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Study 310: Surface Water Monitoring for Pesticides in Agricultural Areas of Northern California, 2018

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1. INTRODUCTION

The California Department of Pesticide Regulation's (CDPR) Surface Water Protection Program (SWPP) regularly monitors for pesticides in urban and agricultural surface waters throughout the state (Budd, 2016; DaSilva, 2016a; Deng, 2017; Ensminger, 2016; Wagner, 2017). Agricultural monitoring has focused on intensively irrigated regions of the Central Coast, Imperial County, and the northernmost part of the state. To expand monitoring sites, CDPR began monitoring in the Sacramento Valley in 2017 (Wagner, 2017). In addition to CDPR's monitoring in the Sacramento Valley, there are two other major monitoring programs in the region: the Sacramento Valley Water Quality Coalition (SVWQC) and the California Rice Commission (CRC). The SVWQC is designed to fulfill Irrigated Land Regulatory Program requirements, as directed through the Central Valley Regional Water Quality Control Board (CVRWQCB) while the CRC program focuses primarily on rice pesticides. Therefore, some pesticides of interest may not be monitored on a regular basis for long-term evaluations. For 2018, CDPR proposes to continue monitoring mostly at the same sites established in 2017 and to monitor more frequently for a broader range of pesticide classes of interest.

CDPR recently developed a watershed prioritization method within the Surface Water Monitoring Prioritization (SWMP) model that systematically ranks watersheds based on pesticide uses at the spatial resolution of the USGS hydrologic unit codes (Luo et al., 2017). The watershed rankings provided by the model helped prioritize our monitoring efforts by identifying watersheds for long-term monitoring. The initial model screening results indicate that many of the current sites monitored by other programs are not in the watersheds identified by the model. Therefore, the monitoring watersheds and sites identified by CDPR could provide data sets that fill the spatial gaps that are not covered by the other monitoring programs. Data from this study will be used to evaluate the spatial and temporal pesticide concentrations in runoff and receiving waters in these agriculturally-dominated regions of Northern California.

According to CDPR's Pesticide Use Reports (PUR), the Sacramento Valley contains watersheds where some of the most intense agricultural pesticide applications occur in Northern California. In these watersheds of high pesticide use, candidate watersheds for monitoring were identified using the watershed prioritization method within the SWMP model (Luo et al., 2017). Watersheds in Colusa, Glenn, Sutter, Solano, Yolo, and Yuba counties were identified by the methodology as candidates for monitoring (Table 1). In keeping with the objectives of this study (stated below), we selected sites within or near the watersheds identified by the prioritization method, but not all prioritized watersheds or represented counties will be monitored. Specific pesticides were then identified for monitoring within each watershed using the pesticide prioritization method within the SWMP model (Luo et al., 2013, 2015).

In the 2017 monitoring conducted by CDPR in the Sacramento Valley, bifenthrin, diflubenzuron, permethrin, and S-metolachlor/metolachlor were detected at concentrations that exceeded their lowest U.S. EPA aquatic life benchmark. The final report and supporting information are available at http://www.cdpr.ca.gov/docs/emon/pubs/ehapreps.htm?filter=surfwater. Further monitoring for thiobencarb was conducted by CRC at Willow Creek and Bounde Creek between April and July of 2017. Based on the results from CRC monitoring, the highest concentrations of thiobencarb were detected in late May.

2. OBJECTIVES

The objectives of the study are to:

1) Prioritize pesticide monitoring candidates (i.e., active ingredients and degradates) based on current use reports and toxicity benchmarks at the watershed level;
2) Determine the presence and concentrations of selected pesticides in surface waters and sediments of selected monitoring regions;
3) Analyze chemistry data to evaluate potential impacts on aquatic life by comparing concentrations with the U.S. EPA aquatic life benchmarks;
4) Analyze spatial correlations between observed pesticide concentrations/detection frequencies and region-specific pesticide uses; and
5) Assess multiple years of data to characterize patterns and trends in detection frequencies and benchmark exceedances.

