 2022 and Senn et al. 2014). The NMS focuses on nutrient impacts to the estuarine San Francisco Bay and is a separate program from the State Biostimulatory Substances Objective and Program to Implement Biological Integrity. This latter program is contemplating the development of statewide nutrient-related WQOs for the protection of aquatic life in freshwater receiving waters. Although the State Biostimulatory Substances Objective and Program to Implement Biological Integrity has not yet published draft WQOs for public review, the supporting science products are evaluating relationships between measures of biological integrity (e.g., California Stream Condition Index) and biostimulatory variables such as total nitrogen (TN) and total phosphorus (TP). Therefore, TN and TP should be included in RWL monitoring with results compared to WQOs developed through the State Biostimulatory Substances Objective program.

Unionized ammonia data were not available on CEDEN and therefore not evaluated as part of the data review. However, the constituents necessary to calculate unionized ammonia should be included in RWL monitoring (i.e., ammonia and field measurements of temperature, pH, specific conductance) per Regional Water Board staff recommendations (Richard Looker, RWQCB, personal communication).

PBDEs. The regional dataset includes result for 42 individual PBDEs from 24 samples which were collected as part of RMP STLS monitoring in Water Years 2011 through 2014. There are no freshwater aquatic life WQOs against which to compare these data. PBDEs are a group of flame retardant additives used in thermoplastics, polyurethane foam, and textiles. They have been studied extensively as part of the RMP Emerging Contaminants Workgroup (ECWG), which lists them as "low concern" due to decreasing concentrations in Bay wildlife and sediment over time, and declining sources due to their phase out (Miller et al. 2020). Because PBDEs are already included in the RMP ECWG and Status and Trends monitoring programs they will not be included in the RWL monitoring program.

ANALYTES FOR RWL MONITORING

Based on the analysis of readily available data collected over the last decade in Bay Area creeks and channels (i.e., receiving waters), the following analytes will be included in the RWL monitoring program:

- *E. coli* – applicable FIB, as required by MRP Provision C.8.f.
- Dissolved copper – required by MRP Provision C.8.f.
- Dissolved zinc - required by MRP Provision C.8.f.

- Dissolved lead – based on the comparison of data to SF Bay Basin Plan WQOs.
- Hardness – ancillary parameter to calculate site-specific metals WQOs.
- Total Mercury – based on the comparison of data to SF Bay Basin Plan WQOs.
- PCBs (RMP 40) – based on the comparison of data to CTR criteria
- Total Phosphorus – based on anticipation of new statewide criteria.
- Total Nitrogen – based on anticipation of new statewide criteria.
- Unionized Ammonia – based on Regional Water Board staff recommendations.
- Ammonia, pH, specific conductance, temperature – ancillary parameters to calculate Unionized ammonia.
- Pesticides as required by provision C.8.g:
  - Pyrethroids: bifenthrin, cyfluthrin, cypermethrin, deltamethrin, esfenvalerate, lambda-cyhalothrin, permethrin;
  - Imidacloprid; and
  - Fipronil and its degradates fipronil-sulfone, fipronil-desulfinyl, fipronil sulfide and fipronil amide (amide is optional – do it if lab offers the suite).
- Toxicity as required by provision C.8.g.

REFERENCES

Miller, E., Mendez, M., Shimabuku, Il, Buzby, N. and Sutton, R. (2020). Contaminants of Emerging Concern in San Francisco Bay: A Strategy for Future Investigations. 2020 Update. Contribution No. 1007.

RWQCB. (2022). San Francisco Bay Nutrient Management Strategy. Website accessed November 17, 2022.

RWQCB. (2019). San Francisco Bay Basin (Region 2) Water Quality Control Plan (Basin Plan). Website accessed November 21, 2022.

Senn, D.B. and Novick, E., (2014). Scientific Foundation for the San Francisco Bay Nutrient Management Strategy. Draft FINAL. October 2014.

