



**Department of Pesticide Regulation
Environmental Monitoring Branch
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**STUDY 329: Surface Water Monitoring for Pesticides in Urban Areas of Northern California
during Water Year 2023-2024**

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1.0 INTRODUCTION

Pesticides can be commonly applied in urban areas. More than 5.75 million pounds of pesticides were reported as used in 2021 for structural and landscape applications in the California Department of Pesticide Regulation (DPR) Pesticide Use Reporting Database (PUR) (DPR, 2021). The total amount of pesticides applied in urban areas can potentially be higher as non-professional use is not reported to PUR. With this potential urban load, a high potential for pesticide runoff into urban creeks and rivers could be observed. Previous DPR monitoring studies have detected pesticides in urban surface waters (Alvarado, 2023; Ensminger, 2021). Toxicity testing has revealed that urban-use pesticides have the potential to adversely affect aquatic invertebrate organisms in urban surface waters (Budd et al, 2020; Holmes et al., 2008; Lao et al., 2010; Weston and Jackson, 2009; Weston and Lydy, 2014). Other studies have reported pesticide concentrations potentially causing toxicity based on exceedances of US EPA's aquatic benchmarks (Budd et al., 2015; Ensminger et al., 2013, Gan et al., 2012, Batikian et al., 2019). Label changes or regulations have been enacted to mitigate the effects of specific pesticides where toxicity was a concern (DPR, 2020b; UC ANR, 2019, USEPA, 2017a, b, c).

To determine pesticide exposures in urban runoff and surface waters, DPR's Surface Water Protection Program (SWPP) began monitoring California's urban areas in 2007; the study became a statewide monitoring program in 2008 (He, 2008; Kelley, 2007). This program helped define pesticide runoff patterns from urban neighborhoods and watersheds (Budd et al, 2020; Budd et al., 2015; Ensminger et al., 2013). Continued high use of pesticides in urban areas (DPR, 2021), frequent detections in surface water (Alvarado, 2023), and implementation of mitigation actions (DPR, 2020b; UC ANR, 2019, USEPA, 2017a, b, c) warrant continued monitoring of the state's urban waterways. Study 329 continues its urban monitoring in Northern California from WY 2022/2023. This study will continue to evaluate sources of pesticide runoff, monitor larger urban watersheds, and evaluate toxicity at selected sites. Resulting data from this protocol will be used in future assessments of trends in pesticide concentrations.

2.0 OBJECTIVES

For Study 329 (WY 2023/2024), Northern California urban monitoring, the objectives are:

- 1) Identify the presence and concentrations of pesticides in urban runoff and waterways;
- 2) Evaluate the magnitude of measured concentrations relative to water quality or aquatic toxicity thresholds;
- 3) Determine the toxicity of water samples in laboratory toxicity tests conducted with *Hyalella azteca* and *Chironomus dilutus* at selected monitoring sites;
- 4) Evaluate the effectiveness of surface water regulations or label changes through long-term (multi year) monitoring;
- 5) Monitor the concentration of sediment-bound pyrethroids at long-term monitoring sites;
- 6) Determine the effectiveness of pesticide residues removal from runoff using a BMP (Best Management Practice) structure (i.e., carbon socks);
- 7) Determine the toxicity of water samples that can be attributed to particle-bound contaminants.

3.0 PERSONNEL

The study will be conducted by staff from the DPR's Environmental Monitoring Branch, Surface Water Protection Program, under the general direction of Anson Main, Ph.D., Environmental Program Manager I. Key personnel are listed below:

- Co-Project Leaders: Joshua Alvarado and Kari McClanahan
- Reviewing Scientist: Robert Budd, Ph.D.
- Statistician: Xuyang Zhang, Ph.D.
- Laboratory Liaison: Joshua Alvarado
- Analytical Chemistry: Center for Analytical Chemistry, California Department of Food and Agriculture (CDFA)

Please direct questions regarding this study to Joshua Alvarado and Kari McClanahan, Environmental Scientists, at Joshua.Alvarado@cdpr.ca.gov and Kari.McClanahan@cdpr.ca.gov.

4.0 STUDY PLAN

4.1 Site Selection. The Surface Water Monitoring Prioritization (SWMP) model is used to identify priority areas for monitoring (Luo et al., 2017). The SWMP model incorporates pesticide use, aquatic toxicity, and population density data at the Hydrological Unit Code 12 (HUC; USGS, 2020a) watershed level to rank areas for monitoring by aggregating HUC12s into larger HUC8 watersheds.

For this study, HUC12s were considered if they met the following criteria:

- 1) Contained in the eight Northern California HUC4s as defined in Luo et al. (2017);
- 2) Ranked in the top eight HUC8s by SWMP (based on final pesticide priority score of ≥ 9 for urban pesticide use [structural pest control and landscape maintenance]);
- 3) Ranked in the top three mainstem or tributary type watersheds at the HUC12 level.

Using a ranking of ≥ 9 allows for selecting monitoring areas that have a higher potential for adverse risk to more sensitive aquatic organisms. Final HUC12 selection was then based on historical monitoring, fulfilling study objectives, site access and safety, budget constraints, exclusion of agricultural inputs, and spatial distribution between top ranked HUC12s selected by the model. With updated PUR data incorporated into the SWMP model, the top monitoring priority areas for water year (WY) 2023/2024 remain fairly constant from the previous protocol. The Sacramento and San Francisco Bay areas are the two main areas of Northern California where the highest levels of pesticide are expected in urban runoff. Of the top eight ranked HUC8s, three are in the Sacramento area, four are in the San Francisco Bay area, and one is in the San Joaquin Delta (Appendix 1).