3. PERSONNEL

The study will be conducted by SWPP staff under the general direction of Nan Singhasemanon, Environmental Program Manager I. Key personnel are listed below:

- Project Leader: Scott Wagner
- Field Coordinator: KayLynn Newhart
- Reviewing Scientist: Xin Deng, Ph.D.
- Statistician: Dan Wang, Ph.D.
- Laboratory Liaison: Sue Peoples
- Analytical Chemistry, water: Center for Analytical Chemistry, California Department of Food and Agriculture (CDFA)

Please direct questions regarding this study to Scott Wagner, Environmental Scientist, at 916-324-4087 or Scott.Wagner@cdpr.ca.gov.

4. STUDY PLAN

4.1. Selection of monitoring sites

Monitoring sites were selected within or near watersheds that were identified by the site prioritization methodology. Specific sites were selected after field scouting trips to the sites to determine ease of access, water flow, and nearby land use. Not all watersheds that appeared in the site prioritization list were selected for monitoring due to accessibility issues or concerns about water flow during the dry summer months. A total of eight sites will be monitored in Colusa, Solano, Yolo, and Yuba counties (Figures 1–5; Table 2). Selected sites include a combination of tributaries, drainage canals, and main waterways that meet the objectives of the study and allow for source identification should there be detections at these sites. All selected monitoring sites were previously included in the 2017 monitoring study.

4.2. Selection of pesticides

Results from CDPR's SWMP model were used as a guide in selecting pesticides for monitoring (Luo et al., 2013, 2015). A range of pesticide classes were identified by the model for each watershed (Tables 3–8). The prioritized lists for each watershed were combined into one list. As a result, each of the selected sites will be monitored for the same suite of pesticides.

Active ingredients, for the four counties and selected watersheds, were chosen based on the following criteria:

1. Pesticides with a final ranking score ≥9 are of high priority and were considered for monitoring. Those with a final score <9 are considered low priority due to low use score (use score <2) and/or low toxicity (toxicity score <3).
2. Pesticides with a use score ≥2 were considered for monitoring. Pesticides that were not in the priority list or had use scores <2 may be analyzed because they were in the multi-residue analytical methods that are being used.
3. Pesticides that were ranked very low by the model are not included in the final monitoring list (Table 9) unless they are in the chosen analytical method groups. Historical monitoring data and/or current availability of analytical methods at the CDFA lab were additional factors to help arrive at a final list for monitoring.

4.3. Sediment Sampling.

Sediment samples will be collected at 3 sites: Stone Corral Creek, Colusa Basin Drain, and Sweany Creek at Weber Road. Sediment from creek and riverbeds will be collected according to the protocol in Mamola, 2005 (http://www.cdpr.ca.gov/docs/emon/pubs/sops/fswa016.pdf). Sediment samples will be collected in July 2018.

4.4. Toxicity.

Water samples will be collected from a subset of sampling sites and sent to the University of California, Davis, Aquatic Health Program Laboratory, to be tested for mortality/survival on *Hyalella azteca* and *Chironomus dilutus*. Since this is the first year of toxicity testing for this study, we will start with a survey of the major drainage points such as Colusa Basin Drain and Sweany Creek at Weber Rd. Pending results from this first round of toxicity testing, we will then narrow the focus of toxicity sampling to better identify areas of concern.

4.5. Sampling plan

There will be three surface water sampling events at each site in 2018: one event each in May, July and September. Events will be coordinated with rice field water release and peak irrigation events. At each site, surface water grab samples will be collected into 1-liter amber glass bottles. Samples will be transported on ice and stored in a refrigerator (4°C) until analyzed. CDPR staff will transport samples following procedures outlined in CDPR SOP QAQC004.01 (Jones, 1999). A chain-of-custody record will be completed for each sample.

