URBAN CREEKS MONITORING REPORT

PART C: PESTICIDES & TOXICITY MONITORING IN SAN MATEO COUNTY

Water Year 2023 (October 2022 – September 2023)

Submitted in Compliance with
NPDES Permit No. CAS612008 (Order No. R2-2022-0018)
Provision C.8.h.iii.

SAN MATEO COUNTYWIDE
Water Pollution Prevention Program

A Program of the City/County Association of Governments of San Mateo County

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CREDITS

This report is submitted by the participating agencies in the

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List of Acronyms

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
DF	Detection Frequency
DPR	(California) Department of Pesticide Regulation
FY	Fiscal Year
IPM	Integrated Pest Management
MDL	Method Detection Limit
MPC	Monitoring and Pollutants of Concern
MRP	Municipal Regional Permit
NPDES	National Pollutant Discharge Elimination System
PAH	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
PEC	Probable Effects Concentrations
PRM	Pathogen Related Mortality
QAPP	Quality Assurance Project Plan
QAPrP	Quality Assurance Program Plan
QA/QC	Quality Assurance/Quality Control
RMC	Regional Monitoring Coalition
SCCWRP	Southern California Coastal Water Research Project
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 Procedures
SPoT	Stream Pollution Trends Program
SWAMP	Surface Water Ambient Monitoring Program
SWPP	Surface Water Protection Program
TEC	Threshold Effects Concentrations
TOC	Total Organic Carbon
TST	Test of Significant Toxicity
TU	Toxic Unit
UCMR	Urban Creeks Monitoring Report
USEPA	Environmental Protection Agency
WQO	Water Quality Objective
WY	Water Year

1.0 Introduction

This *Urban Creeks Monitoring Report (UCMR) Part C: Pesticides & Toxicity Monitoring Status, Water Year[1] (WY) 2023* was prepared by the San Mateo Countywide Water Pollution Prevention Program (SMCWPPP). SMCWPPP is a program of the City/County Association of Governments (C/CAG) of San Mateo County. Each incorporated city and town in the county, OneShoreline, and the County of San Mateo share a common National Pollutant Discharge Elimination System (NPDES) stormwater permit for Bay Area municipalities referred to as the Municipal Regional Permit (MRP).

The MRP was first adopted by the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB or Regional Water Board) on October 14, 2009 as Order R2-2009-0074 (SFBRWQCB 2009; referred to as MRP 1.0). On November 19, 2015, the Regional Water Board updated and reissued the MRP as Order R2-2015-0049 (SFBRWQCB 2015; referred to as MRP 2.0). The current, and third, version of the MRP (i.e., MRP 3.0, SFBRWQCB 2022) was issued by the Regional Water Board as Order R2-2022-0018 and became effective July 1, 2022. The monitoring requirements in MRP 3.0 (SFBRWQCB 2022) are similar to those within MRP 2.0 (SFBRWQCB 2009), with minor differences in analytes and reporting structure.

This report fulfills the requirements of Provision C.8.h.iii.(3) of MRP 3.0 for interpreting and reporting all Pesticides & Toxicity monitoring data collected during WY 2023 by SMCWPPP.[2]

Data presented in this report were collected pursuant to water quality monitoring requirements in Provision C.8.g (Pesticides & Toxicity Monitoring) of the MRP.[3] Data presented in this report were submitted electronically to the Regional Water Board by SMCWPPP and may be obtained via the California Environmental Data Exchange Network (CEDEN).

1.1 Report Organization

This report is organized into the following sections:

- **Section 1.0** provides the relevant background information and regulatory requirements for Pesticides & Toxicity monitoring pursuant to the MRP.
- **Section 2.0** describes the methods used to generate and analyze data.
- **Section 3.0** presents the results of Pesticides & Toxicity monitoring conducted by the Program in WY 2022, including brief descriptions of sampling protocols and analytical methods and a statement of data quality.
- **Section 4.0** describes conclusions and recommendations based on WY 2023 monitoring data.
- **Section 5.0** provides all the references cited with the report.

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[1] Most hydrologic monitoring occurs for a period defined as a Water Year, which begins on October 1 and ends on September 30 of the named year. For example, Water Year 2023 (WY 2023) began on October 1, 2022 and concluded on September 30, 2023.

[2] Prior monitoring reports prepared by SMCWPPP are available at https://www.flowstobay.org/data-resources/reports/urban-creek-monitoring-reports/

[3] Monitoring data collected pursuant to other C.8 provisions (e.g., Pollutants of Concern Monitoring, LID Monitoring, and Trash Monitoring) are reported in other Reports of the SMCWPPP Urban Creeks Monitoring Reporting series (UCMR) for WY 2023.

1.2 Monitoring Requirements

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

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

1.2.1 Dry Weather

Provision C.8.g.ii. of MRP 3.0 requires SMCWPPP to sample one site each year during dry weather for toxicity and sediment chemistry analysis. The permit provides examples of possible monitoring location types, including sites with suspected or past toxicity results and sites where bioassessment surveys have been conducted. MRP 3.0 dry weather monitoring includes:

- Toxicity testing in water using five species: *Ceriodaphnia* dubia (chronic survival and reproduction), *Pimephales promelas* (larval survival and growth), *Selenastrum capricornutum* (growth), *Hyalella azteca* (survival) and *Chironomus dilutus* (survival).
- Toxicity testing in sediment using two species: *Hyalella azteca* (survival) and *Chironomus dilutus* (survival).
- Sediment chemistry analysis for pyrethroids (bifenthrin, cyfluthrin, cypermethrin, deltamethrin, esfenvalerate, lambda-cyhalothrin, permethrin), fipronil and its degradates (fipronil-sulfone, fipronil-desulfinyl, fipronil sulfide), total polycyclic aromatic hydrocarbons (PAHs), metals (arsenic, cadmium, chromium, copper, lead, nickel, zinc), total organic carbon (TOC), and sediment grain size.

1.2.2 Wet Weather

Provision C.8.g.iii. of MRP 3.0 requires Permittees to collect samples from the water column during storm events for toxicity and pesticide analysis. Sample locations must be representative of urban watersheds (i.e., bottom of watershed locations) Wet weather monitoring includes:

- Toxicity testing in water using five species: *Ceriodaphnia* dubia (chronic survival and reproduction), *Pimephales promelas* (larval survival and growth), *Selenastrum capricornutum* (growth), *Hyalella azteca* (survival) and *Chironomus dilutus* (survival).
- Water chemistry analysis for pyrethroids (bifenthrin, cyfluthrin, cypermethrin, deltamethrin, esfenvalerate, lambda-cyhalothrin, permethrin), fipronil and its degradates (fipronil-sulfone, fipronil-desulfinyl, fipronil sulfide)[4], and imidacloprid[5].

Provision C.8.g.iii provides two options to determine the number of wet weather samples required. If Provision C.8.g.iii. sampling is conducted by the Bay Area Municipal Stormwater

[4] Fipronil amide is optional.

[5] Imidacloprid must be analyzed using a method that achieves a reporting level of 0.01 ppb.

Collaborative (BAMSC)[6] Regional Monitoring Coalition (RMC) on behalf of all MRP Permittees, a collective total of ten wet weather samples is required, with a minimum of six samples collected by the end of the third water year of the permit term (i.e., WY 2024). If Provision C.8.g.iii. sampling is conducted by SMCWPPP, at least one wet weather sample is required per year.

Members of the RMC have completed wet weather Pesticides & Toxicity monitoring in WY 2023. The SMCWPPP collected two of the ten regional samples.

1.2.3 Follow-up

Provision C.8.g.iv of the MRP requires Permittees to provide notification in the next UCMR when analytical results indicate any of the following:

- A toxicity test of growth, reproduction, or survival of any test organism that is reported as "fail" in the both the initial sampling and a second, follow-up sampling, and both have ≥ 50% Percent Effect;
- A pollutant is present at a concentration exceeding its water quality objective (WQO) in the Basin Plan; or
- For pollutants without WQOs, results exceed Probable Effects Concentrations (PECs) or Threshold Effects Concentrations (TECs) as defined in MacDonald et al. (2000).

1.3 Regional Monitoring Coalition

Provision C.8.a. (Compliance Options) of the MRP allows Permittees to address monitoring requirements through a regional collaborative effort, their Stormwater Program, and/or individually[7]. The RMC was formed in early 2010 as a collaboration among several Bay Area Stormwater Management Agencies Association (BASMAA) (now BAMSC) members and MRP Permittees[8] to develop and implement regionally coordinated water quality monitoring programs to improve stormwater management in the region and address water quality monitoring required by the MRP. BAMSC RMC collaboration allows Permittees and the Regional Water Board to improve their ability to collectively answer core management questions in a cost-effective and scientifically rigorous way. Participation in the RMC is facilitated through the BAMSC Monitoring and Pollutants of Concern (MPC) Subcommittee.

[6] The BAMSC was organized by the Bay Area Stormwater Management Agencies Association (BASMAA) Board of Directors to continue the information sharing and permittee advocacy functions of BASMAA in an informal manner after BASMAA's dissolution in 2021.

[7] Provision C.8.g of MRP 3.0 also encourages Permittees to collaborate with the California Department of Pesticide Regulation for data collection and analysis.

[8] BAMSC RMC partners include Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP), Alameda Countywide Clean Water Program (ACCWP), Contra Costa Clean Water Program (CCCWP), SMCWPPP, and the Solano Stormwater Alliance (SSA).