Surface water monitoring programs generally monitor within urban creeks or rivers. In addition to these waterbodies, SWPP's urban monitoring program also monitors at storm drain outfalls. Because of lower dilution effects and proximity to the source of pesticide applications compared to waterbodies, storm drain outfalls tend to have higher pesticide detections and concentrations. Information from storm drain outfalls allows for a more direct measure of land use contributions (e.g., residential, commercial, industrial, and other non-residential areas).

4.1.1 Sacramento Area. The Sacramento area ranks higher than the San Francisco Bay area in the SWMP, with the three top ranked HUC8s (Appendix 1), even given the much larger population in the San Francisco Bay area (California Department of Finance: Demographics, 2020). Monitoring will occur within the two top ranked HUC8s at three HUC12 watersheds: Pleasant Grove Creek, Miner's Ravine, and Arcade Creek (Figure 1). Monitoring will occur at established mainstem or tributary sites in the Pleasant Grove Creek (PGC058) and Arcade Creek (ARC_ARC) watersheds (Appendix 2). The Arcade Creek site is near the USGS gage station 11447360. Sampling sites at or near USGS gage stations allow for quantification of storm runoff collection percentage and can be used to estimate mass loading. In the Miner's Ravine Watershed, the mainstem site has been moved upstream from Dry Creek since FY 2020/2021. The move upstream will allow for sampling closer to urban sources.

For WY 2023/2024, the Northern California Urban Monitoring Program will monitor three storm drain outfalls, two in the Pleasant Grove Creek Watershed and one in the Lower American Watershed (Appendix 2; Figure 1). These sites have been monitored for at least eleven years and are considered long-term monitoring sites, used for trend analysis. The Lower American Watershed (site FOL2) does not rank in the top three HUC12s for monitoring in SWMP as described in the criteria for HUC12 selection, but because of high concentrations in past monitoring data, it will continue to be monitored. Carbon sock structural BMPs will be deployed at two sites (FOL2 and PGC022) during the dry season. Effectiveness of BMP treatment will be determined by comparing pre- and post- carbon sock pesticide concentrations. In addition, water samples from sites with moderate to high toxicity will be collected and mechanically filtered to remove particle-bound contaminants prior to chemical and toxicological analyses. This will help in determining the impact particle-bound contamination has on both pesticide concentration and aquatic toxicity.

San Francisco Bay Area. In the San Francisco Bay area, monitoring will continue at mainstem creeks and rivers in three top ranked HUC8s (consisting of five HUC12 watersheds; Appendix 2, Figure 2). All these mainstem sites were monitored in the past few years, but two of these (Guadalupe River and Silver Creek HUC12s) continue to have limited storm runoff data collected by autosamplers due to issues with site access, autosampler failure, and staffing resource. In the three other HUC12 watersheds (Walnut Creek, San Lorenzo Creek, and South San Ramon Creek), autosampler collection has been successful and continued to provide sufficient data to better understand the storm runoff profile. The San Lorenzo and Guadalupe sites are also important as these sites are at or near USGS gage stations, which allows SWPP staff to calculate the percentage of the storm runoff sampled and pesticide mass loading.

4.1.2 Exploratory Sites. During WY 2023/2024, monitoring may include water samples from sites intended to broaden spatial distribution, investigate runoff from other sources, or collaborate with other monitoring studies.

4.1.3 Collaboratory Sites. Monitoring will continue the expansion of exploratory sites in ranked HUC12 watersheds to cultivate potentially new monitoring sites through a collaboration with the San Francisco Estuary Institute (SFEI). This will expand the knowledge of urban runoff in the San

Francisco Bay area.

4.2 Selection of Pesticides. For ambient monitoring, the SWMP model was used to assist in pesticide selection based on current use patterns, aquatic toxicity benchmarks, and physicochemical properties. The SWMP output is presented as a relative prioritization (final) score (Budd et al., 2013; Luo, 2015). The final score provides a guideline for monitoring. However, the decision to monitor a specific pesticide is influenced by other factors, including previous monitoring data, budgetary constraints, pesticide use patterns, and current analytical capabilities.

For this study, pesticides that received a final score of nine or higher in the SWMP model for urban use (structural pest control and landscape maintenance) were considered for monitoring unless: 1) they received a “false” recommendation in the SWMP model, based on the pesticides physicochemical properties, and therefore are not likely to cause surface water toxicity; 2) there is no analytical method currently available; 3) previous monitoring results had few detections, or 4) their use pattern is not likely to runoff into surface water. Pesticides with a score of less than 9 will not be monitored unless they are included in the same analytical screen as higher ranking pesticides. Other pesticides that received final scores less than 9 have either low urban use or low potential toxicity; therefore, these active ingredients were not considered high priority for monitoring.

The Sacramento and San Francisco Bay areas were modeled separately in SWMP as two distinct geographical areas. In Sacramento, the SWMP model selected 22 pesticides for monitoring with a final score ≥ 9 . Currently, CDFA has analytical methods for 20 of these pesticides (Appendix 3). In the San Francisco Bay area, the SWMP model selected 22 pesticides; CDFA has methods for 19 of the pesticides (Appendix 4). In addition to the analytes included in the present analytical suites, the SWMP identified three analytes in need of method development: 2,2-dibromo-3-nitrilopropionamide, Dithiopyr, and PCNB.

