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

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March 2019

1. INTRODUCTION

Surface water monitoring for pesticides in agricultural areas of California is a priority area for the California Department of Pesticide Regulation (CDPR) to assess potential impacts of pesticides from agricultural runoff on California aquatic environments. Monitoring for pesticides in agricultural areas of the Central Coast and Southern California is one of the CDPR's long-term environmental monitoring efforts initiated in 2008. Annual monitoring data help guide CDPR in the development and implementation of regulatory and non-regulatory mitigation activities. This current project focuses its monitoring efforts on two major agricultural areas of California— the Central Coast and the Imperial Valley. As a result of a wide variety of commodities being grown in both regions, a wide range of pesticide active ingredients (AI) are used across the landscape. The 2019 monitoring areas include major watershed drainages in Monterey, Santa Barbara, San Luis Obispo and Imperial counties (Starner 2010, 2013; Deng 2016, 2017a).

Monitoring results for the Central Coast and Southern California in previous years are summarized in project annual reports (e.g., Deng 2017b, 2018). Over 24 pesticides in 8 chemical groups were monitored each year. In 2017, there were 37 pesticides monitored including 19 insecticides, 13 herbicides, and 5 fungicides. The most frequently detected insecticides included imidacloprid, chlorantraniliprole, methomyl, methoxyfenozide, bifenthrin, and λ-cyhalothrin. Detection frequencies varied from 28% (λ-cyhalothrin) to 95% (imidacloprid). The frequencies of their concentrations exceeding the associated lowest (chronic or acute) U.S. Environmental Protection Agency (US EPA) aquatic life benchmark values ranged from 20% (methomyl) to 95% (imidacloprid; Deng 2018). Those specific insecticides can be highly toxic to sensitive aquatic organisms. Many of the insecticidal active ingredients were commonly detected in single or multiple samples from the same watershed. The frequent co-occurrence of insecticides in a given watershed and frequent exceedance of acute aquatic life benchmarks indicate that insecticide uses in the monitored watershed drainages have the potential to cause adverse impacts to non-target aquatic organisms and communities. Herbicides and fungicides that were frequently detected included bensulide, atrazine, azoxystrobin, prometryn, pyraclostrobin, and oxyfluorfen (range: 33 to 82%). By comparison, the frequency of US EPA acute aquatic life benchmark exceedances for herbicides and fungicides were low in frequency (<9%). In these focal regions, annual surface water monitoring results indicate that a number of pesticides continue to increase in use (e.g., neonicotinoids) compared to older chemistries such as organophosphates (e.g., diazinon). Future monitoring efforts may need to include other neonicotinoid active ingredients such as acetamiprid, clothianidin, and thiamethoxam as laboratory methods become available.

Study 321 is a continuation of CDPR's agricultural monitoring efforts in the Central Coast and Southern California (*see Study 304*). Monitoring sites have been established in previous years (Deng 2017a). Priority lists of pesticides recommended for monitoring in each watershed were identified using CDPR's Prioritization Model (Luo et al. 2013, 2014, 2015). The watershed-based prioritization approach was applied to help refine the pesticide priority list for monitoring in 2019. Monitoring frequency in the Central Coast and Southern California will follow efforts from previous years with no major modifications in 2019.

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 the potential impact to aquatic environments. Results can be used to assess the efficacy of mitigation efforts and provide information to CDPR managers to determine whether mitigation responses are necessary to address pesticide contamination. Objectives of the project are as follows:

1) Prioritize pesticide monitoring candidates based on current pesticide use at the watershed level;
2) Determine occurrences and measure chemical concentrations of high-priority pesticides in aqueous and sediment samples;
3) Test acute toxicity of water samples using lab surrogate species;
4) Analyze chemistry data to evaluate potential impacts on aquatic environments by comparing environmental concentrations with US EPA aquatic life benchmarks;
5) Analyze spatial correlations between observed pesticide concentrations/detection frequencies and region-specific pesticide use;
6) Assess multiple years of data to characterize patterns and trends in detection frequencies and potential impact to aquatic organisms.

3. PERSONNEL

The study will be conducted by staff from the Environmental Monitoring Branch, Surface Water Protection Program, under the general direction of Jennifer Teerlink, Senior Environmental Scientist (Supervisor). Key personnel are listed below:

Project Leader: Anson Main, Ph.D.
Field Coordinator: Xin Deng, Ph.D.[1]

Review Scientist: Yuzhou Luo, Ph.D.
Statistician: Dan Wang, Ph.D.
Laboratory Liaison: Sue Peoples
Analytical Chemistry: Center for Analytical Chemistry, California Department of Food and Agriculture (CDFA)

Questions concerning this monitoring project should be directed to Dr. Anson Main, Environmental Scientist, at (916) 322-0496 or by email at Anson.Main@cdpr.ca.gov.