APPENDIX B
Field Datasheets

Receiving Water Limitations Monitoring
Field Data Log Sheet

GENERAL INFORMATION:

Site ID:	Site Name:	
Field Personnel:		Stormwater Consultant:
Arrival Date:	Arrival Time:	Departure Time:

Purpose of visit: ☐ Site Inspection ☐ Wet Season Sampling ☐ Dry Season Sampling

Antecedent Dry Period: ☐ 0-12 hrs ☐ 12-24 hrs ☐ 24-36 hrs ☐ 36-48 hrs ☐ 48-72 hrs ☐ >72 hrs

SAMPLE LOCATION & TYPE DETAILS:

Position Coordinates:	Latitude:	Longitude:

Collection Location: ☐ Right Bank ☐ Left Bank ☐ Center of Flow ☐ Other______________________________

Collection Depth: ☐ Near Surface ☐ Mid Water ☐ Near Bottom ☐ Depth Integrated ☐ Other_______________

Collection Method: ☐ Manual Grab by Hand ☐ Manual with Grab Pole ☐ Isokinetic Sampler

SAMPLES COLLECTED (check all that apply and record time of collection):

☐ Copper, Lead, Zinc (Dissolved)	Time: _____________	☐ Hardness	Time: _____________
☐ Mercury (Total)	Time: _____________	☐ PCB Congeners	Time: _____________
☐ *E. coli*	Time: _____________	☐ TKN	Time: _____________
☐ Nitrate	Time: _____________	☐ Nitrite	Time: _____________
☐ Ammonia	Time: _____________	☐ Total Phosphorus	Time: _____________

FIELD QA/QC SAMPLES COLLECTED (check all that apply):

☐ Field duplicate (analytes and time of collection) ____

☐ MS/MSD (analytes and time of collection) ____

☐ Field blank (analytes and time of collection) ____

FIELD MEASUREMENTS:

Staff Plate Reading (if present): ________________ ft Time of reading: _______________

If staff plate not present, provide estimate of flow rate or qualitative description:__________________________________

____

pH _________ Temperature ___________ Specific Conductance: ___________ Time of measurements _____________

Duplicate pH _______ Duplicate Temp. _______ Duplicate Specific Cond.________ Time of duplicates___________

STANDARD OBSERVATIONS:

Rainfall: ☐ None ☐ Intermittent ☐ Light ☐ Moderate ☐ Heavy

Oil: ☐No ☐Yes (extent)____________________ Floating material ☐No ☐Yes (type) _______________________

Odor: ☐No ☐Yes ______________ Turbidity ☐No ☐Yes ______________ Color ☐No ☐Yes _______________

Other observations (wildlife, construction, recreational activity)

____

Photos taken: ☐ Sampling Point ☐ Upstream ☐ Downstream ☐ Other _________________________________

COMMENTS / SAMPLING NOTES:

SWAMP Field Data Sheet (Water Chemistry & Discrete Probe) - EventType=WQ		Entered in d-base (initial/date)	Pg of Pgs
*StationID: ___ ___ ___ ___ ___ ___ ___ ___ ___	*Date (mm/dd/yyyy): / /	*Group:	*Agency:
Funding: ___ ___ ___ ___ ___ ___ ___ ___	ArrivalTime: DepartureTime:	*SampleTime (1st sample):	*Protocol:
*ProjectCode:	*Personnel:	*Purpose (circle applicable): WaterChem WaterTox Habitat FieldMeas	*PurposeFailure:

*Location: Bank Thalweg Midchannel OpenWater	*GPS/DGPS	Lat (dd.ddddd)	Long (ddd.ddddd)	OCCUPATION METHOD: Walk-in Bridge R/V __________ Other
GPS Device:	Target:		-	STARTING BANK (facing downstream): LB / RB / NA
Datum: NAD83 Accuracy (ft / m):	*Actual:		-	Point of Sample (if Integrated, then -88 in dbase)

Habitat Observations (CollectionMethod = Habitat_generic)