4.3 Water Sampling. Water samples will be collected four times a year: during two rain events and two dry-season events, according to Deng and Ensminger, 2021. SWPP will attempt to collect storm samples during the first major storm (rain) event of WY 23-24 and during a second major storm in the winter of 2024. Dry-season sampling will occur in June and August 2024. The first storm will be collected in the fall (October-December), with priority to the “first flush” storm after the long dry season, regardless of month. The second storm will be collected in the winter (January–February). Water samples from exploratory sites may be monitored during any dry or storm event. During dry-season monitoring, water samples will be collected as grab samples directly into 1-L amber bottles (Deng and Ensminger, 2021). Where the stream is too shallow to collect water directly into these bottles, a stainless-steel container will be used to initially collect the water samples. During storm events, samples will usually be collected with Teledyne ISCO automatic 6700 series samplers unless resources are lacking; in these cases, grab samples may be substituted. For ISCO samplers, time-weighted aliquots of the entire storm sample will be collected as a composite sample (Jones, 2000). Samples will be transported on wet ice and then refrigerated at 4°C until analyzed.

4.4 Sediment Sampling. Sediments will be collected with stainless steel scoops from the top bed layer (Deng and Ensminger, 2021). All sediments will be sifted through a 2-mm sieve to remove gravel and plant material and analyzed for pyrethroids and total organic carbon. In the Sacramento area, sediments will be collected twice a year at selected Roseville and Folsom sites during the dry season (Table 1). In the San Francisco Bay area, sediments will be collected once a year at San Ramon and Silver Creek sites, usually during the second dry sampling event. Other sites in the San Francisco Bay area where sediments can be collected are currently monitored through the stream pollution trends (SPoT) monitoring program (SWRCB, 2020).

4.5 Toxicity. Water samples will be collected from a subset of the sampling sites and sent to the University of California, Davis, Aquatic Health Program to be tested for toxicity to *H. azteca* and *C. dilutus*. Roseville monitoring sites and joint SPoT-DPR sampling sites are the focus for toxicity testing because of high toxicity at these sites.

4.6 Field Measurements. Water physicochemical properties (dissolved oxygen, electrical conductivity, pH, salinity, temperature, and total dissolved solids) will be measured *in situ* during all sampling events with a calibrated Aqua TROLL 400 multiparameter probe. Flow data at or near sites at USGS gaging stations (Arcade Creek, Guadalupe River, and San Lorenzo Creek) will be utilized to estimate storm percentage completion (USGS, 2020b).

4.7 Sample Transport. SWPP staff will transport samples following the procedures outlined in DPR SOP QAQC004.01 (Jones, 1999). A chain-of-custody record will be completed and accompany each sample.

4.8 Modifications for WY 2023/2024. The current sampling plan is an extension of urban monitoring in Northern California (previous sampling protocols, including Studies 269, 299, and 329 can be found on the [Environmental Monitoring Protocols webpage](#)). The sampling and analysis schedule are similar to previous years with a few main differences from WY 2022/2023 (Table 2).

5.0 LABORATORY ANALYSES

5.1. Chemical Analysis. CDFA will conduct pesticide analysis for water and sediment samples. CDFA will analyze up to 84 different pesticides and degradates in seven different analytical screens (Appendixes 5 and 6). All laboratory QA/QC will follow DPR guidelines and will consist of laboratory blanks, matrix spikes, matrix spike duplicates, surrogate spikes, and blind spikes (Peoples, 2019). Laboratory blanks and matrix spikes will be included in each extraction set.

5.2 Organic Carbon and Suspended Sediment Analysis. SWPP staff will analyze water samples for total organic carbon (TOC) and dissolved organic carbon (DOC) using a Vario TOC Cube TOC/TNb Analyzer (Elementar Analysensysteme GmbH, Langenselbold, Germany) based on previously outlined methods (Goh, 2011; Ensminger, 2013a). Water samples will also be analyzed for suspended sediment (Goh, 2010; Ensminger, 2013b). Sediment samples will be analyzed for TOC (Goodell, 2016).

6.0 DATA ANALYSIS

All data generated by this project will be entered into a Microsoft® Office Access database that holds site information, field measurements, and laboratory data since the state-wide project was initiated in 2008. All ambient monitoring analytical, toxicity, and water quality data will also be uploaded into the publicly available DPR Surface Water Database (SURF) (DPR, 2018c). Toxicity and water quality data are not accessible via SURF; however, they are available upon request. An annual report will be written to summarize detections, exceedances of aquatic life toxicity benchmarks (USEPA, 2020), and potential sediment toxicity. Upon completion the report will be available at DPR [Environmental Monitoring's Study Report web page](#). In the annual report, recommendations will be made for any follow-up or detailed data analysis for pesticides that consistently exceeded benchmarks.

7.0 TIMETABLE

Field Sampling:	October 2023- August 2024
Chemical Analysis:	October 2023 – December 2024
Summary Report:	January - March 2025
SURF Data Upload:	March - May 2025

8.0 LABORATORY BUDGET

SWPP requests that CDFA analyze 302 water samples and 10 sediment samples over a minimum five monitoring events for Study 329, WY 2023/2024 (Table 1).

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Table 1. Water and sediment monitoring for WY 2023/2024. For monitoring site information, see Appendix 2. For chemical screen information, see Appendices 5 and 6.