[1] Dr. Xin Deng will act as a co-Project Leader for the 2019 sampling season.

4. SELECTION OF PESTICIDES FOR MONITORING

All pesticides selected for monitoring were prioritized following the procedures described in the Monitoring Prioritization Model (Luo et al. 2013, 2014, 2015). The 12-digit hydrologic units on the U.S. Geological Survey (USGS) Watershed Boundary Database tool (USGS, 2018) is used to define the watershed boundary as an input to the prioritization model. The model utilizes pesticide use reporting database to aggregate the total use of each pesticide within the watershed and adjusts the total use by factoring in pesticide aquatic dissipation as a function of travel time. The model uses the water-sediment DT50 (half-life) to account for persistence and/or potential mobility of each pesticide of interest. The model was used to generate a ranked list of pesticides for the watershed contributing to each sampling site. Pesticides were then screened to produce final monitoring lists following the general criteria below:

1) Pesticides with final ranking scores ≥ 9 in a priority list for a watershed of interest **will be monitored** as pesticides with this ranking have higher use (use scores ≥ 2) and toxicity (tox scores ≥ 3, the lowest benchmark values ≤ 100 ppb), and thus have higher potential risks to aquatic communities.
2) Pesticides with final scores ≤ 8 and use scores ≥ 2 in a priority list *will be considered for monitoring*. The use criterion includes the top 30% pesticides with the highest use amounts among all the pesticides reported to PUR from 2014–2016 for a watershed of interest. Pesticides that are not in the priority lists or have use scores < 2 may be reported when they are concurrently analyzed with other prioritized pesticides in an analytical group.
3) Historical monitoring data, current use trends, availability of analytical methods, and budget constraints are additional factors to help decide a final list for monitoring.

5. STUDY PLAN

5.1. Imperial County

Ambient monitoring will be conducted in Imperial County twice a year in April and October at six established sites. Water samples will be collected in both events and sediment samples will be collected only in October for pyrethroid analysis. Monitoring locations are located in the Alamo River and New River watersheds (Table 1, Figure 1).

The priority lists for monitoring in the New River and Alamo River in March and October were generated using the average use data from January to March and from August to October from 2014–2016, respectively (Tables 2 and 3). We focused on these data as they closely mimic the annual agricultural use patterns and further represent the ”worst case” scenario for monitoring. The chemical lists recommended by the model are similar to those in 2018. Chlorantraniliprole will be monitored in March despite its low priority score (final score = 4) because the compound was detected frequently (~87%) during surface water monitoring in 2017 (Deng 2018).

5.2. Monterey County

Ambient monitoring will be conducted in Monterey County four times a year in May, July, September, and November at six established sites. Water samples will be collected during each sampling event for chemical analysis and a subset of water samples from 3 to 5 selected sites will be collected during each sampling event for toxicity testing. Sediment samples will be collected only in September for pyrethroid analysis. Monitoring locations are located in Salinas River and Tembladero Slough watersheds (Table 1, Figure 2).

The priority lists for monitoring in each watershed were generated using the average pesticide use data from May to November from 2014–2016 (Table 4). The chemical lists recommended by the model are similar to those in 2018 with changes on rankings of a few chemicals due to changes of their use scores from 2014–2016. Notably, the use amounts of chlorpyrifos and diazinon had significantly reduced and so did their ranking scores on the priority list in recent years. Nevertheless, the monitoring results indicated about 2–3% detections for chlorpyrifos and 0–11% detections annually for diazinon from 2014 to 2016 with no diazinon detected in 2017 (Deng 2018). We will keep monitoring for chlorpyrifos, but not diazinon in 2019. Pyraclostrobin, prometryn, and quinoxyfen with final scores <8 will be monitored in the Salinas River Watershed in 2019 due to frequent detections in 2017 and their increasing use in recent years. Although listed as a priority pesticide, paraquat dichloride will not be monitored in 2019 due to a statewide low detection frequency in previous years. Additionally, glufosinate-ammonium, fenamidone, and PCNB are on the priority list in the Salinas River Watershed but will not be monitored as analytical methods are currently unavailable (Table 4).

5.3. Santa Barbara and San Luis Obispo Counties

Ambient monitoring will be conducted in Santa Barbara and San Luis Obispo counties four times a year in May, July, September, and November at three established sites and one new site. Water samples will be collected during each sampling event for chemical analysis and a subset of water samples from three sites will be collected during each sampling period for toxicity testing. Sediment samples will be collected only in September for pyrethroid analysis. Monitoring sites are located in Orcutt Creek and Oso Flaco Creek watersheds (Table 1, Figure 3). A site on Main Ditch at HWY166 was monitored in previous years and will be monitored in 2019 to replace the 2018 site at Bradley Channel as it dried out during the last monitoring year.

