Department of Pesticide Regulation
Environmental Monitoring Branch
1001 I Street
Sacramento, California 95812

Study 321. Surface Water Monitoring for Pesticides in Agricultural Areas in the Central Coast and Southern California, 2024

Pedro Lima, Ph.D.
January 2024

1. INTRODUCTION

Surface water monitoring in agricultural areas is a priority for the California Department of Pesticide Regulation (DPR) to assess potential impacts of pesticides from agricultural runoff on California's aquatic environments. Initiated in 2008, collection of agricultural runoff within the Central Coast and southern regions of California represents one of DPR's long-term environmental monitoring efforts. Annual surface water monitoring data help guide DPR in the development and implementation of regulatory and non-regulatory mitigation activities. This project's current monitoring efforts are focused on two major agricultural regions of California: the Central Coast and the Imperial Valley (Southern California). Both regions are known for growing a wide variety of crops and apply a wide range of pesticide active ingredients (AIs). The 2024 monitoring areas include major watersheds in Monterey, Santa Barbara, San Luis Obispo and Imperial counties (Deng 2018a; Main 2019, 2020a; Deng 2021a, 2022, Lima 2023).

The monitoring results for the Central Coast and Southern California from previous years are summarized in annual project reports (e.g., Main 2020b; Deng 2021b, 2023). The most recent report presented the monitoring results from 2021. Excluding metabolites, there were 74 pesticides monitored including 32 insecticides, 22 herbicides, and 13 fungicides in 2021 (Deng 2023). The most frequently detected insecticides included imidacloprid, chlorantraniliprole, thiamethoxam, methoxyfenozide, clothianidin, bifenthrin, permethrin, and methomyl, respectively. Detection frequencies ranged from 96% (imidacloprid) to 58% (methomyl). The frequency of a measured concentration exceeding its associated lowest (chronic or acute) U.S. Environmental Protection Agency (US EPA) aquatic life benchmark value ranged from 96% (imidacloprid) to 15% (fenpropathrin; Deng 2023). Many of the insecticidal AIs were frequently detected from the same watershed (whether at an individual site or multiple sampling locations from that watershed). The frequent co-occurrence of insecticides in a given watershed and frequent exceedance of chronic or acute aquatic life benchmarks indicate that insecticide uses in the monitored watershed have the potential to cause adverse impacts to non-target aquatic organisms and communities. Herbicides and fungicides that were frequently detected included bensulide, prometryn, oxyfluorfen, boscalid, azoxystrobin, propiconazole, and mefenoxam respectively. Their detection frequency ranged from 90% (boscalid) to 50% (mefenoxam). By comparison, the frequency of US EPA acute aquatic life benchmark exceedances for herbicides and fungicides were relatively low (oxyfluorfen [25%], diuron [15%], and bensulide [8%]) (Deng 2023).

In 2021, DPR collected sediment samples from all 18 monitoring sites in southern California (Central Coast and Imperial Valley). The samples were analyzed for the presence of seven pyrethroids: bifenthrin, cyfluthrin, cypermethrin, fenpropathrin, fenvalerate/esfenvalerate, λ-cyhalothrin, and permethrin. Detection frequencies from the highest to the lowest were: λ-cyhalothrin (61%), bifenthrin (56%), permethrin (56%), cyfluthrin (17%), esfenvalerate (17%), fenpropathrin (17%), and cypermethrin (11%).

DPR's long-term agricultural monitoring efforts in the Central Coast and Southern California initiated in 2008 (*see Study 304*) and continued with Study 321 that began in 2019. Most current monitoring sites were established in previous years (Deng 2017, 2022). The watershed-based prioritization approach was applied to help refine the pesticide priority list for monitoring using DPR's Surface Water Monitoring Prioritization model (SWMP; Luo et al. 2013, 2014, 2015). In 2024, the priority lists of pesticides recommended for monitoring were utilized to determine whether the current analytical screens have included all the AIs of potential concerns, and which analytical methods require development to include those AIs in the future. Monitoring frequency in the Central Coast will include three sampling events during the irrigation season from May to September, and two sampling events in the winter from November to February to capture storm runoff. Monitoring in Southern California will be conducted twice a year in March and October.

2. OBJECTIVES

The goals of the project are to assess short-term changes and long-term trends of pesticide occurrence in surface water resulting from agricultural runoff and their potential impact to the surrounding aquatic environments. Monitoring results can be used to assess the efficacy of mitigation efforts and provide information to DPR management to determine whether additional mitigation are necessary. The objectives of this study are as follows:

- Determine occurrences and measure chemical concentrations of high-priority pesticides in aqueous and sediment samples;
- Determine toxicity of water samples using lab surrogate species (*Hyalella azteca*, *Chironomus dilutus*);
- Evaluate potential impacts on aquatic environments by comparing environmental concentrations with current toxicity thresholds;

- Analyze spatial correlations between observed pesticide concentrations and detection frequencies with region-specific pesticide use;
- Assess trends in pesticide concentrations at long-term monitoring stations to evaluate efficacy of mitigation efforts and future needs;
- Publish raw data sets on Surface Water Monitoring Database (SURF) and annual monitoring results in a summary report. Share aforementioned evaluation reports on DPR Surface Water Protection Program website once they become available.
- Evaluate storm runoff on pesticide transport from agricultural fields.