Site	Analytical Screen*	First Storm 2023	Second Storm 2024	First Dry 2024	Second Dry 2024	Exploratory Event	Total Samples
ARC_ARC	DN, LC, PYW, PX, NEO	5	5	5	5	0	20
FOL2	DN, LC, PYS, PYW, PX, NEO	5	5	6	6	0	22
MIN_MR	DN, LC, PYW, PX, NEO	5	5	5	5	0	20
PGC010	DN, LC, PYS, PYW, PX, NEO, GLY	6	6	7	7	0	26
PGC019/022	DN, LC, PYS, PYW, PX, NEO, GLY	6	6	7	7	0	26
PGC058	DN, LC, PYW, PX, NEO, GLY	6	6	6	6	0	24
GUA_TRM	DN, LC, PYW, PX, NEO, GLY	6	6	6	6	0	24
SLC_LA	DN, LC, PYW, PX, NEO, GLY	6	6	6	6	0	24
SLV_KNG	DN, LC, PYS, PYW, PX, NEO	5	5	5	6	0	21
SRC_JD	DN, LC, PYS, PYW, PX, NEO	5	5	5	6	0	21
WAL_CA	DN, LC, PYW, PX, NEO	5	5	5	5	0	20
Exploratory (up to 4 sites)	DN, LC, PYW, PX, NEO	0	0	0	0	40	40
QC (Dup)	DN, LC, PYS, PYW, PX, NEO	5	5	6	6	0	22
QC (FMS/FMSD)	PYW	2	2	2	2	0	8
Total	DN, LC, PYS, PYW, PX	67	67	71	73	40	312

* **DN**, dinitroaniline herbicides, oxyfluorfen, and chlorfenapyr; **LC**, liquid chromatography multi-analyte; **PY**, pyrethroid (water and sediment); **PX**, phenoxy/synthetic auxin herbicides; **NEO**, neonicotinoids; **GLY**, Glyphosate, Glufosinate and Aminomethylphosphonic Acid (AMPA).

Table 2. Modifications from sampling plan for water year 2022-2023

Change from WY 22-23	Justification
Fiscal year (FY) to water year (WY) calendar transition complete. Sampling schedule returns to four events per sampling period.	Alignment of sampling schedule with annual precipitation patterns
Addition of glyphosate and neonicotinoid analysis	Provides supporting information on presence of high interest pesticides in surface waters
Addition of exploratory sites, for example the Lower Sacramento subbasin at Lower Morrison Creek	Collecting information to assess the inclusion of additional sites in the monitoring plan. Lower Morrison Creek has moved up in priority on the SWMP model