The priority lists for monitoring in each watershed were generated using the average use data from May to November from 2014–16 (Table 5). The chemicals recommended by the model for monitoring in the Orcutt Creek Watershed are similar to those in 2018. Chlorpyrifos dropped out of the lists for both watersheds but will be kept on the monitoring list in 2019 as part of the multi-analyte screen. Linuron appears as a medium priority for monitoring at Orcutt Creek (score = 8). However, despite an analytical method available for groundwater, it will not be included for monitoring as there is no method similarly available for surface water. Fenhexamid is a fungicide on the priority list for the Oso Flaco Creek Watershed (Table 5) but will not be monitored because an analytical method is not currently available.

5.4. Modifications from 2018

There will be no major modifications to the 2019 sampling events. Based on previous monitoring, bimonthly sampling in May, July and September captures the worst case scenario during the irrigation season. Maintaining the same sampling schedule in both areas in the Central Coast will further help simplify comparative analyses between the two areas (including previous data years) and reduce the potential for bias introduced by the sampling design. However, weather permitting, efforts will be made to conduct storm sampling in the Central Coast to capture the first storm runoff in the fall presumably from October to November. In addition, as the analytical methods for other neonicotinoid AIs become available through the CDFA lab, these AIs will be added to our LC-Screen as a priority pesticide for monitoring during the sampling year. Tentatively, methods for additional neonicotinoid AIs may be available in summer of 2019.

6. SAMPLING METHOD

6.1. Water and Sediment Sampling

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 (Bennett, 1997). Sediment samples will be collected into 1-quart 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 (Mamola, 2005; Ensminger, 2017). Samples will be stored and transported on wet ice or refrigerated at 4°C until analyzed.

6.2. Sample Transport

CDPR staff will transport water and sediment samples to the Center for Analytical Chemistry at California Department of Food and Agriculture for chemical analysis and to the UC Davis Marine Pollution Studies Laboratory following the procedures outlined in CDPR 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, turbidity and, water temperature will be measured *in situ* during each sampling event with an YSI EXO1 multi-parameter water quality Sonde (Doo and He 2008).

7. LABORATORY ANALYSES

7.1. Chemical Analysis

Chemical analyses will be performed by the Center for Analytical Chemistry, California Department of Food and Agriculture, Sacramento, CA. A total of 24 pesticides on the priority list of each watershed and an additional 13 active ingredients will be analyzed in all of the water samples collected from all of the sampling sites in 2019. A full scan of over 50 pesticides will be conducted once during 2019 on a subset of water samples collected from sites in the Central Coast (July) and Southern California (October). Table 6 and 7 (LC-Full) present the pesticides and their associated analytical method reporting limits and method detection limits. Twenty-four of the pesticides in the screening groups will be selected from a single liquid chromatograph multi-analyte screen (LC-screen). Seven pyrethroids and six dinitroanilines will also be analyzed. Quality control (QC) will be conducted in accordance with the Standard Operating Procedure QAQC001.00 (Segawa 1995). Approximately 10% of all samples collected during the 2019 monitoring year will be included for QC. Laboratory QA/QC will follow CDPR guidelines and will consist of laboratory blanks, matrix spikes, matrix spike duplicates, surrogate spikes, and blind spikes (Segawa 1995). Laboratory blanks and matrix spikes will be included in each extraction set.

7.2. Organic Carbon and Suspended Solid Analyses

Total organic carbon (TOC) and dissolved organic carbon (DOC) in water samples will be analyzed by CDPR staff using a TOC-V CSH/CNS analyzer (Shimadzu Corporation, Kyoto, Japan) (Ensminger 2013a). Water samples will also be analyzed for suspended sediment (Ensminger 2013b). Lab blanks and calibration standards will be ran before every sample set to ensure the quality of the data.

7.3. Toxicity Analysis

Toxicity analyses will be conducted in collaboration with the Central Coast Regional Water Quality Control Board and the UC Davis Marine Pollution Studies Laboratory (MPSL). Grab water samples collected from a set of selected sampling sites in the Central Coast and Southern California regions will be tested for mortality and growth by the MPSL using *Hyalella azteca, Chironomus dilutus* or *Ceriodaphnia dubia* 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 CDPR Surface Water Database (SURF, 2018).