3. PERSONNEL

This study will be conducted by staff from the Environmental Monitoring Branch, Surface Water Protection Program, under the general direction of Dr. Anson Main, Environmental Program Manager I (Supervisory). Key personnel are listed below:

Project Leader:	Pedro Lima, Ph.D.
Field Coordinator:	DPR SWPP staff.
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)

Questions concerning this monitoring project should be directed to Dr. Pedro Lima, Sr. Environmental Scientist (Specialist), at (916) 324-4186 or by email at pedro.lima@cdpr.ca.gov.

4. PESTICIDES FOR MONITORING

Pesticides of potential concern were prioritized following the procedures described in the SWMP model memos (Luo et al. 2013, 2014, 2015). The 12-digit hydrologic units (HUC12) on the U.S. Geological Survey (USGS) Watershed Boundary Database tool (USGS 2023) are used to define the watershed boundary as an input to the SWMP model. The watershed boundary identifies the areas that contribute to the specific HUC12 where the monitoring site is located. The SWMP model aggregates the total use of each pesticide within each upstream HUC12 by utilizing their use amounts reported in the (PUR) database. The model adjusts the total use by factoring in pesticide aquatic dissipation as a function of travel time between each upstream HUC12 and the HUC12 where the monitoring site is located. Pesticide aquatic dissipation was calculated based on water-sediment DT_{50} (half-life) of each pesticide of interest. This study applied the SWMP model to generate a ranked list of pesticides for the watershed contributing to each sampling site. The final *rank score* of a pesticide is the product of the rank in use amount and the relative toxicity of that pesticide among all pesticides used upstream. Pesticides were then analyzed to produce final monitoring lists for individual watershed following the general procedure below:

1) Pesticides with a use score ≥ 2 and a final ranking scores ≥ 8 in a priority list for a watershed of interest will be monitored;
2) Pesticides with a use score < 2 and final scores < 8 in a priority list are considered low priority but may be monitored as part of a large analytical screen;
3) Historical monitoring data and/or current availability of analytical methods at the CDFA lab are additional factors to consider in deciding a final list for monitoring recommendation.
4) Pesticides that are identified as high priority for monitoring that are not included in current analytical screens will be noted for requiring method development.

5. STUDY PLAN

Monitoring will be conducted in Monterey, Santa Barbara, and San Luis Obispo counties in the Central Coast and Imperial County in Southern California. Monitoring plans for each county is described below. The chemical lists for monitoring were generated by the SWMP model using the average yearly pesticide use from 2019–2021.

5.1. Imperial County

Ambient monitoring will be conducted in Imperial County twice a year at six established sites. Whole water samples will be collected during two sampling events, and sediment samples will be collected once a year in the fall. Sediment samples will be analyzed for seven pyrethroids (bifenthrin, λ-cyhalothrin, permethrin, cyfluthrin, cypermethrin, fenpropathrin, and fenvalerate/esfenvalerate). Monitoring locations are located at the Alamo River and New River watersheds (Table 1, Figure 1). Monitoring will be conducted in March and October to capture the runoff during the periods of higher pesticide uses coinciding with spring and fall in Imperial County.

The recommended chemicals for monitoring by the model for the New River and Alamo River (Tables 2-3) are similar to those in 2023. Linuron, ametoctradin, and 4-(2,4-DB), dimethylamine salt are recommended for monitoring by the prioritization model, but will not be monitored in 2024 because the analytical method for the three AIs are not currently developed.

5.2. Monterey County

Ambient monitoring will be conducted in Monterey County five times a year at eight sites including three times during the growing season (May, July, and September), and two times during storm events in the winter. Whole water samples will be collected during each sampling event for chemical analysis and a subset of water samples will be collected during each sampling event for toxicity testing. Sediment samples from all eight sites will be collected only in September for pyrethroid analysis. Monitoring sites are located at the Salinas River and Tembladero Slough watersheds (Table 4, 5; Figure 2).

The chemicals recommended by the priority model (Table 4, 5) are similar to those in 2023. External stakeholder interest in the presence of glyphosate in regional waterbodies brought the need to verify if concentrations are of concern to surface water endpoints. Glufosinate-ammonium is listed as priority pesticide for the Salinas River (Table 4), and the recent development of a glyphosate screening method (Table 13) will allow the incorporation of the analyte to the monitoring list in 2024. Spinetoram, paraquat dichloride, PCNB, ametoctradin, and propyzamide are recommended for monitoring by the prioritization model, but will not be monitored in 2024 because the analytical method for the three AIs are not currently developed (Table 4, 5).

5.3. Santa Barbara and San Luis Obispo Counties

Ambient monitoring will be conducted in Santa Barbara and San Luis Obispo counties three times a year in May, July, and September at four established sites and at two short-term monitoring sites (Table 1). The addition of the two sites will allow evaluation of the pesticide runoff reduction efficacy of a recently constructed sediment basin in the San Luis Obispo County. Whole water samples will be collected during each sampling event for chemical analysis and a subset of water samples from the six sites will be collected during each sampling period for toxicity testing. Sediment samples will only be collected in September for pyrethroid analysis. Monitoring sites are located at Orcutt Creek and Oso Flaco Creek watersheds (Table 1, Figure 3).