The goals of the RMC are to:

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

2.0 Methods

Water quality data were collected and reviewed in accordance with California Surface Water Ambient Monitoring Program (SWAMP) comparable methods and procedures described in the RMC Standard Operating Procedures (SOPs; BASMAA 2016) and the associated Quality Assurance Project Plan (QAPP; BASMAA 2020). These documents are updated as needed to optimize applicability. Where applicable, monitoring data were collected using methods comparable to those specified by the SWAMP Quality Assurance Program Plan (QAPrP)[9], and were submitted in SWAMP-compatible format to the Regional Water Board. The SOPs were developed using a standard format that describes health and safety cautions and considerations, relevant training, site selection, and sampling methods/procedures, including pre-fieldwork mobilization activities to prepare equipment, sample collection, and de-mobilization activities to preserve and transport samples.

2.1 Monitoring Methods

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

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

Sediment samples were collected after any water samples were collected. Sediment samples were collected from the top 2 cm at each sub-site beginning at the downstream-most location and continuing upstream. Field staff walk in an upstream direction, carefully avoiding disturbance of sediment at collection sub-sites. Sediment samples were placed in a compositing container, thoroughly homogenized, and then aliquoted into separate jars for chemical or toxicological analysis using standard clean sampling techniques (see SOP FS-6, BASMAA 2016).

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

2.2 Laboratory Analysis Methods

RMC participants, including SMCWPPP, agreed to use the same laboratories for individual parameters, developed standards for contracting with the labs, and coordinated shared quality assurance samples. All samples collected by RMC participants that were sent to laboratories for analysis were analyzed and reported per SWAMP-comparable methods as described in the QAPP (BASMAA 2020). Analytical laboratory methods, reporting limits, and holding times for

[9]The current SWAMP QAPrP is available at: https://www.waterboards.ca.gov/water_issues/programs/swamp/docs/swamp-qaprp-2022.pdf

chemical water quality parameters are also described in the QAPP (2020). Analytical laboratory contractors in WY 2023 included:

- CalTest, Inc. – Sediment chemistry
- Pacific EcoRisk, Inc. – Water and sediment toxicity

2.3 Data Evaluation

2.3.1 Water and Sediment Toxicity

Toxicity data evaluation required by the MRP involves first assessing whether the samples are toxic to the test organisms relative to the laboratory control treatment via statistical comparison. using the Test of Significant Toxicity (TST) statistical approach. For samples with toxicity (i.e., those that "failed" the TST), the Percent Effect is evaluated. The Percent Effect compares sample endpoints (survival, reproduction, growth) to the laboratory control endpoints. Both the statistical comparison (e.g., TST) and the comparison of the sample results to the laboratory control (e.g., Percent Effect) are determined by the laboratory. If both the initial and follow-up sample are reported as "fail" with ≥ 50% Percent Effect, the Regional Water Board is notified in the next UCMR.

2.3.2 Sediment Chemistry

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

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

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

MRP 3.0 does not specify follow-up actions for pyrethroid or fipronil sediment chemistry data, perhaps because pyrethroids are ubiquitous in the urban environment and little is known about fipronil distribution. However, SMCWPPP computed toxic unit (TU) equivalents for individual pyrethroid results based on available literature values for pyrethroids in sediment LC50 values.[10] Because organic carbon mitigates the toxicity of pyrethroid pesticides in sediments, the LC50 values were derived on the basis of TOC-normalized concentrations. Therefore, the

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

pesticide concentrations as reported by the lab were divided by the measured TOC concentration at each site, and the TOC-normalized concentrations were then used to compute TU equivalents for each constituent. Concentrations equal to one-half of the respective laboratory MDLs were substituted for non-detect data so that these statistics could be computed, potentially resulting in artificially elevated results.

2.3.3 Water Chemistry

Provision C.8.g.iv of the MRP requires that chemical pollutant data from water and sediment monitoring be compared to the corresponding WQOs in the Basin Plan for each analyte sampled. If concentrations in the samples exceed their WQOs, then the Regional Water Board is notified in the next UCMR. However, the Basin Plan does not contain numeric WQOs for the chemical analytes encompassed within the wet weather pesticide monitoring.

2.4 Statement of Data Quality

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

Overall, the results of the QA/QC review suggest that Pesticides & Toxicity Monitoring data generated during WY 2023 were of sufficient quality for the purposes of this monitoring program, in comparison to objectives outlined in the QAPP. However, some data were flagged in accordance with QA/QC protocols and the dry weather *Pimephales promelas* (i.e., fathead minnow) toxicity results were flagged as questionable due to pathogen related mortality (PRM). A detailed QA/AC report for WY 2023 pesticides and toxicity data is included as Appendix A.

3.0 Results and Discussion

This section describes the results of toxicity testing, sediment chemistry, and pesticide monitoring (collectively referred to as pesticides and toxicity monitoring) conducted during WY 2023 in compliance with Provision C.8.g of the MRP.

3.1 Site Selection

From WY 2012 through WY 2022 pesticide and toxicity monitoring sites were selected to represent mixed-land use in urban watersheds not already being monitored for toxicity or pesticides by other programs, such as the SWAMP SPoT Program. A different watershed was targeted each year with the goal of eventually developing a geographically diverse dataset. Specific monitoring locations within the identified creeks were based on the likelihood that they would contain fine depositional sediments during the dry season and would be safe to access during wet weather sampling, if relevant. A new approach was initiated in WY 2023 - Pilarcitos Creek was selected for annual dry weather monitoring so that long-term trends can be observed and to better inform management actions. This approach was motivated by the Draft 2024 California Integrated Report (SWRCB 2023) which recommends adding Pilarcitos Creek to the Clean Water Act 303(d) list of impaired waterbodies for water and sediment toxicity, based on multiple lines of evidence (LOE) with significant toxicity with a Percent Effect greater than 20%. The LOE used to support the proposed listing include toxicity to *C. dubia* (WY 2014) in water and *H. azteca* (WYs 2014, 2019) in sediment. It is anticipated that the new 303(d) listing will be adopted by the State Board in February 2024, and approved by the USEPA in summer 2024. The Pilarcitos Creek monitoring site is located downstream of Highway 1 in the City of Half Moon Bay (37.46803, -122.43467; site ID 202R01308; Figure 3.2).

Wet weather sites targeted in WY 2023 include San Mateo Creek at Gateway Park (37.56997, -122.31845; site ID 204SMA020), which is monitored annually through the SPoT Program, and Colma Creek at Orange Ave (37.65336, -122.42588; site ID 204COL040), which is just downstream of the Orange Memorial Park Regional Stormwater Capture Project (Figure 3.2). Photos of both wet weather sites are included in Figure 3.1.

Figure 3.1 Left to right: San Mateo Creek (204SMA020) and Colma Creek (204COL040) on November 8, 2022 (photo credit: Kinnetic Environmental, Inc.).

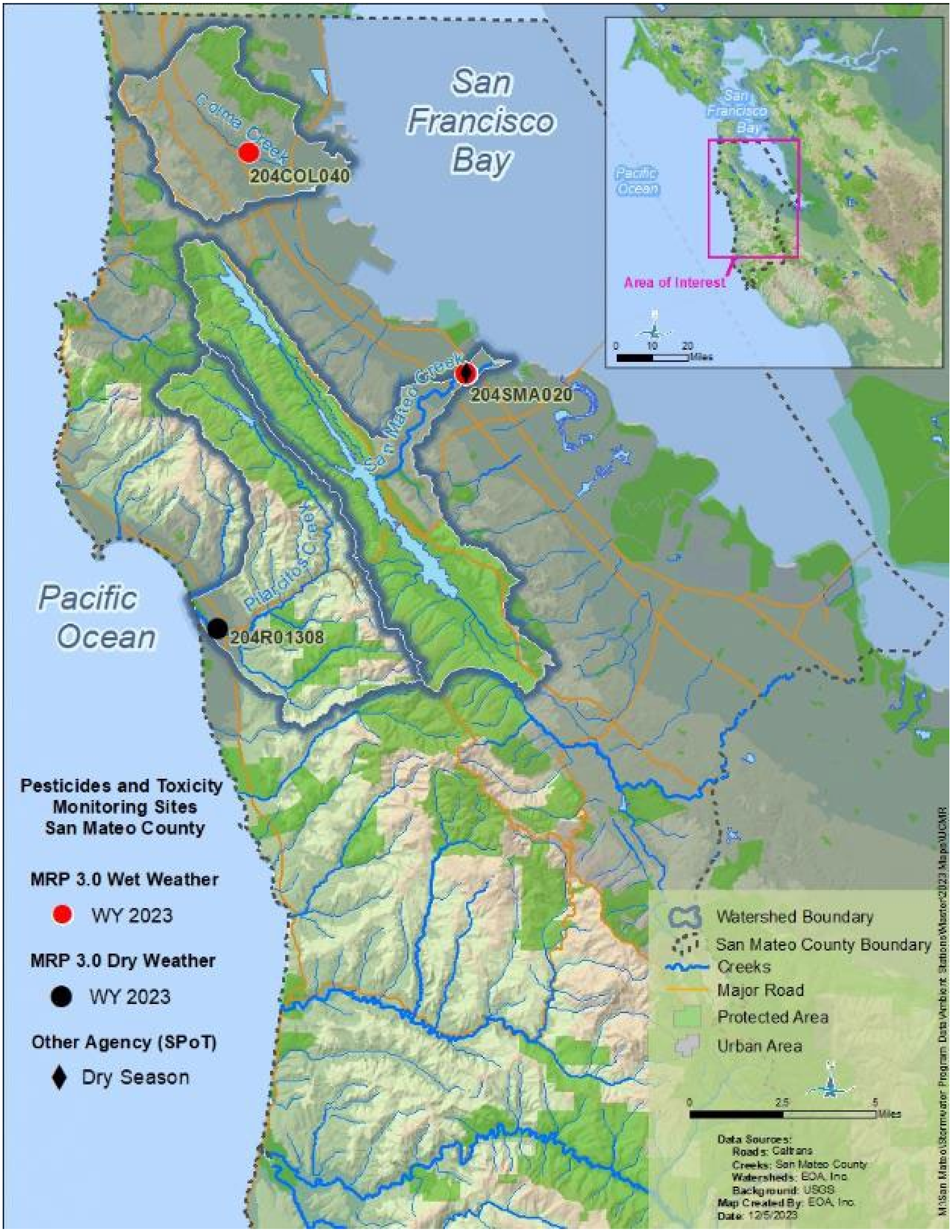

Figure 3.2 SMCWPPP Program Area, major creeks, and monitored sites during WY 2023.