Resulting data will be analyzed and reported as appropriate, potentially including the following:

- Comparison of pesticide concentrations to aquatic toxicity benchmarks, water quality limits, and other toxicity data (CCVRWQCB 2012, US EPA 2018).
- Spatial analysis of data in order to identify correlations between observed pesticide concentrations and region-specific pesticide uses 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 additional monitoring in regions with similar pesticide use patterns.

9. TIMETABLE

Field Sampling:	April 2019–November 2019
Chemical Analysis:	April 2019–December 2019
Draft Report:	March 2020
Data Entry into SURF:	April 2020

10. SAMPLING EVENTS AND BUDGET

The sampling schedule for each county and the estimated total cost for chemical analyses are provided in Table 8.

11. REFERENCES

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Table 1. Sampling Site Information for Study 321 in 2019.

County	Site ID	Location	Watershed	Latitude	Longitude	Site Type
Imperial	Imp_Newriv27	New River at HWY S27/Keystone Road	New River	32.9136	-115.60646	Main Stream
	Imp_Lack	New River at Lack Road		33.0999	-115.64876	Main Stream
	Imp_Rice3	Rice Drain III at Weinert Road		32.8691	-115.651	Tributary
	Imp_Rutherford	Alamo River at Rutherford Rd	Alamo River	33.0447	-115.48829	Main Stream
	Imp_Garst	Alamo River at Garst Road		33.199	-115.59696	Main Stream
	Imp_Holtville	Holtville Main Drain at HWY115		32.9309	-115.40611	Tributary
Monterey	Sal_Quail	Quail Creek at HWY 101, btwn Spence and Potter Roads	Salinas River	36.6092	-121.56269	Tributary
	Sal_Chualar	Chualar Creek at Chualar River Rd.		36.5584	-121.52964	Tributary
	Sal_Davis	Salinas River at Davis Road		36.647	-121.70219	Main Stream
	Sal_Hartnell	Alisal Creek at Hartnell Rd	Tembladero Slough	36.6435	-121.57836	Tributary
	Sal_SanJon	Rec Ditch at San Jon Road		36.7049	-121.70506	Tributary
	Sal_Haro	Tembladero Slough at Haro Street		36.7596	-121.75433	Main Stream
San Luis Obispo	SM_OFC	Oso Flaco Creek at OFL Road	Oso Flaco Creek	35.0164	-120.58755	Tributary
Santa Barbara	SM_Solomon	Solomon Creek at HWY 1	Orcutt Creek	34.9414	-120.5742	Tributary
	SM_Orcutt	Orcutt Creek at W. Main Street		34.9576	-120.63244	Main Stream
	SM_Main[1]	Main Ditch at HWY 166	Main Ditch	34.95474	-120.48501	Tributary

[1]SM_Main is a replacement site for SM_Bradley (2018).

Table 2. Pesticide Prioritization for Surface Water Monitoring in Alamo River and New River in Imperial County. Ranking of Pesticides Based on Average Use Data from January through March of 2014–2016.

Alamo River, Drainage Area = 1,264 km^2

Chemical	Use score	Tox score	Final score	Monitoring inclusion
MALATHION	4	6	24	Yes
PENDIMETHALIN	5	4	20	Yes
TRIFLURALIN	5	4	20	Yes
CHLORPYRIFOS	3	6	18	Yes
LAMBDA-CYHALOTHRIN	2	7	14	Yes
DIMETHOATE	4	3	12	Yes
PERMETHRIN	2	6	12	Yes
ATRAZINE	2	5	10	Yes
CYPERMETHRIN	2	5	10	Yes
METHOMYL	2	4	8	Yes
CYFLUTHRIN	1	6	6	Yes
IMIDACLOPRID	1	5	5	Yes

New River, Drainage Area = 1,729 km^2

Chemical	Use score	Tox score	Final score	Monitoring inclusion
CHLORPYRIFOS	4	6	24	Yes
MALATHION	4	6	24	Yes
PENDIMETHALIN	5	4	20	Yes
PERMETHRIN	3	6	18	Yes
TRIFLURALIN	4	4	16	Yes
DIMETHOATE	5	3	15	Yes
ATRAZINE	3	5	15	Yes
LAMBDA-CYHALOTHRIN	2	7	14	Yes
METHOMYL	3	4	12	Yes
OXYFLUORFEN	2	5	10	Yes
IMIDACLOPRID	2	5	10	Yes
CYPERMETHRIN	2	5	10	Yes
FENAMIDONE	3	3	9	No[1]

Notes for exclusion:
[1]Analytical method not currently available.

Table 3. Pesticide Prioritization for Surface Water Monitoring in Alamo River and New River in Imperial County. Ranking of Pesticides Based on Average Use Data from August through October of 2014–2016.