The chemicals recommended by the model for monitoring in the Orcutt Creek Watershed are similar to those in 2023, with the addition of the glyphosate analytes (Table 13). Propyzamide, linuron, and ametoctradin at Orcutt Creek, and ametoctradin at Oso Flaco Creek, appear on the priority list for monitoring (score = 8, Tables 6, 7). However, they will not be included for monitoring as analytical methods have not been developed for the three AIs.

5.4. Modifications from 2023

The 2024 protocol is a continuation of DPR's long-term agricultural monitoring efforts in the Central Coast and Southern California initiated in 2008 (*see Study 304,* Deng 2018a; Main 2019, 2020a; Deng 2021a, 2022, Lima 2023) with a few notable modifications (Table 16). In addition to the four established sites in the Santa Barbara and San Luis Obispo Counties, another two sites will be added to further assess the efficacy of mitigation efforts using a sedimentation basin. A glyphosate screen that includes three analytes (glufosinate-ammonium, aminomethylphosphonic acid (AMPA), and glyphosate) will be added for calendar year 2024 (Table 13).

6. SAMPLING METHOD

6.1. Water and Sediment Sampling

Whole water samples will be collected as grab samples directly into 1-liter amber glass bottles by hand or using a pole and then sealed with Teflon-lined lids (Deng and Ensminger 2021). Auto samplers (Teledyne Isco, Inc., Lincoln, NE) will be used to collect storm runoff over the course of a storm event (time-weighted) where possible. Sediment samples will be collected into half-pint Mason jars using stainless steel scoops from the top 2-cm bed layer. Sediments will be sieved through a 2-mm sieve to remove gravel and plant materials and homogenized (Deng and Ensminger 2021; Ensminger 2017). Samples will be stored and transported on wet ice or refrigerated at 4ºC until analyzed.

6.2. Sample Transport

The SWPP staff will transport water and sediment samples to the Center for Analytical Chemistry at CDFA for chemical analysis and to the UC Davis Aquatic Health Program Laboratory (AHPL) following the procedures outlined in DPR SOP QAQC004.01 (Jones 1999). A chain-of-custody record will be completed and will accompany each sample.

6.3. Field Measurements

Dissolved oxygen, pH, specific conductivity, total dissolved solids (TDS), salinity and water temperature will be measured *in situ* during each sampling event (Edgerton 2020) with an Aqua Troll 400 multi-parameter water quality Sonde (In Situ Inc., Fort Collins, CO).

7. LABORATORY ANALYSES

7.1. Chemical Analysis

Chemical analyses will be performed by the Center for Analytical Chemistry at CDFA. A total of 81 pesticides will be analyzed in the water samples collected from the sampling sites in 2024. Table 8 presents 54 pesticides and their associated analytical method reporting limits and method detection limits in a single liquid chromatograph multi-analyte screen (LC-screen). Additional screens (and number of AIs) including dinitroanilines (6), phenoxies (4), neonicotinoids (7), pyrethroids (7), and glyphosate (3), will also be analyzed (Tables 9, 10, 11, 12, and 13). Sediment samples will be analyzed for seven pyrethroids (Table 14). Quality Assurance/Quality Control (QA/QC) will be conducted in accordance with the Standard Operating Procedure QAQC001.00 (Peoples, 2019). Approximately 10% of all samples collected during the 2024 monitoring year will be included for QC. Laboratory QA/QC will follow DPR guidelines and will consist of laboratory blanks, matrix spikes, matrix spike duplicates, surrogate spikes, blind spikes, field matrix spikes, and field matrix spikes duplicates (Peoples 2019). Laboratory blanks and matrix spikes will be included in each extraction set. All pesticides identified as high priority by the SWMP model are included in current analytical screens except for the following seven pesticides: ametoctradin, linuron, 4-(2,4-DB), dimethylamine salt, PCNB, spinetoram, paraquat dichloride, and propyzamide. Analytical methods will need to be developed for the aforementioned pesticides before their inclusion for monitoring.

7.2. Organic Carbon and Suspended Solid Analyses

Total organic carbon (TOC) and dissolved organic carbon (DOC) in water samples will be analyzed by DPR staff using a Vario TOC Cube TOC/TNb Analyzer (Elementar Analysensysteme GmbH, Langenselbold, Germany) following a procedure similar to that outlined in Elementar (2009). Before analysis of each sample set, lab blanks and calibration standards will be run to ensure the quality of the TOC and DOC data. Water samples will also be analyzed for suspended sediment (Ensminger 2013). Similarly, sediment samples collected during September (Central Coast) and October (Imperial Valley) will be analyzed for TOC using the TOC Cube TOC/TNb Analyzer.

7.3. Toxicity Analysis

Toxicity analyses will be conducted in collaboration with the UC Davis AHPL. Grab whole water samples collected from a set of selected sampling sites in the Central Coast and Southern California regions will be tested for mortality by the AHPL using *Hyalella azteca* and *Chironomus dilutus* as surrogate species.