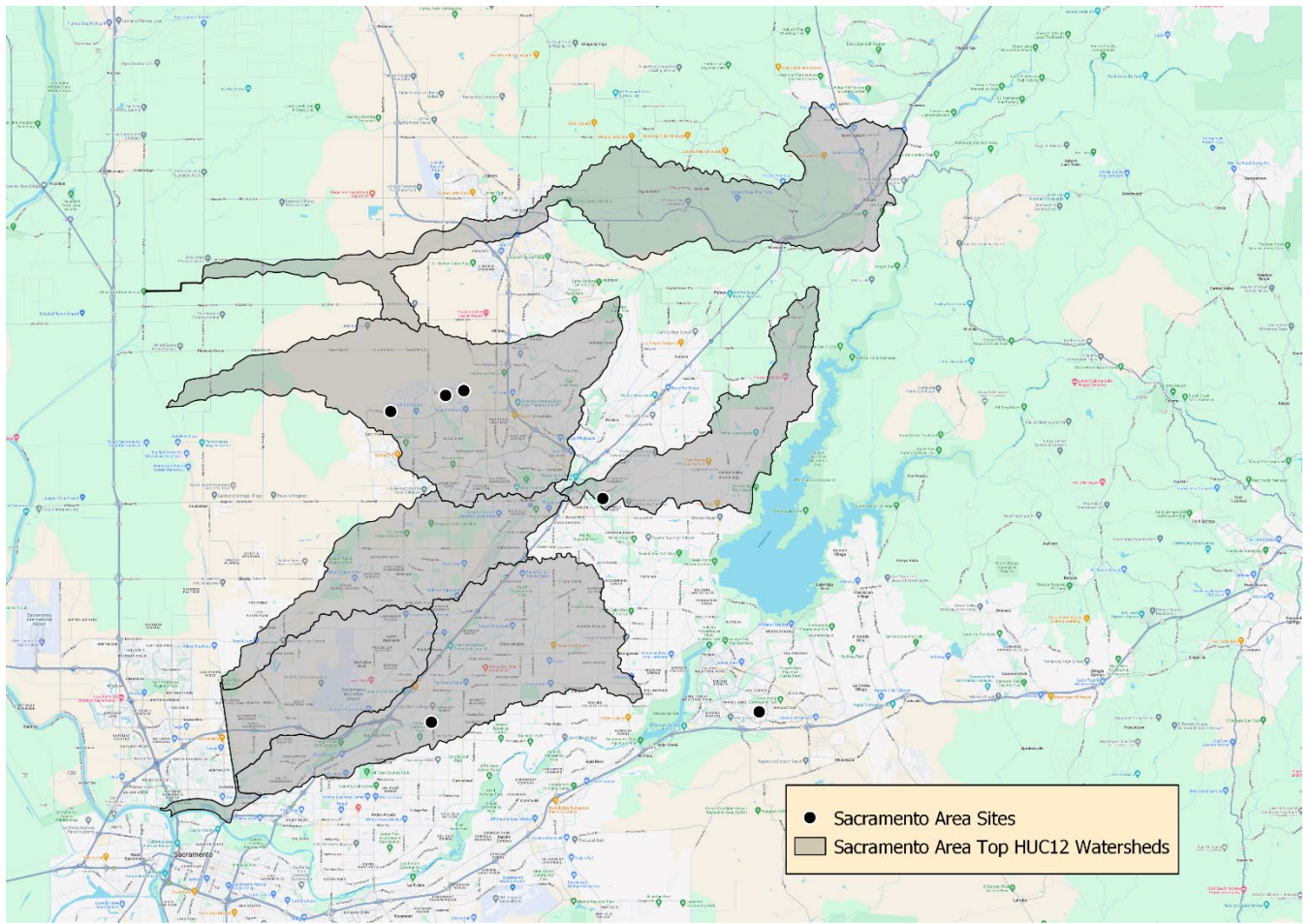


Figure 1. Sacramento area monitoring sites (black dots) and top HUC12 watersheds for WY 2023/2024.

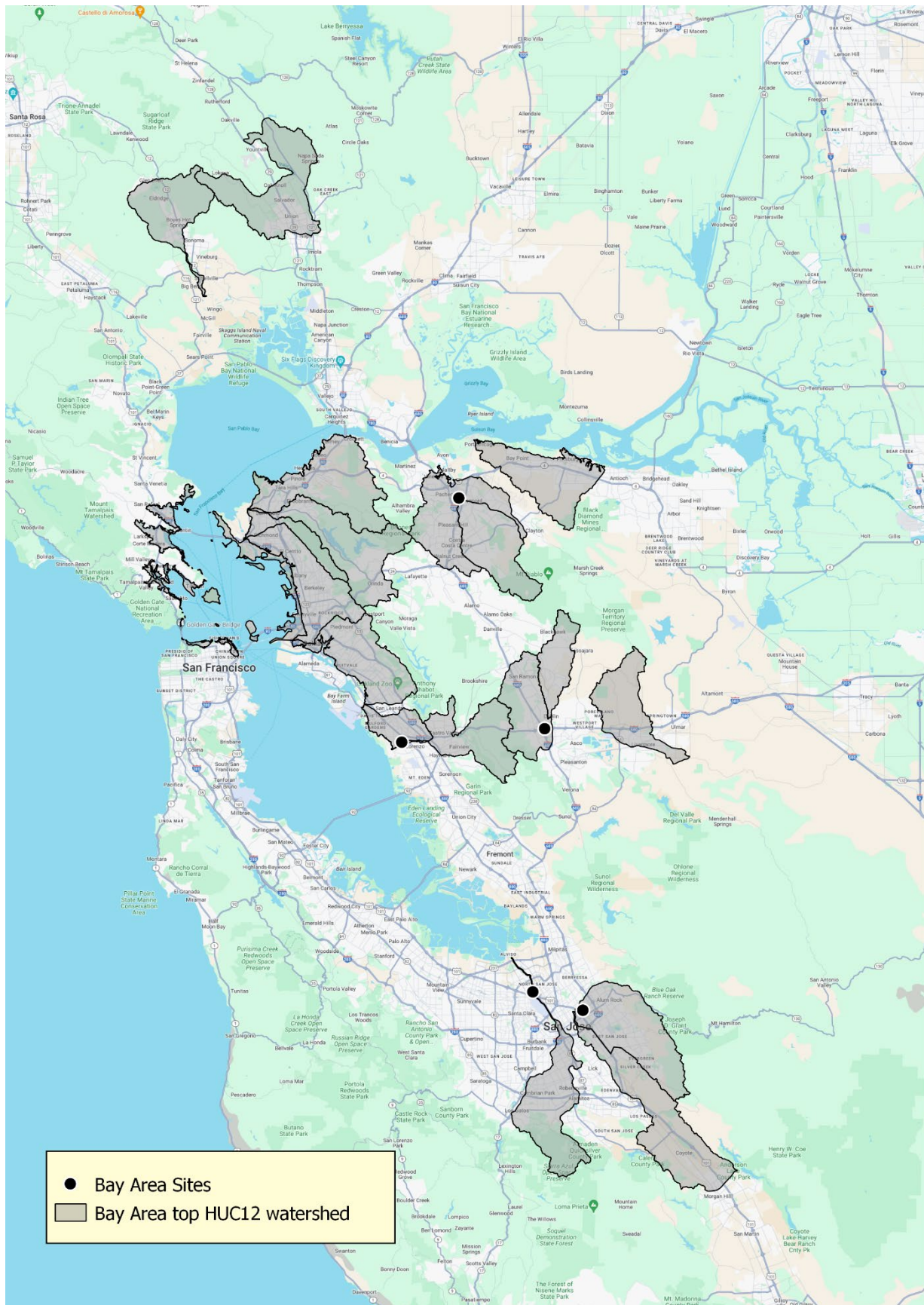


Figure 2. San Francisco Bay area monitoring sites and top HUC12 watersheds for WY 2023/2024.

Appendix 1. HUC12 selection for Northern California. Monitored HUC12 watersheds contain a double asterisk (**) next to the HUC12 name. See Appendix 2 for site codes and HUC12 information. For area, SAC = Sacramento area, SFB = San Francisco Bay area, and SJD = San Joaquin Delta.