Alamo River, Drainage Area = 1,264 km^2

Chemical	**Use score**	**Tox score**	**Final score**	**Monitoring inclusion**
CHLORPYRIFOS	5	6	30	Yes
IMIDACLOPRID	4	5	20	Yes
TRIFLURALIN	3	4	12	Yes
ESFENVALERATE	2	6	12	Yes
MALATHION	2	6	12	Yes
PERMETHRIN	2	6	12	Yes
CYPERMETHRIN	2	5	10	Yes
METHOXYFENOZIDE	3	3	9	Yes
PENDIMETHALIN	2	4	8	Yes
METHOMYL	2	4	8	Yes
LAMBDA-CYHALOTHRIN	1	7	7	Yes
BENSULIDE	3	2	6	Yes
DIMETHOATE	2	3	6	Yes
CYFLUTHRIN	1	6	6	Yes

New River, Drainage Area = 1,729 km^2

Chemical	**Use score**	**Tox score**	**Final score**	**Monitoring inclusion**
CHLORPYRIFOS	4	6	24	Yes
IMIDACLOPRID	3	5	15	Yes
TRIFLURALIN	3	4	12	Yes
PENDIMETHALIN	3	4	12	Yes
PERMETHRIN	2	6	12	Yes
ESFENVALERATE	2	6	12	Yes
BENSULIDE	5	2	10	Yes
CYPERMETHRIN	2	5	10	Yes
BENEFIN	3	3	9	Yes
METHOMYL	2	4	8	Yes
CHLORANTRANILIPROLE	2	4	8	Yes
LAMBDA-CYHALOTHRIN	1	7	7	Yes

Table 4. Pesticide Prioritization for Surface Water Monitoring in Salinas River and Tembladero Slough in Monterey County. Ranking of Pesticides Based on Average Use Data from May through November of 2014–2016.

Salinas River, Drainage Area = 11,082 km^2

Chemical	Use score	Tox score	Final score	Monitoring inclusion
PERMETHRIN	3	6	18	Yes
MALATHION	3	6	18	Yes
METHOMYL	4	4	16	Yes
IMIDACLOPRID	3	5	15	Yes
PARAQUAT DICHLORIDE	3	5	15	No[1]
LAMBDA-CYHALOTHRIN	2	7	14	Yes
BENSULIDE	5	2	10	Yes
OXYFLUORFEN	2	5	10	Yes
GLUFOSINATE-AMMONIUM	3	3	9	No[2]
CYPRODINIL	3	3	9	Yes
PYRACLOSTROBIN	2	4	8	Yes
PROMETRYN	2	4	8	Yes
FENAMIDONE	2	3	6	No[2]
QUINOXYFEN	2	3	6	Yes

Tembladero Slough, Drainage Area = 291 km^2

Chemical	Use score	Tox score	Final score	Monitoring inclusion
MALATHION	5	6	30	Yes
PERMETHRIN	3	6	18	Yes
METHOMYL	4	4	16	Yes
BIFENTHRIN	2	6	12	Yes
IMIDACLOPRID	2	5	10	Yes
PCNB	3	3	9	No[2]
CYPRODINIL	3	3	9	Yes
PYRACLOSTROBIN	2	4	8	Yes
PROMETRYN	2	4	8	Yes
LAMBDA-CYHALOTHRIN	1	7	7	Yes

Notes for exclusion:
[1]Low detection frequencies statewide (less than 1 % detection in 1828 samples; SURF database, 2016) from monitoring results in previous years.
[2]Analytical method not currently available.

Table 5. Pesticide Prioritization for Surface Water Monitoring in Orcutt Creek and Oso Flaco Creek in Santa Barbara and San Luis Obispo Counties. Ranking of Pesticides Based on Average Use Data from May through November of 2014–2016.

Orcutt Creek, Drainage Area = 301 km^2

Chemical	Use score	Tox score	Final score	Monitoring inclusion
MALATHION	5	6	30	Yes
IMIDACLOPRID	4	5	20	Yes
OXYFLUORFEN	3	5	15	Yes
PROMETRYN	3	4	12	Yes
METHOMYL	3	4	12	Yes
PERMETHRIN	2	6	12	Yes
BIFENTHRIN	2	6	12	Yes
FENPROPATHRIN	2	5	10	Yes
CYPRODINIL	3	3	9	Yes
PYRACLOSTROBIN	2	4	8	Yes
LINURON	2	4	8	No[1]
TRIFLURALIN	2	4	8	Yes
LAMBDA-CYHALOTHRIN	1	7	7	Yes

Oso Flaco Creek, Drainage Area = 51 km^2

Chemical	Use score	Tox score	Final score	Monitoring inclusion
MALATHION	5	6	30	Yes
IMIDACLOPRID	4	5	20	Yes
OXYFLUORFEN	3	5	15	Yes
PYRACLOSTROBIN	3	4	12	Yes
BIFENTHRIN	2	6	12	Yes
PERMETHRIN	2	6	12	Yes
FENPROPATHRIN	2	5	10	Yes
CYPRODINIL	3	3	9	Yes
FENHEXAMID	4	2	8	No[1]

Notes for exclusion:
[1]Analytical method not currently available.