8. DATA ANALYSIS

All data generated by this project will be entered in a Microsoft Office Access database that holds field information, field measurements, and laboratory analytical data. All ambient monitoring analytical data will also be uploaded into the DPR Surface Water Database (SURF, DPR 2023).

Periodic assessments of monitoring data can include the following:

- Comparison of pesticide concentrations to aquatic toxicity benchmarks, water quality objectives, and other toxicity thresholds (CCVRWQCB 2012, US EPA 2023).
- Spatial analysis of data to identify correlations between observed pesticide concentrations and pesticide uses, rainfall and geographical features.
- Assessment of multiple years of data to characterize patterns and trends in detection frequencies and exceedances of current aquatic benchmarks.
- Assessment of results to determine potential needs of additional monitoring in regions with similar pesticide use patterns.

9. ESTIMATED TIMETABLE

Field Sampling:	January 2024–December 2024
Chemical Analysis:	January 2024–February 2025
Draft Report:	May 2025
Data Entry into SURF:	May 2026

10. SAMPLING EVENTS

The sampling schedule for each county is provided in Table 15.

11. REFERENCES

California Central Valley Regional Water Quality Control Board (CCVRWQCB). 2012. Criteria reports.

California Department of Pesticide Regulation (DPR). 2023. Surface Water Database (SURF).

Deng, X. 2017. Study 304. Surface Water Monitoring for Pesticides in Agricultural Areas in Central Coast and Southern California, 2017. Study 304 Protocol, 2017

Deng, X. 2018a. Study 304. Ambient Monitoring Report: Surface Water Monitoring for Pesticides in Agricultural Areas of California, 2017. Study 304 Report, 2018

Deng, X. 2018b. Study 304. Surface Water Monitoring for Pesticides in Agricultural Areas in the Central Coast and Southern California, 2018. Online access currently unavailable.

Deng, X. 2021a. Study 321. Surface Water Monitoring for Pesticides in Agricultural Areas of California, 2021. Study 321 Protocol, 2021

Deng, X. 2021b. Study 321. Ambient Monitoring Report: Surface Water Monitoring for Pesticides in Agricultural Areas of California, 2020. Study 321 Report, 2020

Deng, X. 2022. Study 321. Surface Water Monitoring for Pesticides in Agricultural Areas in the Central Coast and Southern California, 2022. Study 321 Protocol, 2022

Deng, X. 2023. Study 321. Ambient Monitoring Report: Surface Water Monitoring for Pesticides in Agricultural Areas of California, 2021. Study 321 Report, 2021.

Deng, X. and M. Ensminger. 2021. DPR SOP FSWA017.00: Procedures for Collecting Water and Sediment Samples for Pesticide Analysis. SOP FSWA017.00

Edgerton, E. 2020. DPR SOP (Standard Operating Procedures) EQWA012.00: Calibration, Field Measurement, Cleaning, and Storage of the YSI EXO1 Multi-parameter Sonde. SOP EQWA012.

Elementar Analysensysteme GmbH. 2009. TOC/TNb Analyzer: vario TOC cube. Operating instructions.

Ensminger, M. 2013. DPR SOP METH010.01: Analysis of whole sample suspended sediments in water. SOP METH0.10.01

Ensminger, M. 2017. Study 299. Ambient and mitigation monitoring in urban areas in Northern California FY 2017/18. Online access currently unavailable.

Jones, D. 1999. SOP QAQC004.01: Transporting, packaging, and shipping samples from the field to the warehouse or laboratory. California Department of Pesticide Regulation, Sacramento, CA. SOP QAQC004.01

Lima, P. 2023. Study 321. Surface Water Monitoring for Pesticides in Agricultural Areas in the Central Coast and Southern California, 2023. Study 321 Protocol, 2023

Luo, Y., X. Deng, R. Budd, K. Starner and M. Ensminger. 2013. Methodology for Prioritizing Pesticides for Surface Water Monitoring in Agricultural and Urban Areas. May 2013. Prioritization Model I

Luo, Y., M. Ensminger, R. Budd, X. Deng and A. DaSilva . 2014. Methodology for Prioritizing Pesticides for Surface Water Monitoring in Agricultural and Urban Areas II: Refined Priority List. July 2014. Prioritization Model II

Luo, Y and X. Deng. 2015. Methodology for Prioritizing Pesticides for Surface Water Monitoring in Agricultural and Urban Areas III: Watershed-Based Prioritization. February 2015. Prioritization Model III

Main, A. 2019. Study 321. Surface Water Monitoring for Pesticides in Agricultural Areas in the Central Coast and Southern California, 2020. Study 321 Protocol, 2019

Main, A. 2020a. Study 321. Surface Water Monitoring for Pesticides in Agricultural Areas in the Central Coast and Southern California, 2020. Study 321 Protocol, 2020

Main, A. 2020b. Study 321. Ambient Monitoring Report: Surface Water Monitoring for Pesticides in Agricultural Areas of California, 2019. Study 321 Report, 2019

Peoples, S. 2019. SOP QAQC001.01: Chemistry Laboratory Quality Control. Department of Pesticide Regulation, Sacramento, CA. SOP QAQC001.01

US EPA. 2023. Aquatic Life Benchmarks and Ecological Risk Assessments for Registered Pesticides. Benchmarks

U.S. Geological Survey (USGS). 2023. The National Map

12. TABLES

Table 1. Sampling site information for Study 321 in 2024.