HUC4	HUC8	HUC8 Rank	HUC12	HUC12 name	Type	Area	DPR Site Code
1802	18020111	1	180201110102	Miners Ravine**	Mainstem	SAC	MIN_MR
1802	18020111	1	180201110105	Gibson Lake-Dry Creek	Mainstem	SAC	
1802	18020111	1	180201110303	Lower Steelhead Creek	Mainstem	SAC	
1802	18020111	1	180201110103	Antelope Creek	Tributary	SAC	
1802	18020111	1	180201110302	Arcade Creek**	Tributary	SAC	ARC_ARC
1802	18020111	1	180201110105	Gibson Lake-Dry Creek	Tributary	SAC	
1802	18020161	2	180201610102	Dutch Ravine-Auburn Ravine	Mainstem	SAC	
1802	18020161	2	180201610302	Pleasant Grove Creek**	Tributary	SAC	PGC010 PGC019 PGC022 PGC058
1802	18020161	2	180201610101	Orchard Creek	Tributary	SAC	
1802	18020161	2	180201610102	Dutch Ravine-Auburn Ravine	Tributary	SAC	
1802	18020163	3	180201630404	Lower Morrison Creek	Mainstem	SAC	
1802	18020163	3	180201630404	Lower Morrison Creek	Tributary	SAC	
1802	18020163	3	180201630401	Elder Creek	Tributary	SAC	
1802	18020163	3	180201630701	Lake Greenhaven-Sacramento River	Tributary	SAC	
1805	18050001	4	180500010204	Walnut Creek-Frontal Suisin Bay Estuaries**	Mainstem	SFB	WAL_CA
1805	18050001	4	180500010203	Pine Creek	Tributary	SFB	
1805	18050001	4	180500010204	Walnut Creek-Frontal Suisin Bay Estuaries	Tributary	SFB	
1805	18050001	4	180500010301	Kirker Creek-Frontal Suisin Bay Estuaries	Tributary	SFB	
1805	18050004	5	180500040502	South San Ramon Creek**	Mainstem	SFB	SRC_JD
1805	18050004	5	180500040802	San Lorenzo Creek**	Mainstem	SFB	SLC_LA
1805	18050004	5	180500040203	Lower Arroyo Las Positas	Mainstem	SFB	
1805	18050004	5	180500040501	Alamo Creek	Tributary	SFB	
1805	18050004	5	180500040502	South San Ramon Creek	Tributary	SFB	
1805	18050004	5	180500040805	Sausal Creek-Frontal San Francisco Bay Estuaries	Tributary	SFB	
1805	18050002	6	180500021001	Angel Island-San Francisco Bay Estuaries	Mainstem	SFB	
1805	18050002	6	180500020303	Lower Sonoma Creek	Mainstem	SFB	
1805	18050002	6	180500020205	Lower Napa River	Mainstem	SFB	
1805	18050002	6	180500020702	Pinole Creek-Frontal San Pablo Bay Estuaries	Tributary	SFB	

HUC4	HUC8	HUC8 Rank	HUC12	HUC12 name	Type	Area	DPR Site Code
1805	18050002	6	180500020904	Cerrito Creek-Frontal San Francisco Bay Estuaries	Tributary	SFB	
1805	18050002	6	180500020701	San Pablo Creek	Tributary	SFB	
1805	18050003	7	180500030304	Guadalupe River**	Mainstem	SFB	GUA_TRM
1805	18050003	7	180500030202	Metcalfe Canyon-Coyote Creek	Mainstem	SFB	
1805	18050003	7	180500030201	Silver Creek**	Tributary	SFB	SLV_KNG
1805	18050003	7	180500030302	Canoas Creek	Tributary	SFB	
1805	18050003	7	180500030304	Guadalupe River	Tributary	SFB	
1804	18040003	8	180400030702	Lower Marsh Creek	Mainstem	SJD	
1804	18040003	8	180400030303	McLeod Lake-Mormon Slough	Mainstem	SJD	
1804	18040003	8	180400030803	Dutch Slough-Big Break	Mainstem	SJD	
1804	18040003	8	180400030702	Lower Marsh Creek	Tributary	SJD	
1804	18040003	8	180400030803	Dutch Slough-Big Break	Tributary	SJD	
1804	18040003	8	180400030907	Markley Canyon-San Joaquin River	Tributary	SJD	

SWMP Model Parameters: Use pattern: Urban; PUR Data 2019-2021; Toxicity Data (acute and chronic): USEPA Aquatic Life Benchmarks/Supplemented by Benchmark Equivalent; Max. number of top pesticides for reporting: 100.

SWMP AOI/POI Determination: Study Domain by HUC4: 8 Northern HUC4s; POI Selection: All AI with final score ≥ 9 (36 AI selected); HUC8 Analysis: All (105 HUC8s selected); HUC12 Analysis: 3 HUC12s per selected HUC8.

Appendix 2. Sampling site details for WY 2023/2024. For site type, SD = storm drain outfall; MS = mainstem creek or river. PGC022 sediment sampling will be downstream of the union of PGC021 and PGC022 (reported as PGC019). If there is no measurable runoff at PGC058, water will be collected at PGC040 (38.79857, -121.34802) to be consistent with previous years.