Table 6. Reporting Limit and Method Detection Limit for Pesticides Monitored in 2019.

Analytic Screen	Pesticide	Method Detection Limit (µg/L)	Reporting Limit (µg/L)
Liquid chromatograph multi-analyte screen (LC)*	Atrazine	0.004	0.02
	Azoxystrobin	0.004	0.02
	Bensulide	0.004	0.02
	Carbaryl	0.004	0.02
	Chlorantraniliprole	0.004	0.02
	Chlorpyrifos	0.004	0.02
	Cyprodinil	0.004	0.02
	Diflubenzuron	0.004	0.02
	Dimethoate	0.004	0.02
	Diuron	0.004	0.02
	Hexazinone	0.004	0.02
	Imidacloprid	0.004	0.01
	Indoxacarb	0.004	0.02
	Malathion	0.004	0.02
	Methomyl	0.004	0.02
	Methoxyfenozide	0.004	0.02
	Oryzalin	0.004	0.02
	Prometryn	0.004	0.02
	Propargite	0.004	0.02
	Pyraclostrobin	0.004	0.02
	Quinoxyfen	0.004	0.02
	Simazine	0.004	0.02
	S-Metolachlor	0.004	0.02
	Trifloxystrobin	0.004	0.02
Dinitroanilines and Oxyfluorfen (DN/OX)	Benfluralin (*Benefin*)	0.014	0.05
	Ethalfluralin	0.015	0.05
	Oxyfluorfen	0.01	0.05
	Pendimethalin	0.012	0.05
	Prodiamine	0.012	0.05
	Trifluralin	0.014	0.05
Pyrethroids (PY) - Water	Bifenthrin	0.00091	0.001
	Lambda-cyhalothrin	0.00174	0.002
	Permethrin	0.00105	0.002
	Cyfluthrin	0.00146	0.002
	Cypermethrin	0.00154	0.005
	Fenpropathrin	0.00132	0.005
	Fenvalerate/esfenvalerate	0.00166	0.005

		Method Detection Limit (ng/g dry wt)	Reporting Limit (ng/g dry wt)
Pyrethroids (PY) - Sediment	Bifenthrin	0.1083	1
	Lambda-cyhalothrin	0.1154	1
	Permethrin	0.1159	1
	Cyfluthrin	0.183	1
	Cypermethrin	0.107	1
	Fenpropathrin	0.1094	1
	Esfenvalerate/fenvalerate	0.143	1

*Additional analytes may be included in the LC screen as methods become available. These include: acetamiprid, boscalid, dinotefuran, fenamidone, fenhexamid, fludioxinil, mefonoxam, nithiazine, tebuconazole, thiabendazole, thiacloprid, and thiamethoxam.

Table 7. Reporting Limit and Method Detection Limit for Pesticides Monitored in 2019. The LC-Full Screen will be conducted at a subset of sampling locations throughout the year.

Analytic Screen	Pesticide	Method Detection Limit (µg/L)	Reporting Limit (µg/L)
Liquid chromatograph multi-analyte screen (LC) - Full	Abamectin	0.004	0.02
	Atrazine	0.004	0.02
	Azoxystrobin	0.004	0.02
	Bensulide	0.004	0.02
	Bromacil	0.004	0.02
	Carbaryl	0.004	0.02
	Chlorantraniliprole	0.004	0.02
	Chlorpyrifos	0.004	0.02
	Cyprodinil	0.004	0.02
	Diazinon	0.004	0.02
	Diflubenzuron	0.004	0.02
	Dimethoate	0.004	0.02
	Diuron	0.004	0.02
	Ethoprop	0.004	0.02
	Hexazinone	0.004	0.02
	Imidacloprid	0.004	0.01
	Indoxacarb	0.004	0.02
	Isoxaben	0.004	0.02
	Malathion	0.004	0.02
	Methidathion	0.004	0.02
	Methomyl	0.004	0.02
	Methoxyfenozide	0.004	0.02
	Metribuzin	0.004	0.02
	Norflurazon	0.004	0.02
	Oryzalin	0.004	0.02
	Oxadiazon	0.004	0.02
	Prometon	0.004	0.02
	Prometryn	0.004	0.02
	Propanil	0.004	0.02
	Propargite	0.004	0.02
	Propiconazole	0.004	0.02
	Pyraclostrobin	0.004	0.02
	Pyriproxyfen	0.004	0.015
	Quinoxyfen	0.004	0.02