4.6. Protocol Revisions

This 2018 revised protocol incorporates some changes based on experience and feedback from monitoring conducted under the 2017 protocol (Appendix 1). Below, we elaborate on some of those changes and explain the reasoning behind revising the protocol.

1. *Malathion samples will not be acidified:* The malathion sampling procedure for the 2017 study involved acidifying the sample to prevent the decay of malathion in ambient water. The other malathion sampling procedure does not involve acidification of the sample water and thus does not require a separate analytical screen. To free up room in the budget for other elements of the monitoring plan while continuing to collect malathion data, we will use the non-acidification sampling procedure for the 2018 study. This non-acidification procedure is also used in SWPP's urban surface water monitoring studies. During the September sampling event in 2017 for Northern California agricultural monitoring, paired non-acidified and acidified samples were taken for malathion at each of ten sampling sites to compare results. The sample results for all sites were in agreement. Note that detections of malathion were infrequent in 2017; when detected, samples contained low concentrations.

2. *Two sites with infrequent detections will be dropped*: Samples will no longer be collected at two sites from the 2017 study—Meridian Road and Midway Road sites, southwest of Dixon, Calif. Since 2017 results showed infrequent detections at these sites, resources for 2018 will be shifted away from these sites. In this monitoring region southwest of Dixon, we will maintain the Sweany Creek at Weber Road site, which is downstream of Meridian and Midway Road; thus, monitoring in this area near Dixon is expected to still capture pesticide runoff.

3. *Addition of a May sampling event*: CRC pesticide monitoring in 2017 took place between May and July, with sampling occurring at least weekly. The CDPR monitoring program shared two sites with the CRC program at Willow Creek at Norman Road and Bounde Creek at Norman Road. CRC monitoring results from these two sites show that peak thiobencarb detections occurred in late May. In order to better capture runoff

associated with peak pesticide concentrations, the monitoring protocol for this year will add a sampling event in May to all sites, which will also enrich temporal characterization of pesticides in the region.

5. LABORATORY ANALYSES

5.1. Chemical Analysis

The Center for Analytical Chemistry, CDFA will conduct the chemical analyses for this study. The lab will utilize four pesticide screens, which includes 36 chemical compounds in surface water and 5 compounds in sediment (Table 9). The Liquid Chromatography (LC) short screen used by the CDFA analytical laboratory has the ability to analyze for a variety of compounds from different pesticide classes (Table 10). The method detection limit and reporting limit for each analyte are listed as well (Table 11 and 12). Laboratory QA/QC will follow CDPR guidelines provided in the Standard Operating Procedure QAQC001.00 (Segawa, 1995). Extractions will include laboratory blanks and matrix spikes. The analytical methods, method detection limits, reporting limits, QA/QC results and detected compounds will be reported by the lab for each sample set.

5.2. 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.

6. DATA ANALYSIS

Concentrations of pesticides in water will be reported as micrograms per liter (µg/L)/parts per billion (ppb) or nanograms per liter (ng/L)/parts per trillion (ppt). Concentrations of pesticides in sediment will be reported as $ng*g^{-1}$ dry weight. Data from this study will be stored in a Microsoft Office Access database that holds all field measurements and lab data. Ultimately, the data will be uploaded to CDPR's publicly-available Surface Water Database (SURF). Pesticide concentrations will be evaluated against aquatic life toxicity benchmarks, water quality limits or other toxicity data (US EPA, 2018; CCVRWQCB, 2012). Patterns and trends in detections may be identified as data from multiple years of monitoring accumulate in the database.

7. TIMETABLE

Field Sampling: May 2018 – September 2018
Chemical Analysis: May 2018 – October 2018
Summary Report: March 2019
SURF Data Upload: April 2019

8. LABORATORY BUDGET

The expected cost for chemical analysis of samples through the CDFA lab is $87,180 (Table 13). This estimate includes laboratory QC samples.