Site Code	Site Type	Sample Type	Description	City	HUC12/Name	Latitude GPS Coordinates (NAD83)	Longitude GPS Coordinates (NAD83)
PGC010	SD	Water Sediment	Outfall at Diamond Woods Circle	Roseville	180201610302 Pleasant Grove Creek	38.80477	-121.32733
PGC022	SD	Water	Outfall at Opal and Northpark Drive	Roseville	180201610302 Pleasant Grove Creek	38.802599	-121.338787
PGC019	SD	Sediment	Combination of outfalls at Opal and Northpark Drive (this site may also substitute for PGC022 if limited runoff)	Roseville	180201610302 Pleasant Grove Creek	38.80248	-121.3386
PGC058	MS	Water	near Hayden Pkwy and Blue Oaks Blvd	Roseville	180201610302 Pleasant Grove Creek	38.79477	-121.37251
ARC_ARC	MS	Water	Arcade Creek at American River College	Sacramento	180201110302 Arcade Creek	38.645293	-121.347359
FOL2	SD	Water Sediment	Outfall at Brock Circle	Folsom	180201110201 Upper American River (Alder Creek)	38.6503	-121.14494
MIN_MR	MS	Water	Miner's Ravine at Orvietto Drive (tentative Miner's Ravine site)	Roseville	180201110102 Miner's Ravine	38.752947	-121.241557
WAL_CA	MS	Water	Walnut Creek near Concord Avenue	Concord	180500010204 Walnut Creek	37.980630	-122.0516
SLC_LA	MS	Water	San Lorenzo Creek at Lorenzo Avenue	San Leandro	180500040802 San Lorenzo	37.684572	-122.139337
SRC_JD	MS	Water Sediment	South San Ramon Creek at Johnson Drive	Pleasanton	180500040502 South San Ramon Creek	37.700976	-121.919837
GUA_TRM	MS	Water	Guadalupe River at Trimble Road	San Jose	180500030304 Guadalupe River	37.38062	-121.93802
SLV_KNG	MS	Water Sediment	Silver Creek at McKee Road and King Road	San Jose	180500030201 Silver Creek	37.35815	-121.861192

Appendix 3. Priority pesticides for the Sacramento area based on acute and chronic toxicity values. Listed, pesticides with priorities greater or equal to the priority score of 9, with a “TRUE” monitoring recommendation from SWMP (based on acute toxicity). Priority model does not include homeowner pesticide use. CDFA Screen codes *: DN, dinitroaniline herbicides, oxyfluorfen, and chlorfenapyr; LC, liquid chromatography multi-analyte; PY, pyrethroid; PX, phenoxy/synthetic auxin herbicides; NEO, neonicotinoids. For method information, see our [analytical methods page](#).

Pesticide	CDFA Screen*	2019-2021 Average Use (lb AI)	Use Score	Benchmark (µg/L)	Tox Score	Final Score	Monitored?
Bifenthrin	PY	9326.7	5	0.00005	8	40	Y
Permethrin	PY	11644.4	5	0.0033	7	35	Y
Cypermethrin	PY	2167.4	4	0.00005	8	32	Y
Deltamethrin	PY	1465.3	4	0.000026	8	32	Y
Imidacloprid	NEO	4274.8	4	0.01	7	28	Y
Fipronil	LC	1479	4	0.01	6	24	Y
Lambda-Cyhalothrin	PY	462.8	3	0.00004	8	24	Y
Cyfluthrin	PY	446.3	3	0.00012	8	24	Y
Pendimethalin	DN	3787.9	4	5.2	4	16	Y
Dithiopyr	None	2640	4	6.11	4	16	N
Prodiamine	DN	1452.7	4	1.5	4	16	Y
Isoxaben	LC	1361.6	4	10	4	16	Y
Esfenvalerate	PY	68.5	2	0.0000309	8	16	Y
Diuron	LC	356.1	3	0.13	5	15	Y
Chlorfenapyr	DN	393.8	3	2.91	4	12	Y
Clothianidin	NEO	131.9	2	0.05	6	12	Y
Oxadiazon	LC	114.6	2	0.88	5	10	Y
Triclopyr, Butoxyethyl Ester	PX	1149.5	3	26	3	9	Y
PCNB	None	878.5	3	13	3	9	N
Oryzalin	LC	514.2	3	13	3	9	Y
Propiconazole	LC	450.7	3	15	3	9	Y
Tebuthiuron	LC	400.8	3	50	3	9	Y

Appendix 4. Priority pesticides for San Francisco Bay area sampling sites based on acute and chronic toxicity values. Listed, pesticides with priorities greater or equal to the priority score of 9, with a “TRUE” monitoring recommendation from SWMP (based on acute toxicity). Priority model does not include homeowner pesticide use. CDFA Screen codes *: DN, dinitroaniline herbicides, oxyfluorfen, and chlorfenapyr; LC, liquid chromatography multi-analyte; PY, pyrethroid; PX, phenoxy/synthetic auxin herbicides. For method information, see the Environmental Monitoring Branch’s analytical methods webpage. For pesticides with an analytical method but not monitored, see Appendix 5.