Simazine	0.004	0.02
S-Metolachlor	0.004	0.02
Tebufenozide	0.004	0.02
Thiobencarb	0.004	0.02
Trifloxystrobin	0.004	0.02
Fipronil	0.004	0.01
Fipronil Amide	0.004	0.01
Fipronil Sulfide	0.004	0.01
Fipronil Sulfone	0.004	0.01
Desulfinyl Fipronil	0.004	0.01
Desulfinyl Fipronil Amide	0.004	0.01

Table 8. Number of Samples Collected for Pesticide Analyses for the County or Counties and Associated Budget from April–November, 2019.

Analyte Group[A]	April	May	July	September	October	November	Total samples	Cost Per	Total Cost Per
	Imperial	Central Coast[1]			Imperial	Central Coast[1]	(n)	Sample	Analyte Group
LC-Screen	6	10	5	10	4	5	40	1,700	68,000
LC-Full			5		2	5	12	2,500	30,000
DN/OX	6	10	10	10	6	10	52	840	43,680
PY-Water	6	10	10	10	6	10	52	600	31,200
PY-Sediment				10	6		16	600	9,600
Overall	**18**	**30**	**30**	**40**	**24**	**30**	**172**	**4,540***	**182,480**

[A] LC-Screen = Liquid chromatograph multi-analyte screen (24 AIs); LC-Full = similar to LC-Screen, but includes 47 analytes; DN/OX = Dinitroaniline & Oxyfluorfen; PY = Pyrethroid.
[1]Central Coast = Monterey, Santa Barbara and San Luis Obispo counties.
*10% of the equivalent total samples collected will be used for QA/QC.
**Cost based on inclusion of the LC-Full rather than the LC-Screen.
Numbers under each month represent the total number of samples collected for each analyte or analyte group. One grab sample for each analyte or analyte group will be collected from one site.