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Table 1. Watersheds identified by the SWMP model as candidates for monitoring. This list was considered when selecting final sites for monitoring.

HUC	HUCNAME	type
18020163:		
180201630502	Gibson Canyon Creek-Sweany Creek	mainstem
180201630102	Lamb Valley Slough-South Fork Willow Slough	mainstem
180201630203	South Fork Ditch-Willow Slough	mainstem
180201630501	McCune Creek-Sweany Creek	tributary
180201630301	Knights Landing Ridge Cut	tributary
180201630602	Tremont School	tributary
18020104:		
180201040703	Salt Creek	mainstem
180201040203	Lower Walker Creek	mainstem
180201040504	Lower Logan Creek	mainstem
180201041201	Deadmans Reach-Sacramento River	tributary
180201041008	Smith Creek-Colusa Basin Drainage Canal	tributary
180201041003	Clarks Ditch-Colusa Basin Drainage Canal	tributary
18020159:		
180201590400	Gilsizer Slough-Snake River	tributary
180201590107	Wilson Creek-North Honcut Creek	tributary
180201590502	Ellis Lake-Feather River	tributary
180201590107	Wilson Creek-North Honcut Creek	mainstem
180201590302	Reeds Creek	mainstem

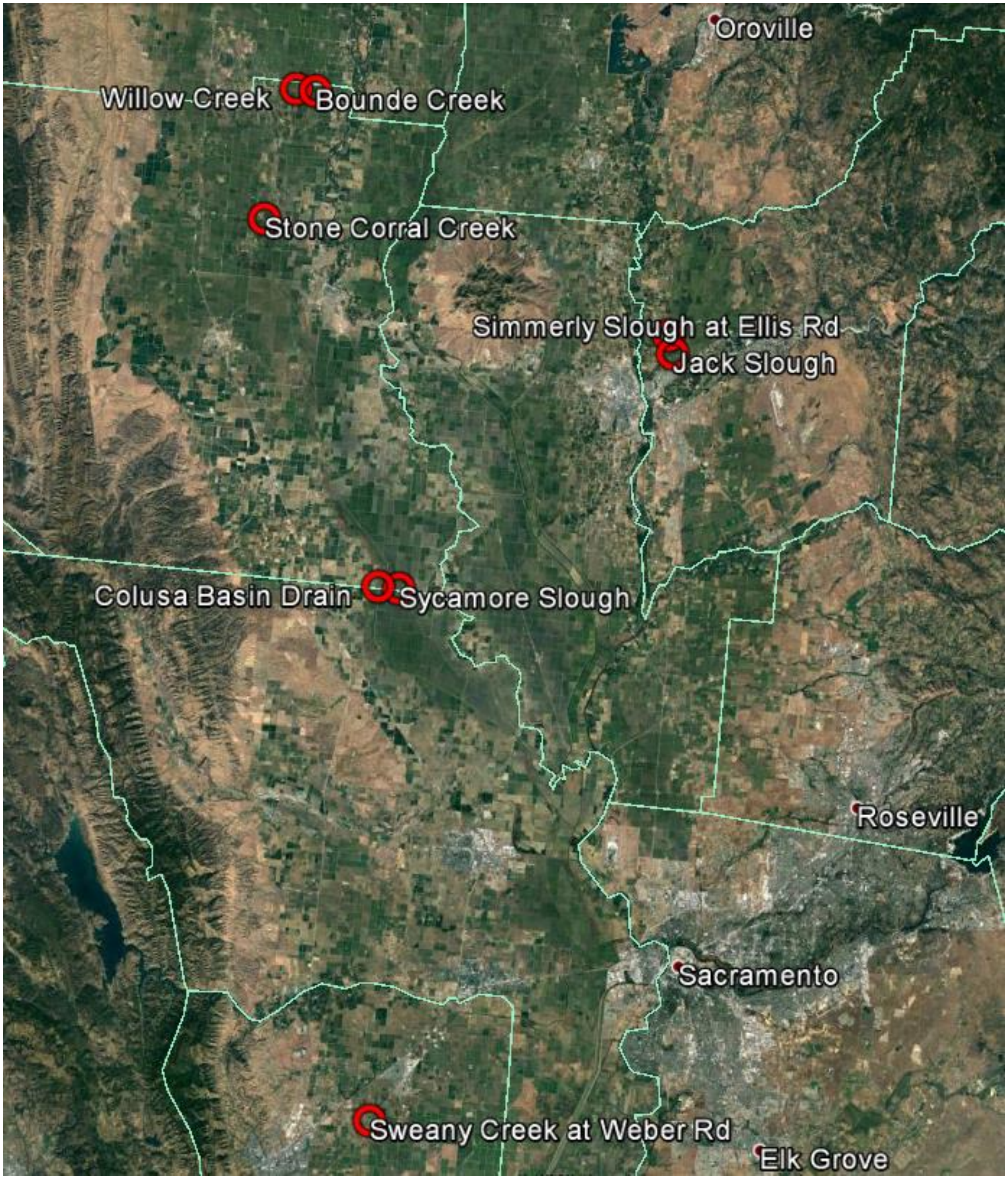

Figure 1. Monitoring sites in Colusa, Yuba, Yolo, and Solano counties, Calif.