Pesticide	CDFA Screen*	2019-2021 Average Use (lb AI)	Use Score	Benchmark (µg/L)	Tox Score	Final Score	Monitored?
Deltamethrin	PY	18540.1	5	0.000026	8	40	Y
Bifenthrin	PY	5766.6	4	0.00005	8	32	Y
Imidacloprid	NEO	2502.9	4	0.01	7	28	Y
Fipronil	LC	2590.5	4	0.01	6	24	Y
Lambda-cyhalothrin	PY	926.9	3	0.00004	8	24	Y
Cyfluthrin	PY	626.1	3	0.00012	8	24	Y
Permethrin	PY	1755.2	3	0.0033	7	21	Y
Pendimethalin	DN	4795.9	4	5.2	4	16	Y
Prodiamine	DN	2927	4	1.5	4	16	Y
Dithiopyr	None	2029.4	4	6.11	4	16	N
Esfenvalerate	PY	151.8	2	0.0000309	8	16	Y
Cypermethrin	PY	62	2	0.00005	8	16	Y
Diuron	LC	517.8	3	0.13	5	15	Y
Triclopyr, butoxyethyl ester	PX	4340.2	4	26	3	12	Y
Chlorfenapyr	DN	919.3	3	2.91	4	12	Y
2,2-dibromo-3-nitrilopropionamide	None	844.7	3	10	4	12	N
Isoxaben	LC	652.4	3	10	4	12	Y
Pyriproxyfen	LC	138.8	2	0.01	6	12	Y
Oxyfluorfen	DN	317.5	2	0.33	5	10	Y
Oxadiazon	LC	274	2	0.88	5	10	Y
PCNB	None	781.7	3	13	3	9	N
Propiconazole	LC	561.7	3	15	3	9	Y

Appendix 5. Chemical analyses of pesticides in Northern California urban monitoring Study 329. CDFA will analyze all water samples. Specific methods can be found on the Environmental Monitoring Branch's [Analytical Methods webpage](#).

Analyte Screen (Method ID)	Pesticide	Reporting Limit (ng L ⁻¹)	Method Detection Limit (ng L ⁻¹)
Dinitroaniline (DN) (EMON-SM-05-006)	chlorfenapyr	100	33.3
	oxyfluorfen	50	10
	pendimethalin	50	12
	prodiamine	50	12
	trifluralin	50	14
LC-multi analyte (LC) (EMON-SM-05-037)	abamectin	20	4
	acetamiprid	20	4
	atrazine	20	4
	azoxystrobin	20	4
	bensulide	20	4
	boscalid	20	4
	bromacil	20	4
	carbaryl	20	4
	chlorantraniliprole	20	4
	chlorpyrifos	20	4
	clothianidin	20	4
	cyprodinil	20	4
	desulfinyl fipronil	10	4
	desulfinyl fipronil amide	10	4
	diazinon	20	4
	diflubenzuron	20	4
	dimethoate	20	4
	diuron	20	4
	ethoprop	20	4
	etofenprox	20	4
	fenamidone	20	4
	fenhexamid	20	4
	fipronil	10	4
	fipronil amide	10	4
	fipronil sulfide	10	4
	fipronil sulfone	10	4
	fludioxonil	20	4
	hexazinone	20	4
	imidacloprid	10	4
	indoxacarb	20	4
	isoxaben	20	4
	kresoxim-methyl	20	4
	malathion	20	4
	methidathion	20	4
methomyl	20	4	
methoxyfenozide	20	4	
metribuzin	20	4	
norflurazon	20	4	
oryzalin	20	4	
oxadiazon	20	4	
prometon	20	4	
prometryn	20	4	
propanil	20	4	
propargite	20	4	

Analyte Screen (Method ID)	Pesticide	Reporting Limit (ng L ⁻¹)	Method Detection Limit (ng L ⁻¹)
	propiconazole	20	4
	pyraclostrobin	20	4
	pyriproxyfen	15	4
	quinoxifen	20	4
	simazine	20	4
	s-metolachlor	20	4
	tebuconazole	20	4
	tebufenozide	20	4
	tebuthiuron	20	4
	thiabendazole	20	4
	thiacloprid	20	4
	thiamethoxam	20	4
	trifloxystrobin	20	4
Pyrethroid (PYW) (EMON-SM-05-022)	bifenthrin	1	0.91
	cyfluthrin	2	1.46
	cypermethrin	5	1.54
	deltamethrin/tralomethrin	5	1.77
	esfenvalerate/fenvalerate	5	1.66
	lambda-cyhalothrin	2	1.74
	permethrin cis	2	1.05
	permethrin trans	5	1.05
	Phenoxy/Synthetic Auxin Herbicides (PX) (EMON- SM-05-012)	2,4-D	50
dicamba		50	17
MCPA		50	22
triclopyr		50	20
Neonicotinoids (NEO) (EMON-SM-05-052)	Acetamiprid	20	4
	Atrazine-d5	20	4
	Clothianidin	20	4
	Dinotefuran	20	4
	Imidacloprid	10	4
	Sulfoxaflor	20	4
	Thiacloprid	20	4
	Thiamethoxam	20	4
	Imidacloprid-d4	20	4
Glyphosate (GLY) (EM-SM-05-046)	AMPA	20	28
		0	
	Glufosinate	70	11.5
	Glyphosate	70	5

Appendix 6. Chemical analysis of pyrethroids in Northern California urban monitoring Study 329. CDFA will analyze sediment samples (Method EMON-SM 52-9 [PYS]). Specific methods can be found on the Environmental Monitoring Branch's [analytical methods webpage](#).

Pesticide	Method Detection Limit (ng g⁻¹ dry wt)	Reporting Limit (ng g⁻¹ dry wt)
Bifenthrin	0.1083	1.0
Cyfluthrin	0.183	1.0
Cypermethrin	0.107	1.0
Deltamethrin/Tralomethrin	0.0661	1.0
Esfenvalerate/Fenvalerate	0.143	1.0
Lambda-cyhalothrin	0.1154	1.0
Permethrin cis	0.1159	1.0
Permethrin trans	0.1352	1.0