County	Site ID	Location	Watershed	Latitude	Longitude	Waterbody Type	Site Type
Imperial	Imp_Newriv27	New River at HWY S27/Keystone Rd	New River	32.9136	-115.60646	Waterway	Main Stem
Imperial	Imp_Lack	New River at Lack Road	New River	33.0999	-115.64876	Waterway	Main Stem
Imperial	Imp_Rice3	Rice Drain III at Weinert Road	New River	32.8691	-115.651	Engineered Conveyance	Ag Ditch
Imperial	Imp_Rutherford	Alamo River at Rutherford Road	Alamo River	33.0447	-115.48829	Waterway	Main Stem
Imperial	Imp_Garst	Alamo River at Garst Road	Alamo River	33.199	-115.59696	Waterway	Main Stem
Imperial	Imp_Holtville	Holtville Main Drain at HWY 115	Alamo River	32.9309	-115.40611	Engineered Conveyance	Ag Ditch
Monterey	Sal_Quail	Quail Creek at HWY 101; Spence and Potter Roads	Salinas River	36.6092	-121.56269	Waterway	Main Stem
Monterey	Sal_Chualar	Chualar Creek at Chualar River Road	Salinas River	36.5584	-121.52964	Engineered Conveyance	Ag Ditch
Monterey	Sal_Davis	Salinas River at Davis Road	Salinas River	36.647	-121.70219	Waterway	Main Stem
Monterey	Sal_Blanco	Blanco Drain at Cooper Road	Salinas River	36.6987	-121.73516	Engineered Conveyance	Ag Ditch
Monterey	Sal_Hartnell	Alisal Creek at Hartnell Road	Tembladero Slough	36.6435	-121.57836	Engineered Conveyance	Ag Ditch
Monterey	Sal_SanJon	Rec Ditch at San Jon Road	Tembladero Slough	36.7049	-121.70506	Engineered Conveyance	Ag Ditch
Monterey	Sal_Tembl	Tembladero Slough at HWY 183	Tembladero Slough	36.75166	-121.74186	Waterway	Tributary Stream
Monterey	Sal_Haro	Tembladero Slough at Haro Street	Tembladero Slough	36.7596	-121.75433	Waterway	Main Stem
San Luis Obispo	SM_OFC	Oso Flaco Creek at Oso Flaco Creek Road	Oso Flaco Creek	35.0164	-120.58755	Waterway	Main Stem
San Luis Obispo	SM_SB1	Inlet of the sedimentation basin	To be determined (TBD)	TBD	TBD	Waterway	Main Stem
San Luis Obispo	SM_SB2	Outlet of the sedimentation basin	To be determined (TBD)	TBD	TBD	Mitigation	Sediment Basin
Santa Barbara	SM_Solomon	Solomon Creek at HWY 1	Orcutt Creek	34.9414	-120.5742	Waterway	Tributary Stream
Santa Barbara	SM_Orcutt	Orcutt Creek at West Main Street	Orcutt Creek	34.9576	-120.63244	Waterway	Main Stem
Santa Barbara	SM_Main	Main Ditch at HWY 166	Main Ditch	34.95474	-120.48501	Engineered Conveyance	Ag Ditch

Table 2. Pesticide prioritization for surface water monitoring in Alamo River in Imperial County.

Chemical	Use Score	Tox Score	Final Score	Monitoring Inclusion
Imidacloprid	5	5	25	Yes
Permethrin	3	7	21	Yes
Pendimethalin	5	4	20	Yes
Trifluralin	5	4	20	Yes
Malathion	3	6	18	Yes
λ-cyhalothrin	2	8	16	Yes
Esfenvalerate	2	8	16	Yes
Carbaryl	3	5	15	Yes
Atrazine	3	5	15	Yes
4-(2,4-DB), dimethylamine salt	4	3	12	No[1]
Methomyl	3	4	12	Yes
Bensulide	5	2	10	Yes
Oxyfluorfen	2	5	10	Yes
Dimethoate	3	3	9	Yes
Methoxyfenozide	3	3	9	Yes
2,4-D	4	2	8	Yes
Ametoctradin	2	4	8	No[1]
Linuron	2	4	8	No[1]
Chlorantraniliprole	2	4	8	Yes

Alamo River drainage area = 1,264 km^2

[1] Analytical method not currently available.

Table 3. Pesticide prioritization for surface water monitoring in New River in Imperial County.