3.2 Toxicity

3.2.1 WY 2023 Dry Results

Details of the WY 2023 dry season toxicity tests are listed in Table 3.1. *C. dilutus* exhibited significant toxic responses to the water sample but with a percent effect below the MRP threshold for retesting (i.e., 50%). *P. promelas* toxicity results, also significantly toxic with a percent effect below 50%, were flagged as questionable due to PRM in one of the sample replicates. No significant toxicity was observed in the sediment samples, corroborating the lack of exceedances of MRP 3.0 thresholds for follow-up actions of sediment chemistry analysis (i.e., TEC or PEC ≥ 1.0) in section 3.3.

Table 3.1 Summary of SMCWPPP dry weather water and sediment toxicity results, Pilarcitos Creek, WY 2023. Shaded cells indicate significant toxicity, none of which had a Percent Effect ≥50%.

Site	Organism	Test Type	Unit	Results		% Effect	TST Value	Follow up needed (TST "Fail" and ≥50%)
				Lab Control	Organism Test			
202R01308 Pilarcitos Creek July 18, 2023	**Water**							
	Ceriodaphnia dubia	Survival	%	90	88.9	1.2%	NA[a] (Pass)	No
		Reproduction	Num/Rep	32	34.9	-9.1%	Pass	No
	Pimephales promelas [b]	Survival	%	95	72.5	23.7%	Fail	No
		Growth	mg/ind	0.82	0.63	23.2%	Fail	No
	Chironomus dilutus	Survival	%	97.5	87.5	10.3%	Fail	No
	Hyalella azteca	Survival	%	98	100	-2%	Pass	No
	Selenastrum capricornutum	Growth	cells/ml	2503000	5650000	-125.7%	Pass	No
	Sediment							
	Chironomus dilutus	Survival	%	72.5	75	-3.4%	Pass	No
	Hyalella azteca	Survival	%	93.8	96.3	-2.7%	Pass	No

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

[b] *P. promelas* toxicity results were flagged as questionable due to pathogen related mortality in one of the replicates.

3.2.2 WY 2023 Wet Results

The MRP 3.0 provision for wet weather toxicity and pesticide analysis was satisfied with a regional sampling event on November 8, 2022. The SMCWPPP was responsible for two of the ten regional water samples. Table 3.2 shows WY 2023 wet weather SMCWPPP toxicity results.

- **Colma Creek (204COL040)**
  Two test organisms, *C. dilutus* and *H. azteca* were found to have significant toxicity in the Colma Creek sample; however, the Percent Effect for both tests was below the MRP threshold for retesting.

- **San Mateo Creek (204SMA020)**
  Two test organisms, *C. dubia* and *H. azteca* were found to have significant toxicity in the San Mateo Creek sample; however, the Percent Effect for both tests was below the MRP threshold for retesting.

Table 3.2 Summary of SMCWPPP wet weather water toxicity results for WY 2023.

Site	Organism	Test Type	Unit	Results		% Effect	TST Value	Follow up needed (TST "Fail" and ≥50%)
				Lab Control	Organism Test			
204COL040 Colma Creek November 8, 2022	*Ceriodaphnia dubia*	Survival	%	100	100	0%	NA[a] (Pass)	No
		Reproduction	Num/Rep	41.9	38.8	7.4%	Pass	No
	Pimephales promelas	Survival	%	100	95	5%	Pass	No
		Growth	mg/ind	0.80	0.79	1.3%	Pass	No
	Chironomus dilutus	Survival	%	95	80.0	15.8%	Fail	No
	Hyalella azteca	Survival	%	100	70	30%	Fail	No
	Selenastrum capricornutum	Growth	cells/ml	2943000	5735000	-94.9%	Pass	No
	Chironomus dilutus	Survival	%	95	80	15.8%	Pass	No
	Hyalella azteca	Survival	%	100	70.0	30%	Pass	No
204SMA020 San Mateo Creek November 8, 2022	*Ceriodaphnia dubia*	Survival	%	100	90	10%	NA[1] (Pass)	No
		Reproduction	Num/Rep	41.9	31.2	25.5%	Fail	No
	Pimephales promelas	Survival	%	100	95	5%	Pass	No
		Growth	mg/ind	0.80	1	-3.7%	Pass	No
	Chironomus dilutus	Survival	%	95	87.5	7.9%	Pass	No
	Hyalella azteca	Survival	%	100	78	22%	Fail	No
	Selenastrum capricornutum	Growth	cells/ml	2943000	5683000	-93.1%	Pass	No
	Chironomus dilutus	Survival	%	95	87.5	7.9%	Pass	No
	Hyalella azteca	Survival	%	100	78.0	22%	Pass	No

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

3.3 Sediment Chemistry

3.3.1 WY 2023 Results

Sediment chemistry results from dry season monitoring in WY 2023 were evaluated based on TEC and PEC quotients (see Section 2.3.2). SMCWPPP also evaluated TU equivalents of pyrethroids and fipronil.

Table 3.3 lists concentrations and TEC quotients for sediment chemistry constituents (metals and total PAHs) collected in WY 2023 from Pilarcitos Creek. The TEC quotients are calculated as the measured concentration divided by the highly conservative TEC value, per MacDonald et al. (2000)[11]. The TECs are extremely conservative and are intended to identify concentrations below which harmful effects on sediment-dwelling organisms are unlikely to be observed. Nickel was the analyte with the highest quotient, but still under 1.0. Nickel and chromium are expected in watersheds draining hillsides underlain by serpentine formations, which is a common geological feature in San Mateo County.

Table 3.3 also lists PEC quotients for sediment chemistry constituents collected in WY 2023. PECs are intended to identify concentrations above which toxicity to benthic-dwelling organisms are predicted to be probable. There were no PEC quotients greater than 1.0. Of the 25 individual PAHs measured, 12 were below the method detection limit (MDL), three were below the reporting limit (J-flagged), and 10 were quantified and reportable.

Table 3.3 TEC and PEC quotients for WY 2023 sediment chemistry constituents, Pilarcitos Creek.

Constituent	202R01308 Pilarcitos Creek	TEC		PEC	
Metals (mg/kg DW)	**Sample Concentration**	**TEC Threshold**	**TEC Quotient**	**PEC Threshold**	**PEC Quotient**
Arsenic	4.1	9.79	0.42	33.0	0.12
Cadmium	0.63	0.99	0.64	4.98	0.13
Chromium	22	43.4	0.51	111	0.20
Copper	17	31.6	0.54	149	0.11
Lead	7.9	35.8	0.22	128	0.06
Nickel	21	22.7	0.93	48.6	0.43
Zinc	95	121	0.79	459	0.21
PAHs (ug/kg DW)					
Total PAHs	35.65	1610	0.022 [ab]	22800	0.002 [ab]
# Constituents with TEC/PEC quotient ≥ 1.0		**0**			

[a] Concentration was below the method detection limit (MDL). TEC/PEC quotient equivalents calculated using 1/2 MDL.
[b] TEC quotient calculated from some concentrations below the reporting limit but above the MDL (J-flagged).

[11] MacDonald et al. (2000) does not provide TEC or PEC values for pyrethroids, fipronil, or carbaryl. Pesticides are compared to LC50 values in Table 3.4.

Table 3.4 lists the concentrations of pesticides measured in the sediment sample collected from Pilarcitos Creek during dry weather monitoring in WY 2023 and the published LC50 values. All pesticides except for bifenthrin and fipronil were measured at concentrations below the MDL of the analyte. Cumulative TU Equivalents for pyrethroid pesticides are well below 1.0.

Table 3.4 Pilarcitos Creek pesticide concentrations and associated LC50 values, WY 2023.