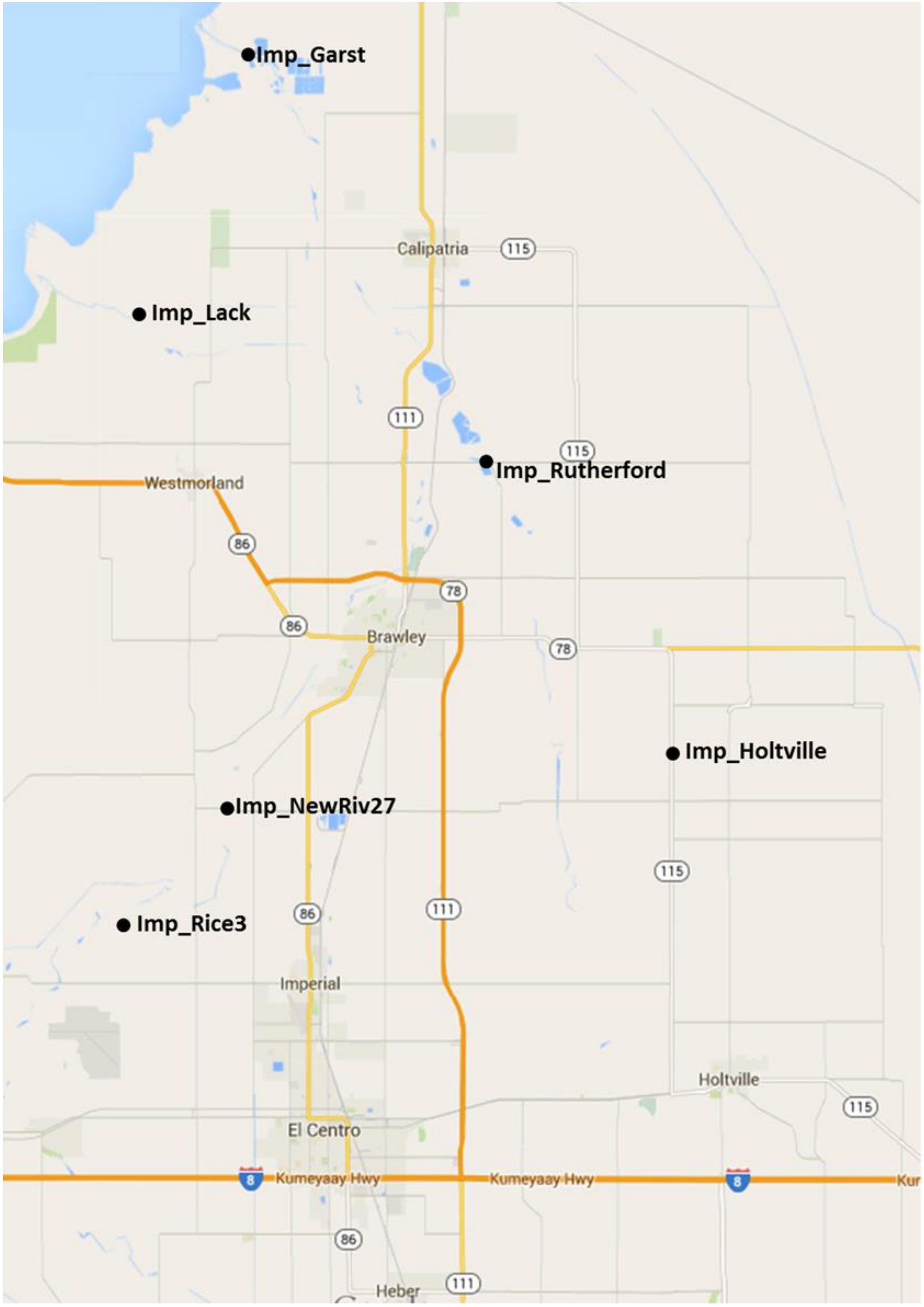

Figure 1. Monitoring Sites in Alamo River and New River in Imperial County.

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

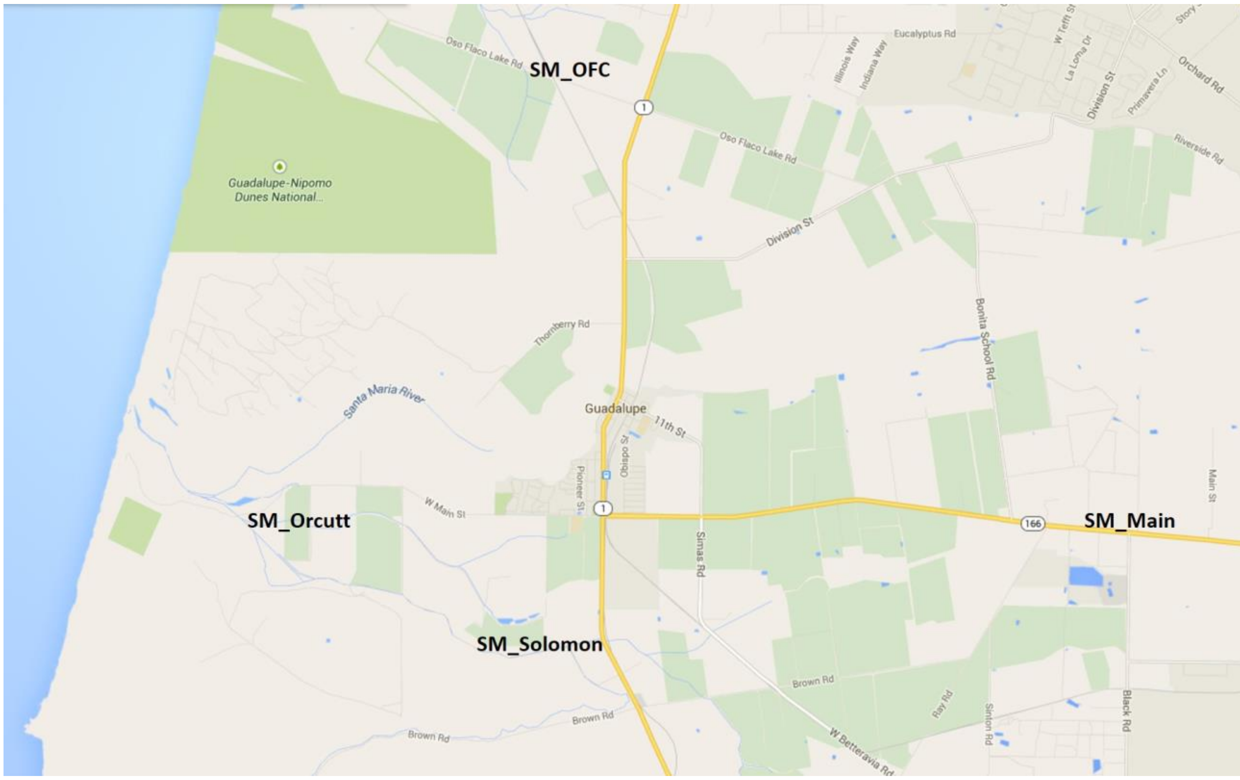

Figure 3. Monitoring Sites in Orcutt Creek and Oso Flaco Creek in Santa Barbara and San Luis Obispo Counties.