Chemical	Use Score	Tox Score	Final Score	Monitoring Inclusion
Pendimethalin	5	4	20	Yes
Imidacloprid	4	5	20	Yes
Malathion	3	6	18	Yes
Trifluralin	4	4	16	Yes
λ-cyhalothrin	2	8	16	Yes
Esfenvalerate	2	8	16	Yes
Carbaryl	3	5	15	Yes
Permethrin	2	7	14	Yes
4-(2,4-DB), dimethylamine salt	4	3	12	No[1]
Methomyl	3	4	12	Yes
Bensulide	5	2	10	Yes
Atrazine	2	5	10	Yes
Oxyfluorfen	2	5	10	Yes
Dimethoate	3	3	9	Yes
Methoxyfenozide	3	3	9	Yes
2,4-D	4	2	8	Yes

Chemical	Use Score	Tox Score	Final Score	Monitoring Inclusion
Linuron	2	4	8	No[1]
Ametoctradin	2	4	8	No[1]
Chlorantraniliprole	2	4	8	Yes

New River drainage area = 1,729 km^2

[1] Analytical method not currently available.

Table 4. Pesticide monitoring prioritization in Salinas River in Monterey County.

Chemical	Use Score	Tox Score	Final Score	Monitoring Inclusion
Permethrin	3	7	21	Yes
Methomyl	5	4	20	Yes
Malathion	3	6	18	Yes
λ-cyhalothrin	2	8	16	Yes
Bifenthrin	2	8	16	Yes
Imidacloprid	3	5	15	Yes
Glufosinate-ammonium	4	3	12	Yes
PCNB	4	3	12	No[1]
Pyraclostrobin	3	4	12	Yes
Bensulide	5	2	10	Yes
Oxyfluorfen	2	5	10	Yes
Paraquat Dichloride	2	5	10	No[1]
Carbaryl	2	5	10	Yes
Spinetoram	3	3	9	No[1]
Cyprodinil	3	3	9	Yes
Quinoxyfen	3	3	9	Yes
Propyzamide	4	2	8	No[1]
Prometryn	2	4	8	Yes
Ametoctradin	2	4	8	No[1]
Trifloxystrobin	2	4	8	Yes
Pendimethalin	2	4	8	Yes
Chlorantraniliprole	2	4	8	Yes

Salinas River drainage area = 11,082 km^2

[1] Analytical method not currently available.

Table 5. Pesticide monitoring prioritization in Tembladero Slough in Monterey County.

Chemical	Use Score	Tox Score	Final Score	Monitoring Inclusion
Malathion	4	6	24	Yes
Permethrin	3	7	21	Yes
Methomyl	5	4	20	Yes
Bifenthrin	2	8	16	Yes
λ-cyhalothrin	2	8	16	Yes
Pyraclostrobin	3	4	12	Yes
Oxyfluorfen	2	5	10	Yes
Imidacloprid	2	5	10	Yes
PCNB	3	3	9	No[1]
Bensulide	4	2	8	Yes

Chemical	Use Score	Tox Score	Final Score	Monitoring Inclusion
Trifloxystrobin	2	4	8	Yes
Prometryn	2	4	8	Yes
Ametoctradin	2	4	8	No[1]

Tembladero Slough drainage area = 291 km^2

[1] Analytical method not currently available.

Table 6. Pesticide monitoring prioritization in Orcutt Creek in Santa Barbara County.

Chemical	Use Score	Tox Score	Final Score	Monitoring Inclusion
Malathion	5	6	30	Yes
Permethrin	3	7	21	Yes
Imidacloprid	4	5	20	Yes
Bifenthrin	2	8	16	Yes
Oxyfluorfen	3	5	15	Yes
Fenpropathrin	2	7	14	Yes
Methomyl	3	4	12	Yes
Prometryn	3	4	12	Yes
Pyraclostrobin	3	4	12	Yes
Pendimethalin	3	4	12	Yes
Propyzamide	4	2	8	No[1]
Pyraclostrobin	2	4	8	Yes
Linuron	2	4	8	No[1]
Chlorantraniliprole	2	4	8	Yes
Ametoctradin	2	4	8	No[1]
Trifloxystrobin	2	4	8	Yes
Trifluralin	2	4	8	Yes

Orcutt Creek drainage area = 301 km^2

[1] Analytical method not currently available.

Table 7. Pesticide monitoring prioritization in Oso Flaco Creek in San Luis Obispo County.

Chemical	Use Score	Tox Score	Final Score	Monitoring Inclusion
Malathion	5	6	30	Yes
Imidacloprid	4	5	20	Yes
Bifenthrin	2	8	16	Yes
Oxyfluorfen	3	5	15	Yes
Permethrin	2	7	14	Yes
Fenpropathrin	2	7	14	Yes
Cyprodinil	4	3	12	Yes
Pendimethalin	3	4	12	Yes
Methomyl	2	4	8	Yes
Pyraclostrobin	2	4	8	Yes
Trifloxystrobin	2	4	8	Yes
Prometryn	2	4	8	Yes
Ametoctradin	2	4	8	No[1]
Chlorantraniliprole	2	4	8	Yes

Oso Flaco Creek drainage area = 51 km^2

1 Analytical method not currently available.

Table 8. Reporting Limits and Method Detection Limits for Pesticides in LC* Multi-Analyte Screen.