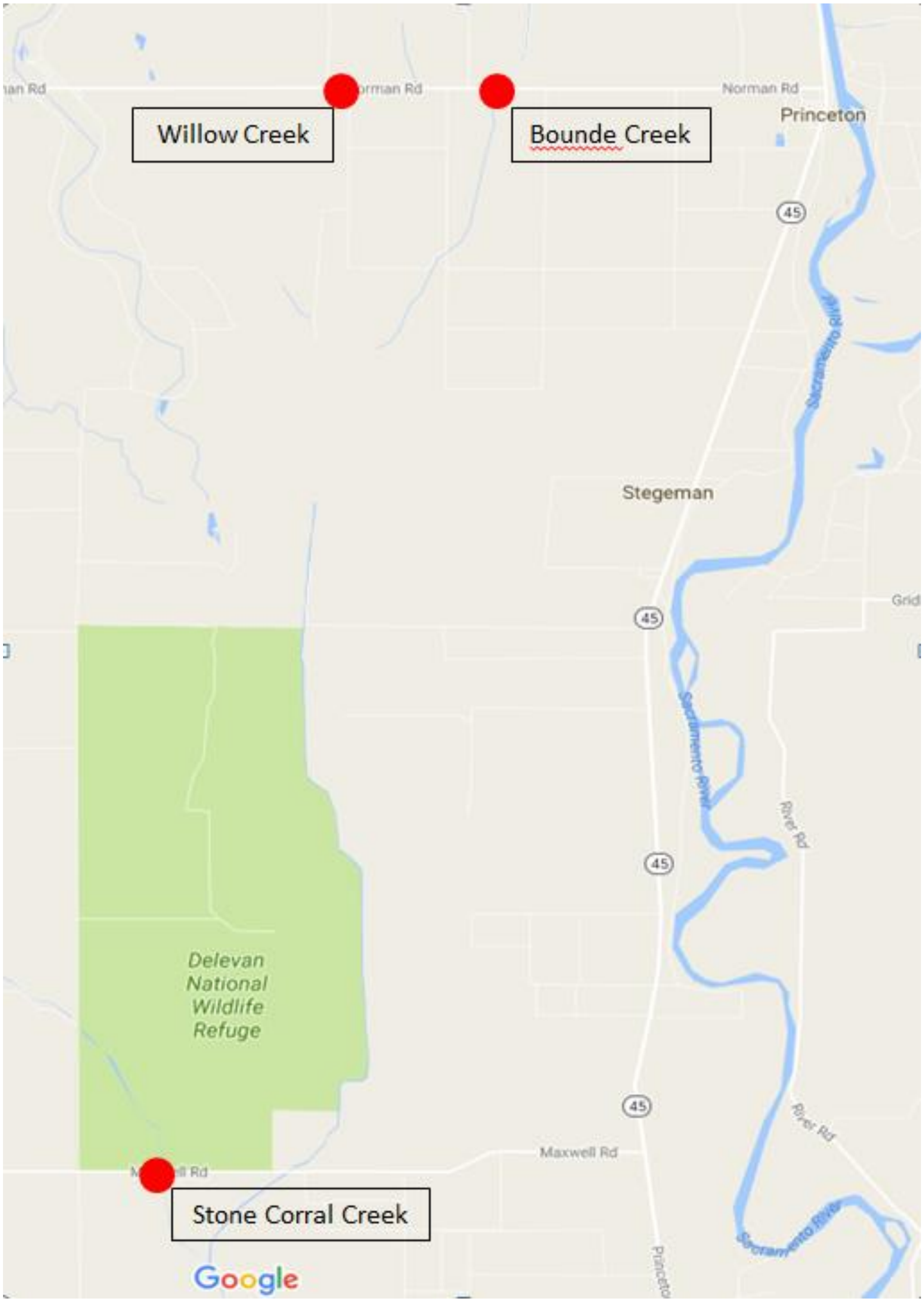

Figure 2. Monitoring sites in Colusa County, Calif.