			202R01308 Pilarcitos Creek			
	Unit	LC50	Concentration		Normalized to TOC	TU Equivalent
Total Organic Carbon	%	NA	2.3		NA	NA
Pyrethroid						
Bifenthrin	µg/g dw	0.52	0.0046		0.20	0.385
Cyfluthrin, total	µg/g dw	1.08	0.000042	a	0.00	0.002
Cypermethrin, total	µg/g dw	0.38	0.000065	a	0.003	0.01
Deltamethrin/Tralomethrin	µg/g dw	0.79	0.000105	a	0.005	0.006
Esfenvalerate/Fenvalerate, total	µg/g dw	1.54	0.000165	a	0.007	0.005
Cyhalothrin, Total lambda-	µg/g dw	0.45	0.0000415	a	0.002	0.004
Permethrin, Total	µg/g dw	10.83	0.000375	a	0.02	0.002
			Sum of TU Equivalents			0.4
Other MRP Pesticides of Concern						
Fipronil	ng/g dw	306	0.27	b	11.7	0.038
Fipronil Desulfinyl	ng/g dw	NA [b]	0.085	a	3.7	NA
Fipronil Sulfide	ng/g dw	435	0.085	a	3.7	0.008
Fipronil Sulfone	ng/g dw	158	0.21	a	9.1	0.06

[a] Concentration was below the method detection limit (MDL). TU equivalents calculated using 1/2 MDL

[b] TU equivalent calculated from concentration below the reporting limit but above the MDL JA-flagged)

[c] No available LC50 value for Fipronil Desulfinyl

In compliance with the MRP, a grain size analysis was conducted on the dry season sediment sample (Table 3.5). The sample was 50.4% fines (i.e., 11.9% clay and 38.5% silt).

Table 3.5 Summary of grain size for site 202R01308 in Half Moon Bay, WY 2023.

Grain Size (%)		202R01308 Pilarcitos Creek
Clay	<0.0039 mm	11.9%
Silt	0.0039 to <0.0625 mm	38.5%
Sand	V. Fine 0.0625 to <0.125 mm	26.3%
	Fine 0.125 to <0.25 mm	18.1%
	Medium 0.25 to <0.5 mm	4%
	Coarse 0.5 to <1.0 mm	0.8%
	V. Coarse 1.0 to <2.0 mm	0.5%
Granule	2.0 to <4.0 mm	0.1%
Pebble	Small 4 to <8 mm	0%
	Medium 8 to <16 mm	0%
	Large 16 to <32 mm	0%
	V. Large 32 to <64 mm	0%

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

3.4 Pesticides in Wet Weather Water Samples

During WY 2023, in compliance with Provision C.8.g.iii, wet weather water samples were collected for pesticide analysis at two sites in San Mateo County (Colma Creek and San Mateo Creek). The concentrations of most pesticides analyzed were below the MDL, meaning that these analytes were reported as non-detects. However, detectable levels of bifenthrin, cyfluthrin, cypermethrin, fipronil and its degradation products were found at both sites (Table 3.6). Significant toxicity was also observed in water samples for the pyrethroid-sensitive *H. azteca* and the neonicotinoid-sensitive *C. dilutus,* although below a Percent Effect of 50%. These toxicity results appear to corroborate the low-level concentrations of pesticides found in synoptic water samples. There are no WQOs specified in the San Francisco Bay Basin Plan for the water column pesticide analytes. As a result, WQO or MRP trigger threshold exceedance analysis was not performed on wet weather pesticide data. A column is included in Table 3.6 that lists the United States Environmental Protection Agency (USEPA) lowest benchmark concentration that may cause chronic effects to freshwater invertebrates (Table 3.6).

Table 3.6 Summary of water column pesticide concentrations sampled during a WY 2023 storm event

	Unit	204COL040 Colma Creek	204SMA020 San Mateo Creek	Lowest USEPA Benchmark [c]
		Concentration	Concentration	Concentration
Pyrethroid				
Bifenthrin	µg/L	0.002	0.0019	0.00005
Cyfluthrin, total		0.0059	0.00049 [a]	0.00012
Cypermethrin, total		0.0010	0.0006	< 0.00005
Deltamethrin/Tralomethrin		< 0.0006 [b]	0.0022	0.000026
Esfenvalerate/Fenvalerate, total		< 0.0004 [b]	< 0.0004 [b]	0.0000309
Cyhalothrin, Total lambda-		< 0.0003 [b]	< 0.0003 [b]	0.00022
Permethrin, Total		< 0.0020 [b]	< 0.0020 [b]	0.0042
Other MRP Pesticides of Concern				
Fipronil	µg/L	0.0077	0.0061	0.01
Fipronil Desulfinyl		0.00097 [a]	0.0015	41
Fipronil Sulfide		0.0003 [a]	0.0008 [a]	5.16
Fipronil Sulfone		0.0019 [a]	0.0058	< 0.22
Imidacloprid		< 0.0040 [b]	< 0.0040 [b]	0.01

[a] Concentration is below the reporting limit but above the MDL (EJ-flagged)

[b] Concentration is below Method Detection Limit (MDL); values are displayed as "< MDL"

[c] Lowest concentration leading to chronic effects for freshwater invertebrates accessed January 2024 (https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/aquatic-life-benchmarks-and-ecological-risk#aquatic-benchmarks)

3.5 Third-Party Monitoring Efforts

Throughout the monitoring period associated with the sampling results described in this report, several additional programs external to SMCWPPP conducted similar pesticides and toxicity studies within the region. These studies provide valuable data for comparison against SMCWPPP findings to view water quality in a broader spatial and temporal context.

3.5.1 DPR Surface Water Protection Program Monitoring

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

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

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

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

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

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

WY 2021: The DPR collected and analyzed water samples for toxicity and pesticide concentrations, and sediment samples for analysis of pyrethroid concentrations. All samples were from Northern Californian urban areas and were collected throughout the water year. Similar to previous years' findings, imidacloprid had the highest DF (68%) while bifenthrin (59%) and fipronil (39%) were the second and third most detected pesticides, respectively. Storm events increased detection frequencies in the top three most detected pesticides by 2-4 times their dry weather detection frequencies. Both imidacloprid and bifenthrin were detected more often in waterways than storm drain systems. However, fipronil was detected slightly more frequently in storm drains compared to waterways. Imidacloprid, bifenthrin, and deltamethrin concentrations were all found to be above their respective lowest USEPA aquatic life benchmark (BM). Some fipronil concentrations were also found to be above the BM. Three of the five fipronil degradates were detected, with sulfone having the highest detections (39%) and amide/desulfinyl both having the second highest (14%). Desulfinyl was detected in one sample at a concentration above the BM. All seven pyrethroids were detected in the eight sediment samples. All pyrethroid concentrations in sediment samples exceeded their BM's. Toxicity testing using *H. azteca* and *C. dilutus* was conducted on water samples collected from Sacramento storm drains during four events: two storm events and two dry season events. All samples were found to be toxic to both test organisms. Samples collected during wet weather were more toxic to *H. azteca* than *C. dilutus*, and overall, wet weather samples were found to be more toxic than dry weather samples (Alvarado, 2023).

WY 2017-WY 2021: Findings from the DPR studies generally corroborate SMCWPPP pesticide monitoring results. For example, bifenthrin has been the most frequently detected pesticide in samples collected by SMCWPPP from WYs 2014 through WY 2023, and the second most detected insecticide in DPR samples. However, although fipronil and its degradates were frequently detected during the DPR studies, they have seldom been found at detectable concentrations in SMCWPPP sediment samples. Yet, recent wet weather monitoring results for SMCWPPP water samples have found detectable amounts of fipronil and its degradates (Table 3.6).

3.5.2 SPoT Monitoring Program

The SPoT Monitoring Program conducts annual dry season monitoring (subject to funding constraints) of sediments collected from a statewide network of large rivers. The goal of the SPoT Program is to investigate long-term trends in water quality. Sites are targeted in bottom-of-the-watershed locations with slow water flow and appropriate micromorphology to allow deposition and accumulation of sediments, including a station near the mouth of San Mateo Creek (Figure 3.2). In most years, sediments are analyzed for toxicity, with pesticides, metals, polychlorinated biphenyls (PCBs), mercury, and organic pollutants analyzed on a less frequent schedule (Phillips et al. 2014). The most recent technical report prepared by SPoT program staff was published in 2020 and describes ten-year trends from the initiation of the program in 2008 through 2017 (Phillips et al. 2020).

Toxicity testing was conducted by SPoT during dry weather in sediment samples collected from San Mateo Creek at Gateway Park (station ID 204SMA020; also monitored by SMCWPPP during wet weather in WY 2023 [see Section 3.4]) using indicator organisms *H. azteca*, which is sensitive to pyrethroids, and *C. dilutus*, added in 2015 to assess neonicotinoid and fipronil impacts. Toxicity samples are evaluated by SPoT using the TST statistical approach (Phillips et al. 2020).

For the ten-year SPoT dataset, acute and chronic toxicity to *H. azteca* was observed; however, the percent effect was less than 20%. Furthermore, there was a statistically significant decreasing trend in acute *H. azteca* toxicity in San Mateo Creek. Neither acute nor chronic *C. dilutus* toxicity have been observed since monitoring for this organism began in 2015. The SPoT findings are consistent with the SMCWPPP toxicity results for WY 2023 summarized in Table 3.2.