Analytic Screen	Pesticide	Method Detection Limit (ng/L)	Reporting Limit (ng/L)
LC	Abamectin	4	20
LC	Atrazine	4	20
LC	Azoxystrobin	4	20
LC	Bensulide	4	20
LC	Boscalid	4	20
LC	Bromacil	4	20
LC	Carbaryl	4	20
LC	Chlorantraniliprole	4	20
LC	Chlorpyrifos	4	20
LC	Cyprodinil	4	20
LC	Diazinon	4	20
LC	Diflubenzuron	4	20
LC	Dimethoate	4	20
LC	Diuron	4	20
LC	Ethoprop	4	20
LC	Etofenprox	4	20
LC	Fenamidone	4	20
LC	Fenhexamid	5	20
LC	Fludioxonil	4	20
LC	Hexazinone	4	20
LC	Indoxacarb	4	20
LC	Isoxaben	4	20
LC	Kresoxim-methyl	4	20
LC	Malathion	4	20
LC	Mefenoxam	4	20
LC	Methidathion	4	20
LC	Methomyl	4	20
LC	Methoxyfenozide	4	20
LC	Metribuzin	4	20
LC	Norflurazon	4	20
LC	Oryzalin	4	20
LC	Oxadiazon	4	20
LC	Prometon	4	20
LC	Prometryn	4	20
LC	Propanil	4	20
LC	Propargite	4	20
LC	Propiconazole	4	20
LC	Pyraclostrobin	4	20
LC	Pyriproxyfen	4	15
LC	Quinoxyfen	4	20
LC	Simazine	4	20
LC	S-Metolachlor	4	20

Analytic Screen	Pesticide	Method Detection Limit (ng/L)	Reporting Limit (ng/L)
LC	Tebuconazole	4	20
LC	Tebufenozide	4	20
LC	Tebuthiuron	4	20
LC	Thiabendazole	4	20
LC	Thiobencarb	4	20
LC	Trifloxystrobin	4	20
LC	Fipronil	4	10
LC	Fipronil Amide	4	10
LC	Fipronil Sulfide	4	10
LC	Fipronil Sulfone	4	10
LC	Desulfinyl Fipronil	4	10
LC	Desulfinyl Fipronil Amide	4	10

*LC = Liquid chromatograph multi-analyte screen (54 AIs).

Table 9. Reporting Limits and Method Detection Limits for Dinitroanilines and Oxyfluorfen (DN/OX) in whole water.

Analytic Screen	Pesticide	Method Detection Limit (ng/L)	Reporting Limit (ng/L)
DN/OX	Benfluralin (*Benefin*)	14	50
DN/OX	Ethalfluralin	15	50
DN/OX	Oxyfluorfen	10	50
DN/OX	Pendimethalin	12	50
DN/OX	Prodiamine	12	50
DN/OX	Trifluralin	14	50

*DN/OX = dinitroanilines and oxyfluorfen.

Table 10. Reporting Limits and Method Detection Limits for Phenoxy in whole water.

Analytic Screen	Pesticide	Method Detection Limit (ng/L)	Reporting Limit (ng/L)
Phenoxy	2,4-D	15	50
Benzoic acide	Dicamba	17	50
Phenoxy	MCPA	22	50
Pyridine	Triclopyr	20	50

Table 11. Reporting Limits and Method Detection Limits for Neonicotinoids in whole water.

Analytic Screen	Pesticide	Method Detection Limit (ng/L)	Reporting Limit (ng/L)
Neonics	Acetamiprid	4	20
Neonics	Clothianidin	4	20
Neonics	Dinotefuran	4	20
Neonics	Imidacloprid	4	10
Neonics	Sulfoxaflor	4	20
Neonics	Thiacloprid	4	20
Neonics	Thiamethoxam	4	20

Table 12. Reporting Limits and Method Detection Limits for Pyrethroids in whole water.

Analytic Screen	Pesticide	Method Detection Limit (ng/L)	Reporting Limit (ng/L)
Pyrethroid	Bifenthrin	0.91	1
Pyrethroid	λ-cyhalothrin	1.74	2
Pyrethroid	Permethrin	1.05	2
Pyrethroid	Cyfluthrin	1.46	2
Pyrethroid	Cypermethrin	1.54	5
Pyrethroid	Fenpropathrin	1.32	5
Pyrethroid	Fenvalerate/esfenvalerate	1.66	5

Table 13. Reporting Limits and Method Detection Limits for Glyphosate in whole water.

Analytic Screen	Pesticide	Method Detection Limit (ng/L)	Reporting Limit (ng/L)
Glyphosate	Glyphosate	0.00495	70
Glyphosate	Glufosinate-ammonium	0.01154	70
Glyphosate	Aminomethylphosphonic Acid (AMPA)	0.02786	200

Table 14. Reporting Limits and Method Detection Limits for Pyrethroids in sediment.

Analytic Screen	Pesticide	Method Detection Limit (ng/g dry wt)	Reporting Limit (ng/g dry wt)
Pyrethroid	Bifenthrin	0.1083	1
Pyrethroid	λ-cyhalothrin	0.1154	1
Pyrethroid	Permethrin	0.1159	1
Pyrethroid	Cyfluthrin	0.1830	1
Pyrethroid	Cypermethrin	0.1070	1
Pyrethroid	Fenpropathrin	0.1094	1
Pyrethroid	Esfenvalerate/fenvalerate	0.1430	1

Table 15. Number of samples for pesticide analyses by counties from January to December 2024*.