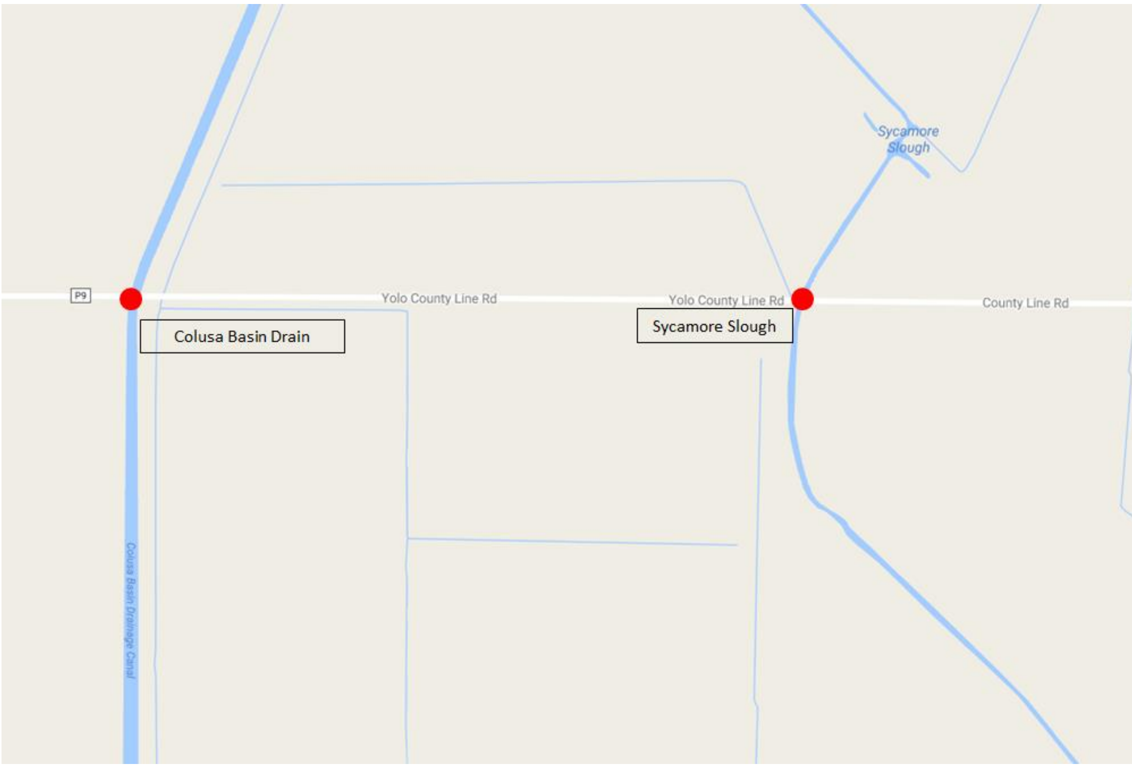

Figure 3. Monitoring sites in Yolo County, Calif.