The SPoT sediment chemistry results from San Mateo Creek do not show a statistically significant trend in sum-of-pyrethroid concentrations but do show a decreasing trend in sum-of-fipronil-and-its-degradates concentrations over the 2008 – 2017 dataset reviewed by Philips et al. (2020). A review of SPoT data from 2008 to 2020 downloaded from CEDEN suggests the following:

- **Pyrethroids.** Pyrethroid concentrations in San Mateo Creek peaked in 2011 (88.2 ng/g). This concentration was driven by a relatively high permethrin concentration that year (58 ng/g). In other years, the individual pyrethroid with the highest was bifenthrin, although permethrin was measured at roughly double (9.3 ng/g) the concentration of bifenthrin in 2018. The most recent available data (2020) for the San Mateo Creek monitoring location reveals that bifenthrin, cyfluthrin, and permethrin had the highest detected concentrations, 6.08 ng/g, 1.69, and 1.44 ng/g, respectively. These amounts are higher than SMCWPPP’s most recent dry season concentrations (Table 3.4).
- **Fipronil.** Fipronil has been detected three times (2014, 2019, and 2020) in the years it was monitored (2013-2020). Three of its degradates (fipronil desulfinyl, fipronil sulfide, and fipronil sulfone) have been found at increasingly measurable concentrations more recently from 2017-2020, suggesting a consistent degradation of fipronil. Fipronil sulfone had the highest levels of concentration in 2020 data. The most recent SpoT data suggests SMCWPPP’s WY 2023 concentrations are lower than SpoT’s 2020 data, with much of WY 2023 concentrations being below the method detection limit.

4.0 Conclusions and Recommendations

This section presents conclusions and recommendations from review of the WY 2023 Pesticides & Toxicity Monitoring data that were generated in compliance with Provision C.8.g. of the MRP and which are presented in the preceding chapters of this report.

All monitoring and data validation were conducted using methods consistent with the BAMSC RMC QAPP (BASMAA 2020) and SOPs (BASMAA 2016). Recommendations for future monitoring are described in Section 4.2.

4.1 Conclusions

Toxicity testing of water and sediment samples and sediment chemistry monitoring, collectively referred to as pesticides and toxicity monitoring, was conducted during WY 2023 in compliance with Provision C.8.g of the MRP. Dry season samples were collected from Pilarcitos Creek to focus on long-term monitoring of a creek that is proposed for CWA 303(d) listing as impaired due to toxicity (SWRCB 2023). The SMCWPPP's wet weather monitoring requirements were also fulfilled for the MRP 3.0 term during WY 2023. Wet weather monitoring was conducted with the goal of a focused long-term comparative analysis. Wet weather monitoring locations included a site on Colma Creek, just downstream of the Orange Memorial Park Regional Stormwater Capture Project, and a site on San Mateo Creek, that is monitored annually by the State Water Board's SWAMP SPoT program.

4.1.1 Data Evaluation Summary

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

Sediment chemistry data for metals and PAHs are compared to Threshold Effect Concentrations (TECs) and Probable Effect Concentrations (PECs) published by MacDonald et al. (2000). Most samples in San Mateo County have chromium and nickel concentrations that exceed the more conservative TEC and many exceed the PEC. These metals are naturally occurring in the serpentine formations that underly mountains and hills in the region, and therefore are not prioritized for follow-up management actions. Sediment chemistry data for pyrethroid and fipronil pesticides are compared to TOC-normalized LC50s, calculated as TU equivalents.

Wet weather monitoring requirements include an analysis of water samples for toxicity, like the dry weather requirements listed above and an analysis of water samples for pesticides (pyrethroids, fipronil and its degradates, and imidacloprid). Due to a lack of numeric thresholds for pesticides in water samples, data collected during the WY 2023 wet weather pesticide monitoring efforts cannot be assessed for individual exceedances of their respective sample sites. However, pesticide concentrations can be compared with parallel data collected across the state. Furthermore, SMCWPPP wet weather pesticide concentrations can be compared to USEPA pesticide concentration benchmarks for a reference of potential effects to key aquatic biological indicators. DPR also maintains SURF to provide public access to quantitative pesticide data from a wide array of surface water monitoring studies. This database could be queried in the future to allow the leverage of DPR monitoring data in more complex analyses of MRP pesticide data.

4.1.2 WY 2023 Results

In WY 2023, SMCWPPP conducted dry season pesticides and toxicity monitoring at one station on Pilarcitos Creek in Half Moon Bay. Statistically significant toxicity was observed *C. dilutus* (acute); however, the Percent Effect was below the MRP threshold for resampling. Pesticide concentrations in the WY 2023 Pilarcitos Creek sediment sample were all very low, with all values except for bifenthrin and fipronil reported below the method detection limit. Nickel was the analyte with the highest TEC and PEC quotients, 0.93 and 0.43 respectively. The nickel TEC and PEC results were likely the result of naturally occurring nickel deposits originating from geologic features common in the region.

The SMCWPPP also satisfied MRP 3.0 wet weather monitoring requirements during WY 2023 by collecting water samples from Colma and San Mateo Creeks in coordination with a the BAMSC RMC. Water column samples from both sites were found to be significantly toxic to *H. azteca, C. dilutus* toxicity was observed in Colma Creek, and *C. dubia* toxicity was present in San Mateo Creek. Percent Effects were less than 50%, so no follow up wet weather testing was required. Toxicity to *H. azteca* may be explained by the presence of pyrethroids in urban runoff, especially bifenthrin, which was found at both sites at concentrations above the lowest USEPA benchmarks. Fipronil was found in small amounts at both monitoring stations, yet the concentrations were far below the USEPA benchmarks. However, this does not rule out potential fipronil-related effects to the neonicotinoid-sensitive species, *C. dilutus* for the Colma Creek samples. Lastly, *C. dubia* toxicity observed in the San Mateo Creek sample may be related to broader issues related to statewide QA inconsistencies detailed below.

Statewide, there have been other reports of unexplained chronic *C. dubia* toxicity, within and between laboratory variability in the magnitude of toxicity, and suspicion of false positives. An analysis by SWAMP in conjunction with the Statewide Toxicity Provisions adopted by the State Water Board on December 1, 2020 indicates that *C. dubia* toxicity variability could arise from inconsistencies in QA procedures used by laboratories. A final report of a nearly three-year special study requested by the State Water Board and completed by the Southern California Coastal Water Research Project (SCCWRP) was released in September 2023 (Brent et al. 2023). The SCCWRP report investigates levels and sources of variability in lab testing for *C. dubia* toxicity testing. The study also provides recommendations for regulators, regulated parties, and testing laboratories that will enhance the data quality for *C. dubia* toxicity tests and affect stormwater toxicity provisions.

There are many factors that may influence *C. dubia* toxicity test results. The *C. dubia* Quality Assurance Guidance Recommendations (Study; Brent et al. 2023) investigated laboratory techniques and historical data to better understand how variabilities in test results can be explained and reduced. Laboratory visits and interlaboratory comparisons were also conducted, which found that no two laboratories performed *C. dubia* toxicity testing in the same manner (Brent et al. 2023). Inconsistencies between lab processes on many factors were observed (e.g. recipes for dilution water, food sources, feeding methods, test chambers, volumes, light intensities, health assessments). The Study recommended guidance for laboratory best practices, accreditation, and training. A list of constraints were also provided by the Study that limit conclusions and recommendations of the Study. Overall, the main concern that was identified in the Study was lab performance, not test methods.

4.2 Recommendations

The following recommendations are based on findings from WY 2023 monitoring of Pesticides & Toxicity monitoring conducted by SMCWPPP, as well as reflections on other monitoring, data analysis, and policy development projects being conducted in the region and statewide.

- SMCWPPP will continue to monitor dry weather samples from Pilarcitos Creek in Half Moon Bay to document the impaired waterway's toxicity and provide information for long-term management actions.
- Results from external pesticide and toxicity monitoring programs will be evaluated as they are published to compare data with SMCWPPP's monitoring results. Long-term trends will hopefully emerge from these data comparisons and facilitate communication between entities responsible for urban runoff management actions.

In compliance with Provision C.9 of the MRP, SMCWPPP permittees are implementing pesticide toxicity control programs that focus on source control and pollution prevention measures. The control measure programs include the implementation of integrated pest management (IPM) policies/ordinances, public education and outreach programs, pesticide disposal programs, and sustainable landscaping requirements for new and redevelopment projects. California's Pesticide Use Reporting Program (PUR) contains extensive data for nearly all types of registered pesticides and their associated applications. Ongoing evaluations of pesticides and their uses through PUR inform DPR, Permittees, and the public about potential emerging trends with registered pesticide usage. These efforts will eventually be supplemented by the statewide Urban Pesticides Amendments (UPAs) which will seek to improve considerations of surface water quality during the registration process overseen by state and federal pesticide regulatory authorities such as DPR and USEPA. The anticipated result of the UPAs will be reduction in pyrethroids and other pesticides in urban stormwater runoff and the eventual elimination of pesticide-related toxicity in local urban creeks. The UPAs would also likely establish a statewide monitoring program that may substitute for pesticides and toxicity monitoring requirements in MS4 permits, such as the MRP. The goal of this statewide coordinated monitoring program is to generate useful data at minimal cost and standardize information at the statewide level to support the objectives of the UPAs. At this time, the mechanism for implementing the statewide monitoring program is uncertain but will likely be developed over the next few years.