SITE ODOR:	None,Sulfides,Sewage,Petroleum,Smoke,Other______	WADEABILITY: Y / N / Unk	BEAUFORT SCALE (see attachment):
SKY CODE:	Clear, Partly Cloudy, Overcast, Fog, Smoky, Hazy	WIND DIRECTION (from):	
OTHER PRESENCE:	Vascular,Nonvascular,OilySheen,Foam,Trash,Other______		
DOMINANT SUBSTRATE:	Bedrock, Concrete, Cobble, Boulder, Gravel, Sand, Mud, Unk, Other_________		
WATERCLARITY:	Clear (see bottom), Cloudy (>4" vis), Murky (<4" vis)	PRECIPITATION:	None, Fog, Drizzle, Rain, Snow
WATERODOR:	None, Sulfides, Sewage, Petroleum, Mixed, Other____	PRECIPITATION (last 24 hrs):	Unknown, <1", >1", None
WATERCOLOR:	Colorless, Green, Yellow, Brown	EVIDENCE OF FIRES:	No, <1 year, <5 years
OVERLAND RUNOFF (Last 24 hrs):	none, light, moderate / heavy, unknown		
OBSERVED FLOW:	NA, Dry Waterbody Bed, No Obs Flow, Isolated Pool, Trickle (<0.1cfs), 0.1-1cfs, 1-5cfs, 5-20cfs, 20-50cfs, 50-200cfs, >200cfs		

DISTANCE FROM BANK (m):	
STREAM WIDTH (m):	
WATER DEPTH (m):	
HYDROMODIFICATION: None, Bridge, Pipes, ConcreteChannel, GradeControl, Culvert, AerialZipline, Other LOCATION (to sample): US / DS / WI / NA	
PHOTOS (RB & LB assigned when facing downstream; RENAME to StationCode_yyyy_mm_dd_uniquecode):	1: (RB / LB / BB / US / DS / ##)
	2: (RB / LB / BB / US / DS / ##)
	3: (RB / LB / BB / US / DS / ##)

Field Measurements (SampleType = FieldMeasure; Method = Field)

	DepthCollec (m)	Velocity (fps)	Air Temp (°C)	Water Temp (°C)	pH	O2 (mg/L)	O2 (%)	Specific Conductivity (uS/cm)	Salinity (ppt)	Turbidity (ntu)			
SUBSURF/MID/ BOTTOM/REP													
SUBSURF/MID/ BOTTOM/REP													
SUBSURF/MID/ BOTTOM/REP													
Instrument:													
Calib. Date:													

Samples Taken (# of containers filled) - Method=Water_Grab

Field Dup YES / NO: (SampleType = Grab / Integrated; LABEL_ID = FieldQA; create collection record upon data entry

SAMPLE TYPE: Grab / Integrated | COLLECTION DEVICE: | Indiv bottle (by hand, by pole, by bucket); Teflon tubing; Kemmer; Pole & Beaker; Other ___________________

	DepthCollec (m)	Inorganics	Bacteria	Chl a	TSS / SSC	TOC / DOC	Total Hg	Dissolved Mercury	Total Metals	Dissolved Metals	Organics	Toxicity	VOAs
Sub/Surface													
Sub/Surface													

COMMENTS:

Appendix 8

Regional Stormwater Monitoring Strategy for Emerging Contaminants

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CONTRA COSTA
CLEAN WATER
PROGRAM

March 31, 2023

Ms. Eileen White, Executive Officer
California Regional Water Quality Control Board, San Francisco Bay Region
1515 Clay Street, Suite 1400
Oakland, California 94612

SUBJECT: Regional Stormwater Monitoring Strategy for Emerging Contaminants in Accordance with MRP 3.0 Provision C.8.f.ii

Dear Ms. White:

In compliance with Provision C.8.f.ii of the Municipal Regional Stormwater Permit (MRP 3.0), NPDES Permit No. CAS612008 (Order No. R2-2022-0018), this letter presents the regional stormwater monitoring strategy for emerging contaminants on behalf of the Permittees that participate in the Contra Costa Clean Water Program (CCCWP).

Provision C.8.f.ii (Table 8.2, footnote c) states:

> *Permittees, collectively, shall produce or cause to be produced a stormwater monitoring strategy for emerging contaminants (ECs) by April 1, 2023 that prioritizes ECs for stormwater monitoring listed in this table and possibly others and establishes an approach for sampling stormwater ECs based on specific or likely physico-chemical properties, sources, transport pathways, and fate of prioritized ECs. Permittees must conduct or cause to be conducted ECs stormwater monitoring to execute the ECs stormwater monitoring strategy at a level of effort indicated in the table. This level of effort can be satisfied either through sampling and analysis of the number of samples indicated in this table or through augmentation of the San Francisco Bay Regional Monitoring Program Emerging Contaminants Monitoring Strategy in the amount of $100,000 per year for all Permittees combined.*

As approved by the CCCWP Management Committee, the Permittees have agreed to satisfy this MRP 3.0 requirement by annually contributing their equitable share of $100,000 to augment the San Francisco Bay Regional Monitoring Program (RMP) Emerging Contaminants Monitoring Strategy[1]. For Permittees in Contra Costa County, annual contributions of $21,649 will be made through CCCWP (see Table 1).