Analyte Group **	Location[1]	1st Storm	Mar	May	July	Sept	Oct	2nd Storm	Total samples[2]
LC-Full	Imperial		6				6		12
DN/OX	Imperial		6				6		12
Phenoxy	Imperial		6				6		12
Neonics	Imperial		6				6		12
PY-Water	Imperial		6				6		12
PY-Sediment	Imperial						6		6
LC-Full	CC	8		14	14	14		8	58
DN/OX	CC	8		14	14	14		8	58
Neonics	CC	8		14	14	14		8	58
PY-Water	CC	8		14	14	14		8	58
GL	CC	8		14	14	14		8	58
PY-Sediment	CC					14			14
Overall		**40**	**30**	**70**	**70**	**84**	**36**	**40**	**428**

*Numbers under each month represent the total number of samples collected for each analyte or analyte group. One whole water grab sample for each analyte or analyte group will be collected from one site.

**LC = Liquid chromatograph multi-analyte screen (54 AIs); DN/OX = Dinitroaniline & Oxyfluorfen; Neonics = Neonicotinoids; PY = Pyrethroid; GL = Glyphosate.

[1] CC = Central Coast = Monterey, Santa Barbara and San Luis Obispo counties.

[2] 10% of the equivalent total samples collected will be used for QA/QC.

Table 16. Modifications from sampling plan for Study 321 in 2024.

Change from 2023	Justification
Addition of two sites in San Luis Obispo County	The addition of the two sites will allow for evaluating pesticide runoff reduction efficacy of a recently constructed sediment basin in San Luis Obispo County.
Inclusion of a glyphosate screen to the monitoring chemical list	External stakeholder interest on glyphosate analytes brought the need to verify if concentrations are of concern to surface water endpoints. The recent development of a glyphosate method will allow the incorporation of these analytes to the monitoring list.

13. FIGURES

Figure 1. Monitoring sites in Alamo River and New River in Imperial County.

Figure 2. Monitoring sites in Salinas River and Tembladero Slough in Monterey County.

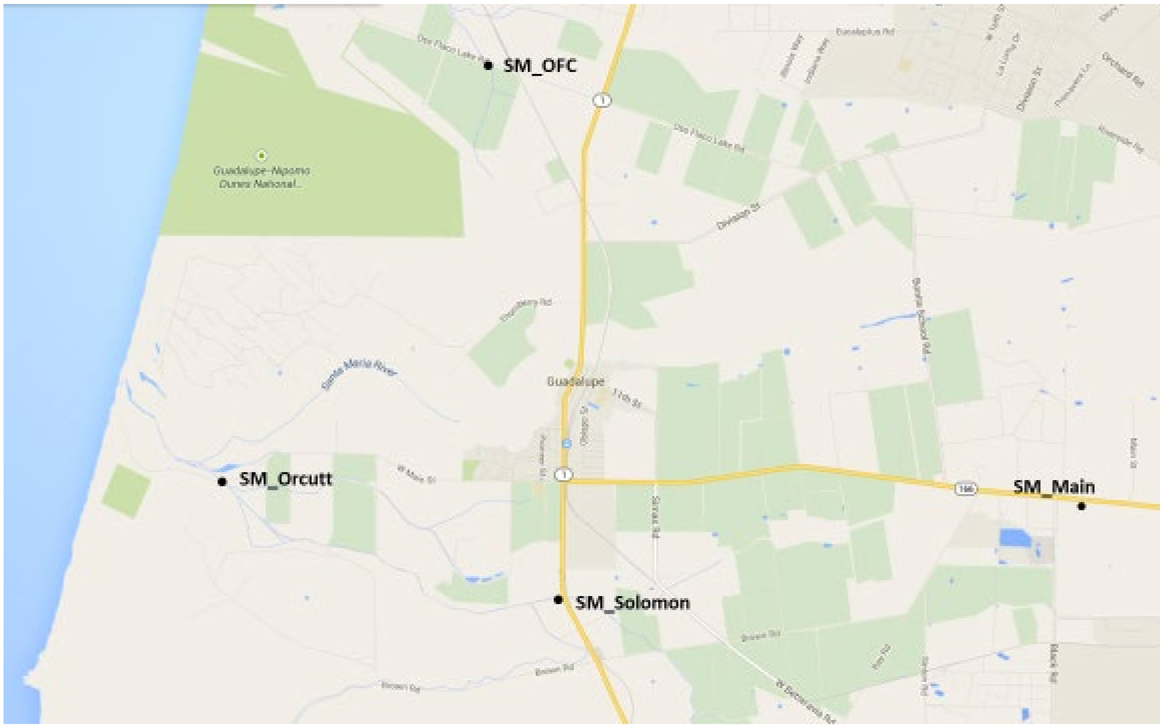

Figure 3. Monitoring sites in Orcutt Creek and Oso Flaco Creek in San Luis Obispo and Santa Barbara Counties.