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APPENDICES

Appendix A

QA/QC Report

Pesticides and Toxicity Monitoring Quality Assurance/Quality Control Report, WY 2023

1.0 Introduction

The San Mateo Countywide Water Pollution Prevention Program (SMCWPPP) conducted Pesticides and Toxicity monitoring in Water Year (WY) 2023 to comply with Provision C.8.g (Pesticides and Toxicity Monitoring) of the National Pollutant Discharge Elimination System Program (NPDES) Municipal Regional Permit for the San Francisco Bay Area (i.e., MRP 3.0; Permit No. CAS612008, Order No. R2-2022-0018). In WY 2023, sediment and stormwater monitoring included analysis for:

- Water toxicity (dry weather, MRP Provision C.8.g.i);
- Sediment toxicity (dry weather, MRP Provision C.8.g.ii);
- Sediment chemistry (dry weather, MRP Provision C.8.g.ii);
- Water toxicity (wet weather, MRP Provision C.8.g.iii); and
- Water chemistry (wet weather, MRP Provision C.8.g.iii).

Kinnetic Environmental, Inc. (KEI) of Santa Cruz, California collected the samples. Caltest Analytical Laboratory (Caltest) of Napa, California, and Pacific EcoRisk, Inc. of Fairfield, California performed the analyses described in Table 1.

Table 1. Pesticides and toxicity monitoring analyses conducted in WY 2023.

Laboratory	Analysis	Matrix	Method Reference
CalTest	Water Chemistry	Water	EPA 625.1_NCI EPA 632
	Sediment Chemistry	Sediment	EPA 6020 EPA 8270C EPA 8270M_NCI EPA 9060M Plumb, 1981, GS
Pacific EcoRisk	Toxicity	Sediment/Water	EPA 600/R-99-064 EPA 821/R-02-012 EPA 821/R-02-013

This report summarizes the Quality Assurance/Quality Control (QA/QC) procedures and results for this monitoring effort for the analyses performed by Pacific EcoRisk in the reports from September 2023 and December 2022, and the analyses performed by CalTest in reports X110572 and Y070662. Samples are listed in Table 2.

Table 2. Pesticides and toxicity monitoring samples analyzed in WY 2023.

<table>
<tr><th>Caltest Report X110572</th><th>Caltest Report Y070662</th><th>Pacific EcoRisk Report December 2022</th><th>Pacific EcoRisk Report September 2023</th></tr>
<tr><td>204SMA020</td><td rowspan="2">202R01308-S-01</td><td>204SMA020</td><td>204R011308-S-01</td></tr>
<tr><td>204COL040</td><td>204COL040</td><td>204R011308-W-01</td></tr>
</table>

SMCWPPP utilizes the BASMAA RMC Quality Assurance Project Plan (QAPP; BASMAA 2020) and BASMAA RMC Standard Operating Procedures (SOP; BASMAA 2016), SOP FS-13 (Standard Operating Procedures for QA/QC Data Review) as a basis for QA/QC procedures. Data were assessed for seven data quality attributes: (1) Representativeness, (2) Comparability, (3) Completeness, (4) Sensitivity, (5) Contamination, (6) Accuracy, and (7) Precision. These seven attributes are compared to Data Quality Objectives (DQOs), which were established to ensure that data collected are of adequate quality and sufficient for the intended uses. DQOs address both quantitative and qualitative assessment of the acceptability of data – representativeness and comparability are qualitative while completeness, sensitivity, precision, accuracy, and contamination are quantitative assessments. Specific DQOs are based on Measurement Quality Objectives (MQOs) for each analyte. The MQOs for each analyte are summarized in Table 3. Target Method Reporting Limits (MRLs) and actual monitoring Reporting Limits (RLs) are summarized in Tables 4 and 5.

Table 3. Measurement quality objectives for analytes from the RMC QAPP (BASMAA, 2020).

Sample	Sediment					Water		
	Inorganics	Synthetic Organic Compounds (Non pyrethroids)	Pyrethroids	Conventional Analytes	Toxicity	Synthetic Organic Compounds (Non pyrethroids)	Pyrethroids	Toxicity
Laboratory Blank (Method Blank, Field Filter Blank, Equipment Rinsate Blank, Trip Blank)	<RL	<RL	<RL	80-120%	The sediment control must meet all test acceptability criteria for the species of interest. Laboratory overlying water must be of uniform quality for the species of interest (USEPA method manual 600/R-99/064)	<RL	<RL	Laboratory control water must meet all test acceptability criteria for the species of interest
Reference Material Recovery (Laboratory Control Sample)	75-125%	50-150% (70-130% if certified)	50-150%	RPD<25%	The last plotted data point (LC50 or EC50) should be within 2 standard deviations of the cumulative mean (n=20). Reference toxicant tests that fall outside of recommended control chart limits are evaluated to determine the validity of associated tests. A reference toxicant test outside of the 2 standard deviations does not invalidate the associated test results.	50-150% (70-130% if certified) 35-135% for fipronil	50-150%	The last plotted data point (LC50 or EC50) should be within 2 standard deviations of the cumulative mean (n=20). Reference toxicant tests that fall outside of recommended control chart limits are evaluated to determine the validity of associated tests. A reference toxicant test outside of the 2 standard deviations does not invalidate the associated test results.
Matrix Spike Recovery	75-125%	50-150%	50-150%	NA	NA	50-150%	50-150%	NA
Duplicates (Matrix Spike, Field, and Laboratory)	75-125%; RPD<25 %	50-150%; RPD<25% (Fipronil RPD<35%)	50-150%; RPD≤ 35%	80-120%; RPD<25%	NA	50-150%; RPD<25% (Fipronil 1-130%; RPD<35%)	50-150%; RPD≤ 35%	NA

Table 4. Comparison of target and actual reporting limits (dry weight) for sediment analytes.

Analyte	Target RL	Actual RL	Unit
Arsenic	0.3	0.52	mg/Kg
Cadmium	0.01	0.042	mg/Kg
Chromium	0.1	0.53	mg/Kg
Copper	0.01	0.21	mg/Kg
Lead	0.01	0.042	mg/Kg
Nickel	0.02	0.084	mg/Kg
Zinc	0.1	0.84 [b]	mg/Kg
PAHs (Individual)	20	18 [b]	ng/g
Bifenthrin	0.33 [a]	1 [b]	ng/g
Cyfluthrin	0.33 [a]	1 [b]	ng/g
Total Lambda-cyhalothrin	0.33 [a]	1 [b]	ng/g
Total Cypermethrin	0.33 [a]	1 [b]	ng/g
Total Deltamethrin	0.33 [a]	1 [b]	ng/g
Total Esfenvalerate/Fenvalerate	0.33 [a]	1 [b]	ng/g
Permethrin	0.33 [a]	1 [b]	ng/g
Fipronil	0.33 [a]	1 [b]	ng/g
Fipronil Desulfinyl	0.33 [a]	1 [b]	ng/g
Fipronil Sulfide	0.33 [a]	1 [b]	ng/g
Fipronil Sulfone	0.33 [a]	1 [b]	ng/g
Total Organic Carbon	0.01	0.049	% dw

[a] There are no appropriate SWAMP targets for pyrethroids or for fipronil and its degradates. For these analytes, the RMC target RLs are based on current lab capabilities.

[b] These samples were diluted, which raised the RL.

Table 5. Comparison of target and actual reporting limits for water analytes.

Analyte	Target RL [a]	Actual RL	Unit
Bifenthrin	2	0.5	ng/L
Cyfluthrin	5	0.5	ng/L
Total Lambda-cyhalothrin	0.5	0.5	ng/L
Total Cypermethrin	5	0.5	ng/L
Total Deltamethrin	5	1	ng/L
Total Esfenvalerate/Fenvalerate	2	1	ng/L
Permethrin	10	5	ng/L
Fipronil	1	0.001	µg/L
Fipronil Desulfinyl	1	0.001	µg/L
Fipronil Sulfide	1	0.001	µg/L
Fipronil Sulfone	1	0.003	µg/L
Imidacloprid	0.02	0.005	µg/L

[a] There are no appropriate SWAMP targets for pyrethroids or for fipronil and its degradates. For these analytes, the RMC target RLs are based on current lab capabilities.

Overall, the results of the QA/QC review suggest that the data generated during WY 2023 pesticides and toxicity monitoring were of sufficient quality for the purposes of this program. There was a recorded pathogen related mortality event in a SMCWPPP water toxicity replicate sample and some external programs' sediment and water data were flagged because of not satisfying minor MQOs and DQOs identified in the QAPP. However, none of the data were rejected. Further details regarding the QA/QC review are provided in the sections below.

2.0 Sediment and Water Chemistry

2.1. Representativeness

Data representativeness assesses whether the data were collected in a manner that represents actual conditions at each monitoring location. For this project, all samples were assumed to be representative if they were collected and analyzed according to protocols specified in the QAPP. Field and laboratory personnel received and reviewed the QAPP and followed prescribed protocols including laboratory methods, holding times, preservation, and storage.

The dry season sediment chemistry sample was collected by KEI in on July 18, 2023. Caltest analyzed samples for inorganic compounds, synthetic organic compounds, and grain size distribution. KEI also collected water column samples on November 8, 2022, which were analyzed for pesticides by CalTest. The laboratory conducted all QA/QC requirements as specified in the RMC QAPP and reported their findings to the RMC.

2.2. Hold Times

Extractions and analyses were performed within the recommended holding time criteria and no additional data flags were assigned by the QA officer.

2.3. Preservation and Sample Storage

The samples were preserved and stored appropriately as ascribed by the respective methods and no additional data flags were assigned by the QA officer.

2.4. Comparability

The QA/QC officer ensures that the data may be reasonably compared to data from other programs producing similar types of data. For pesticides and toxicity monitoring, individual stormwater programs strive to maintain comparability within the Regional Monitoring Coalition (RMC). The key measure of comparability for all RMC data is the California Surface Water Ambient Monitoring Program (SWAMP).