[1] https://www.sfei.org/sites/default/files/biblio_files/CEC%20Strategy%20-%202020%20Update%20-%20Final_92320.pdf

Table 1: Contributions the MRP Permittees have agreed to make annually to augment the RMP's Emerging Contaminant Monitoring Strategy during the term of the permit

Permittee Group	Annual Contribution	Relative Percentage[2]
Alameda County Permittees	$30,923	30.92%
Contra Costa County Permittees	$21,649	21.65%
Santa Clara County Permittees	$33,489	33.49%
San Mateo County Permittees	$13,939	13.94%
Total	**$100,000**	**100%**

The stormwater portion of the RMP's Emerging Contaminants Monitoring Strategy is currently under development and builds upon a stormwater emerging contaminants screening study conducted from 2018-2023 and ongoing watershed hydrology, sediment, and pollutant loads modeling. The stormwater portion of the RMP's Emerging Contaminants Monitoring Strategy is scheduled for completion in late 2023 and will be implemented through the RMP during the MRP 3.0 permit term. This portion of the RMP's Emerging Contaminant Monitoring Strategy includes both watershed and stormwater modeling and monitoring tasks to address high priority management questions established collaboratively through the RMP consistent with those included in MRP 3.0.

CCCWP Permittees maintain continued participation in the RMP and the development and implementation of the stormwater portion of the Emerging Contaminants Monitoring Strategy. If you have any questions or comments, please contact me or Lisa Welsh (lwelsh@geosyntec.com).

Kind Regards,

Karin Graves
Program Manager
Contra Costa Clean Water Program

cc: Zach Rokeach, SFBRWQCB
Richard Looker, SFBRWQCB
Elizabeth Lee, CVRWQCB
Contra Costa County Permittees

[2] Relative percentages are based on the populations within the MRP-associated portions of each county at the start of MRP 3.0 (Department of Finance, January 2022).

Attachment A

Electronic Data Transmittal Letter dated March 31, 2023, with attached file list

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CONTRA COSTA
CLEAN WATER
PROGRAM

March 31, 2023

Eileen White, Executive Officer
California Regional Water Quality Control Board, San Francisco Bay Region
1515 Clay Street, Suite 1400
Oakland, CA 94612

Patrick Pulupa, Esq., Executive Officer
California Regional Water Quality Control Board, Central Valley Region
11020 Sun Center Drive, #200
Rancho Cordova, CA 95670-6114

SUBJECT: Submittal of Electronic Status Monitoring Data Report in Accordance with MRP 3.0 Permit Provision C.8.h.ii and C.8.h.iv

Dear Ms. White and Mr. Pulupa:

Provision C.8.h.ii of the Municipal Regional Permit (MRP) for urban stormwater issued by the San Francisco Bay Regional Water Quality Control Board (Order No. R2-2022-0018) requires submittal of monitoring data collected during the previous water to the California Environmental Data Exchange Network (CEDEN). Data that CEDEN cannot accept are exempt from this requirement. Enclosed please find documentation that applicable monitoring data were uploaded to CEDEN in a Surface Water Ambient Monitoring Program (SWAMP) compatible format on behalf of all Contra Costa County Permittees. Provision C.8.h.iv stipulates that pollutants of concern monitoring data, not reportable to CEDEN, be included with the Urban Creeks Monitoring Report (UCMR). Per historic practice, the Contra Costa Clean Water Program (CCCWP) has also transmitted monitoring data to Mr. Zach Rokeach (SFBRWQCB) and CVRWQCB staff (Ms. Elizabeth Lee) electronically by share site.

With the approval and direction from each duly authorized representative of each Permittee, I have been authorized to submit and certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of a fine and imprisonment for knowing violations.

Regards,

Karin Graves
Program Manager
Contra Costa Clean Water Program

cc: Zach Rokeach, SFBRWQCB
Richard Looker, SFBRWQCB
Elizabeth Lee, CVRWQCB
Contra Costa County Permittees