Electronic data deliverables (EDDs) were submitted to the San Francisco Bay Regional Water Quality Control Board (SFRWQCB) in Microsoft Excel templates developed by the California Environmental Data Exchange Network (CEDEN) which are comparable to SWAMP. In addition, data entry followed SWAMP documentation specific to each data type, including the exclusion of qualitative values that do not appear on CEDEN's look up lists[1]. Completed templates were reviewed using CEDEN's online data checker[2], further ensuring SWAMP-comparability. Pesticides and toxicity monitoring data collected in WY 2023 is required to be reported to CEDEN via the CEDEN data portal.[3]

All WY 2023 data were considered comparable to SWAMP data and other RMC data.

2.5. Completeness

Completeness is the degree to which all data were produced as planned; this covers both sample collection and analysis. An overall completeness of greater than 90% is considered acceptable for RMC chemical data and field measurements. During WY 2023, SMCWPPP collected and analyzed 100% of the planned chemical analytes and field measurements.

2.6. Sensitivity

Sensitivity analysis determines whether the methods can identify and/or quantify results at low enough levels. This data quality attribute is evaluated via the assessment of RLs.

The RLs for many of the analytes in sediment samples exceeded the MRLs specified in the QAPP. All pesticide concentration's RLs were diluted, which raised the RL. However, pesticide RLs would have been under the MRL if dilution would have not occurred. Zinc concentrations were also measured from a diluted sample. Individual PAHs were also measured from diluted samples but were still less than the MRL. The inorganic analysis revealed elevated RLs that were above MRLs and were not from diluted samples. These samples could have had a high amount of other solids present, which could raise the RL. Overall, the data was deemed acceptable by the QA officer with no changes or rejections.

2.7. Contamination

For chemical data, contamination is assessed as the presence of analytical constituents in blank samples. Laboratory method blank analyses were performed at the required frequencies specified by the QAPP (a minimum of one laboratory blank must prepared and analyzed in every analytical batch). For purposes of

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[1] Look up lists available online at https://swamp.waterboards.ca.gov/swamp_checker/LookUpLists.aspx

[2] Checker available online at https://swamp.waterboards.ca.gov/swamp_checker/SWAMPUpload.aspx

[3] Convertor available at: http://www.ceden.org/docs/2015_templates/swamp_to_ceden_converter_042115.xlsm

data qualification, the laboratory method blanks were associated with all samples prepared in the analytical batch.

All laboratory method blank results were non-detect and did not meet MDLs for all target analytes, indicating that there was no contamination present.

2.8. Accuracy

Accuracy is assessed as the percent recovery of samples spiked with a known amount of a specific chemical constituent. The analytical laboratory evaluated and reported the Percent Recovery of Laboratory Control Samples (LCS; in lieu of reference materials) and Matrix Spikes (MS), which were reported by the laboratory as well as recalculated by the QA officer and compared to the target ranges in the QAPP. If a QA sample did not meet MQOs, all samples in that batch for that analyte were flagged.

All sediment and water analytes' LCS and MS samples met their corresponding MQOs and frequency (one LCS and matrix spike per 20 samples or per analytical batch, whichever is more frequent per analyte) and the data were deemed acceptable by the QA officer with no changes. Some regional monitoring results external to SMCWPPP had flagged data due to minor inconsistencies relative to MQOs. No data were rejected.

2.9. Precision

Precision is the repeatability of a measurement and is quantified by the Relative Percent Difference (RPD) of two duplicate samples. Three measures of precision were used for this project, laboratory duplicates (LCSDs), MSDs, and field duplicates (FDs). The MQO for RPDs specified by the QAPP is <25% for most analytes and <35% for pyrethroids.

All water and sediment LCSD and MSD samples met their corresponding MQO RPDs (RPD<25% or <35% for pyrethroids) when compared with their respective paired LCS and MS samples as well as frequency (One LCSD and MSD per 20 samples or per analytical batch, whichever is more frequent).

A sediment sample field duplicate was collected in Contra Costa County on July 18, 2023 and a water sample field duplicate was collected on November 8, 2022. The sediment field duplicate sample and corresponding RPDs were analyzed for precision and values are shown in Table 6. Table 7 displays field duplicate values for water column RPDs. Due to the variability in reporting limits, values less than the RL (J-flagged) should not be evaluated for RPD. The measured concentrations of many of the analytes from the original and duplicate samples were below the method detection limit and therefore reported as non-detect (ND).

The analysis of precision for the sediment sample revealed that a total of eight analytes had RPDs over the MQO (medium sand and granule grain distribution, cyfluthrin, benz(a)anthracene, chrysene, fluoranthene, phenanthrene, and pyrene). However, cyfluthrin, benz(a)anthracene, and chrysene should not be considered for exceeding MQOs due to samples being J-flagged. Qualifying data exceeding MQOs were flagged. Wet weather water samples analyzed for precision found no exceedances of MQOs for pyrethroid pesticides. This list is comparable to past years' results.

Table 6. Summary of sediment sample data qualifiers assigned as a result of field duplicates exceeding the measurement quality objective for relative percent difference (yellow highlight).

Analyte		Unit	Original	Duplicate	RPD (%)	Exceeds MQO? (<25%)[a]
Grain Size Distribution	Clay: <0.0039 mm	%	9.3	8.4	10	No
	Silt: 0.0039 to <0.0625 mm	%	11.1	11.8	6.1	No
	Sand: V. Fine 0.0625 to <0.125 mm	%	21.4	18.9	12	No
	Sand: Fine 0.125 to <0.25 mm	%	51.6	52.1	1.0	No
	Sand: Medium 0.25 to <0.5 mm	%	5.8	8	32	Yes
	Sand: Coarse 0.5 to <1.0 mm	%	0.5	0.6	18	No
	Sand: V. Coarse 1.0 to <2.0 mm	%	0.3	0.2	40	No
	Granule: 2.0 to <4.0 mm	%	0.3	0.2	40	Yes
	Pebble: Small 4 to <8 mm	%	0	0	NA	NA
	Pebble: Medium 8 to <16 mm	%	0	0	NA	NA
	Pebble: Large 16 to <32 mm	%	0	0	NA	NA
	Pebble: V. Large 32 to <64 mm	%	0	0	NA	NA
Metals	Arsenic	mg/Kg dw	3.4	3.2	6.1	No
	Cadmium	mg/Kg dw	0.30	0.30	0	No
	Chromium	mg/Kg dw	26	24	8.0	No
	Copper	mg/Kg dw	20	17	16.2	No
	Lead	mg/Kg dw	11	9.4	15.7	No
	Nickel	mg/Kg dw	31	29	6.7	No
	Zinc	mg/Kg dw	73	73	0	No
	Total Organic Carbon	% dw	0.99	1.1	10.5	No
Pyrethroids (MQO <35%)	Bifenthrin	ng/g dw	1.6	1.6	0	No
	Cyfluthrin	ng/g dw	J 0.16	J 0.29	58	Yes
	Lambda-Cyhalothrin	ng/g dw	J 0.22	J 0.28	24	No
	Cypermethrin	ng/g dw	J 0.25	J 0.24	4.1	No
	Deltamethrin/Tralomethrin	ng/g dw	J 0.46	J 0.47	2.2	No
	Esfenvalerate/Fenvalerate	ng/g dw	ND	ND	NA	NA
	Permethrin, Total	ng/g dw	ND	ND	NA	NA
Fipronil	Fipronil	ng/g dw	ND	ND	NA	NA
	Fipronil Desulfinyl	ng/g dw	ND	ND	NA	NA
	Fipronil Sulfide	ng/g dw	ND	ND	NA	NA
	Fipronil Sulfone	ng/g dw	ND	ND	NA	NA
Polycyclic Aromatic Hydrocarbons	Acenaphthene	ng/g dw	ND	ND	NA	NA
	Acenaphthylene	ng/g dw	ND	ND	NA	NA
	Anthracene	ng/g dw	ND	ND	NA	NA
	Benz(a)anthracene	ng/g dw	J 7.9	27	110	Yes
	Benzo(a)pyrene	ng/g dw	ND	32	NA	NA
	Benzo(b)fluoranthene	ng/g dw	ND	52	NA	NA
	Benzo(e)pyrene	ng/g dw	ND	31	NA	NA
	Benzo(g,h,i)perylene	ng/g dw	ND	ND	NA	NA
	Benzo(k)fluoranthene	ng/g dw	ND	20	NA	NA
	Biphenyl	ng/g dw	ND	ND	NA	NA
	Chrysene	ng/g dw	J 18	54	100	Yes
	Dibenz(a,h)anthracene	ng/g dw	ND	ND	NA	NA
	Dibenzothiophene	ng/g dw	ND	ND	NA	NA
	Dimethylnaphthalene, 2,6-	ng/g dw	ND	ND	NA	NA
	Fluoranthene	ng/g dw	22	65	99	Yes
	Fluorene	ng/g dw	ND	ND	NA	NA
	Indeno(1,2,3-c,d)pyrene	ng/g dw	ND	30	NA	NA
	Methylnaphthalene, 1-	ng/g dw	ND	ND	NA	NA

	Methylnaphthalene, 2-	ng/g dw	ND	ND	NA	NA
	Methylphenanthrene, 1-	ng/g dw	ND	ND	NA	NA
	Naphthalene	ng/g dw	ND	ND	NA	NA
	Perylene	ng/g dw	ND	J12	NA	NA
	Phenanthrene	ng/g dw	21	33	44	Yes
	Pyrene	ng/g dw	22	64	98	Yes
	Trimethylnaphthalene, 2,3,5-	ng/g dw	ND	ND	NA	NA

a. MQO for precision of J-flagged data does not apply

Table 7. Summary of sample water data RPDs.

Analyte		Unit	Original	Duplicate	RPD (%)	Exceeds MQO? (<35%)[a,b]
	Imidacloprid	ug/L	ND	ND	NA	NA
Pyrethroids	Bifenthrin	ug/L	0.0053	0.0049	8	No
	Cyfluthrin	ug/L	0.0006	0.0007	15	No
	Lambda-Cyhalothrin	ug/L	0.0006	J 0.00048	NA	NA
	Cypermethrin, total	ug/L	J 0.0004	ND	NA	NA
	Deltamethrin/Tralomethrin	ug/L	J 0.0009	ND	NA	NA
	Esfenvalerate/Fenvalerate	ug/L	ND	ND	NA	NA
	Fipronil	ug/L	0.0077	0.0072	6.7	No
	Fipronil Desulfinyl	ug/L	0.0028	0.0028	0	No
	Fipronil Sulfide	ug/L	J 0.0006	J 0.0006	NA	NA
	Fipronil Sulfone	ug/L	0.0059	0.0072	20	No
	Permethrin	ug/L	ND	ND	NA	NA

a. MQO for precision of J-flagged data does not apply
b. MQO for imidacloprid not to exceed 25%

3.0 Toxicity Testing

3.1. Representativeness

Data representativeness assesses whether the data were collected in a manner that represents actual conditions at each monitoring location. For this project, all samples were assumed to be representative if they were collected and analyzed according to protocols specified in the QAPP. Field and laboratory personnel received and reviewed the QAPP and followed prescribed protocols including laboratory methods, holding times, preservation, and storage.

Dry weather water and sediment toxicity samples were collected by KEI concurrently with dry season sediment chemistry samples at one San Mateo County site on July 18, 2023. Wet weather water toxicity samples were also collected by KEI for WY 2023 alongside water chemistry samples at two sites in San Mateo County on November 8, 2022. All toxicity tests were performed by Pacific EcoRisk. In accordance with the MRP, the water samples were analyzed for toxicity to five organisms (*Selenastrum capricornutum*, *Ceriodaphnia dubia*, *Pimephales promelas*, *Hyalella azteca*, and *Chironomus dilutus*) and the dry season sediment samples were analyzed for toxicity to *Hyalella azteca* and *Chironomus dilutus*.

3.2. Hold Times

Extractions and analyses were performed within the recommended holding time criteria and no additional data flags were assigned by the QA officer.

3.3. Preservation and Sample Storage

The samples were preserved and stored appropriately as ascribed by the respective methods and no additional data flags were assigned by the QA officer.

3.4. Comparability

The QA/QC officer ensures that the data may be reasonably compared to data from other programs producing similar types of data. For pesticides and toxicity monitoring, individual stormwater programs strive to maintain comparability within the Regional Monitoring Coalition (RMC). The key measure of comparability for all RMC data is the California Surface Water Ambient Monitoring Program (SWAMP).

Electronic data deliverables (EDDs) were submitted to the San Francisco Bay Regional Water Quality Control Board (SFRWQCB) in Microsoft Excel templates developed by the California Environmental Data Exchange Network (CEDEN) which are comparable to SWAMP. In addition, data entry followed SWAMP documentation specific to each data type, including the exclusion of qualitative values that do not appear on CEDEN's look up lists. Completed templates were reviewed using CEDEN's online data checker, further ensuring SWAMP-comparability. Pesticides and toxicity monitoring data collected in WY 2023 is required to be reported to CEDEN via the CEDEN data portal.

All WY 2023 data were considered comparable to SWAMP data and other RMC data.

3.5. Completeness

Completeness is the degree to which all data were produced as planned; this covers both sample collection and analysis. An overall completeness of greater than 90% is considered acceptable for RMC chemical data and field measurements.

The MRP requires the collection of dry weather water and sediment toxicity samples at one site per year in San Mateo County. Two wet weather water toxicity samples were collected at two sites in San Mateo County. Pacific EcoRisk tested the required organisms for toxicity, and 100% of results were reported. During WY 2023, SMCWPPP collected and analyzed 100% of the planned toxicity analytes and field measurements.

3.6. Sensitivity and Accuracy

Internal laboratory procedures that align with the RMC QAPP were performed and submitted to SMCWPPP. Four measures of quality control are assessed, including maintenance of acceptable test conditions, negative control testing, positive control (i.e., reference toxicant testing), and Concentration Response Relationship assessment. The laboratory data QC checks found that all conditions and responses were acceptable. A copy of the laboratory QC report is available upon request.

3.7. Contamination

Field staff followed applicable RMC SOPs to limit possible contamination of toxicity samples. Although it is unknow whether caused by ambient conditions or introduced by field staff, a pathogen related mortality (PRM) event was observed in a replicate of a dry season ambient water sample (202R01308-W-01) for *Pimephales promelas* (Figure 1). No PRM was observed in the lab control (Figure 2). The sample's batch

(KESM_071923_PP_W_TOX) was flagged and submitted by the QA officer with appropriate QA qualifiers. The resultant toxicity finding was flagged as questionable.

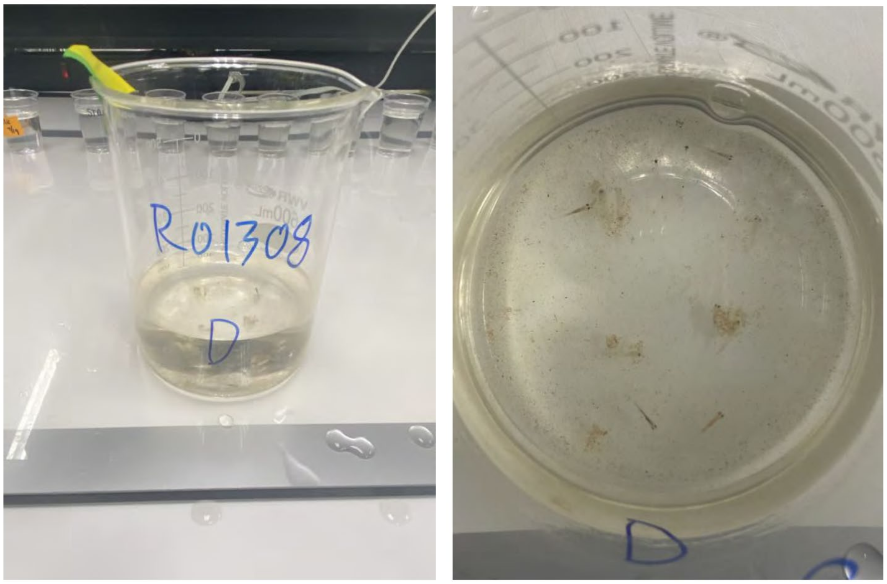

Figure 1. Photograph of affected and unaffected fish from replicate D of treatment 202R01308-W-01.

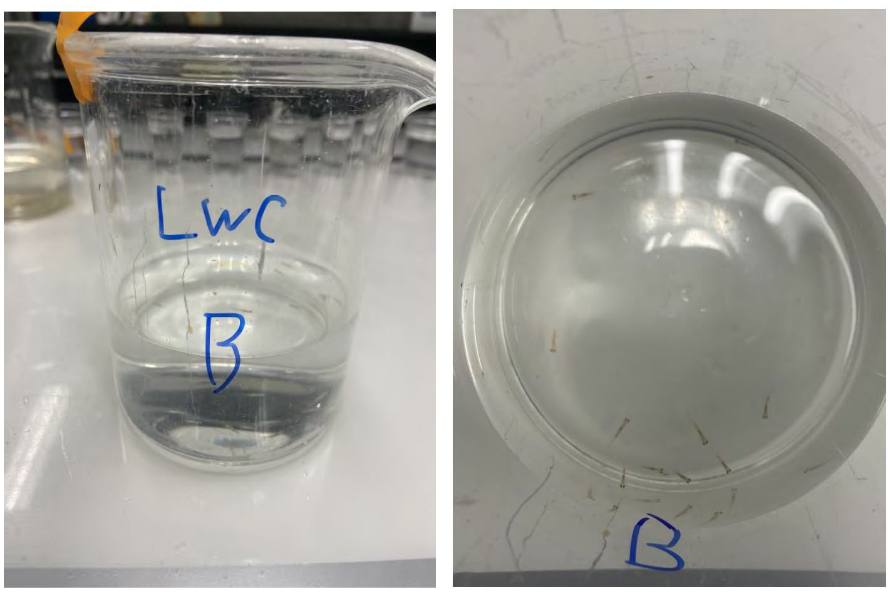

Figure 2. Photograph of un-affected fish from replicate B of the Lab Control on July 25, 2023.

3.8. Precision

Field duplicates for water and sediment toxicity are not required by the RMC QAPP. Subsequently, precision could not be evaluated.

4.0 References

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BASMAA (Bay Area Stormwater Management Agency Association) Regional Monitoring Coalition (RMC). 2016. Creek Status and Pesticides & Toxicity Monitoring Standard Operating Procedures, Final Version 3. 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. 190 pp.

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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