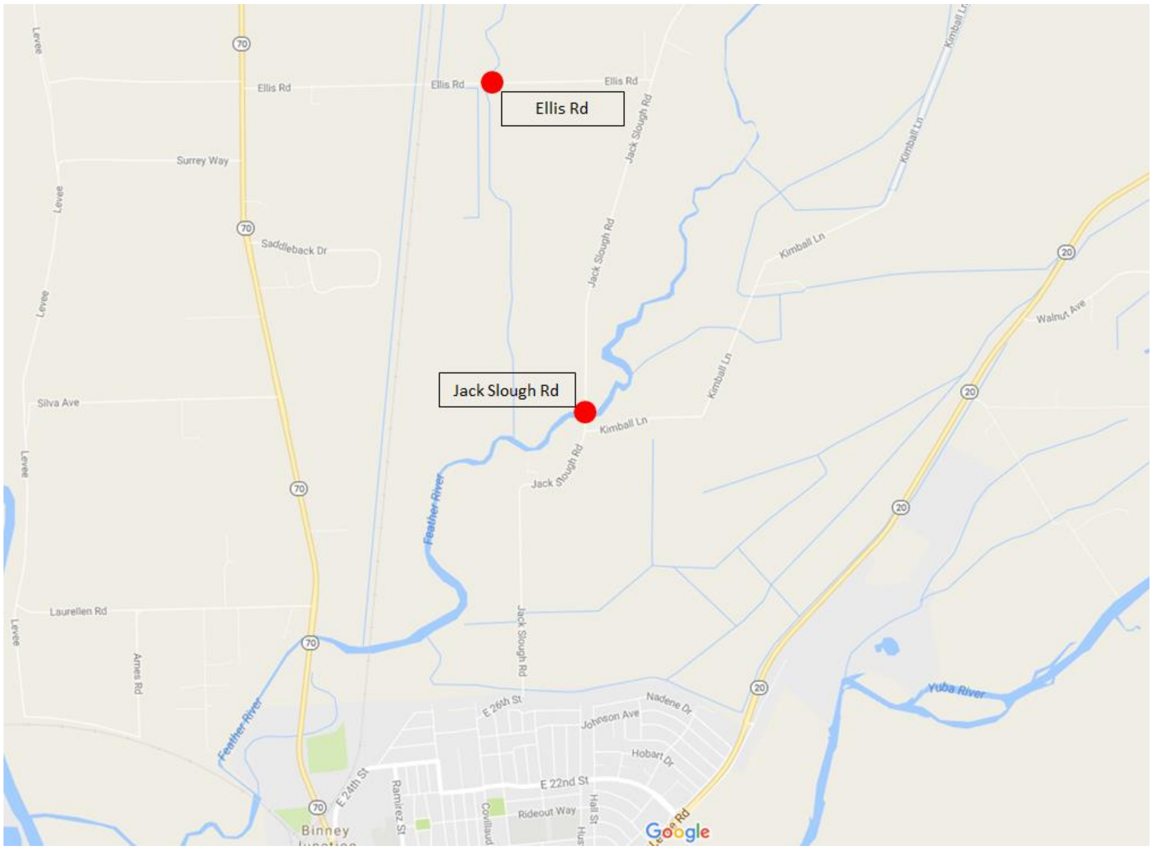

Figure 4. Monitoring sites in Yuba County, Calif.

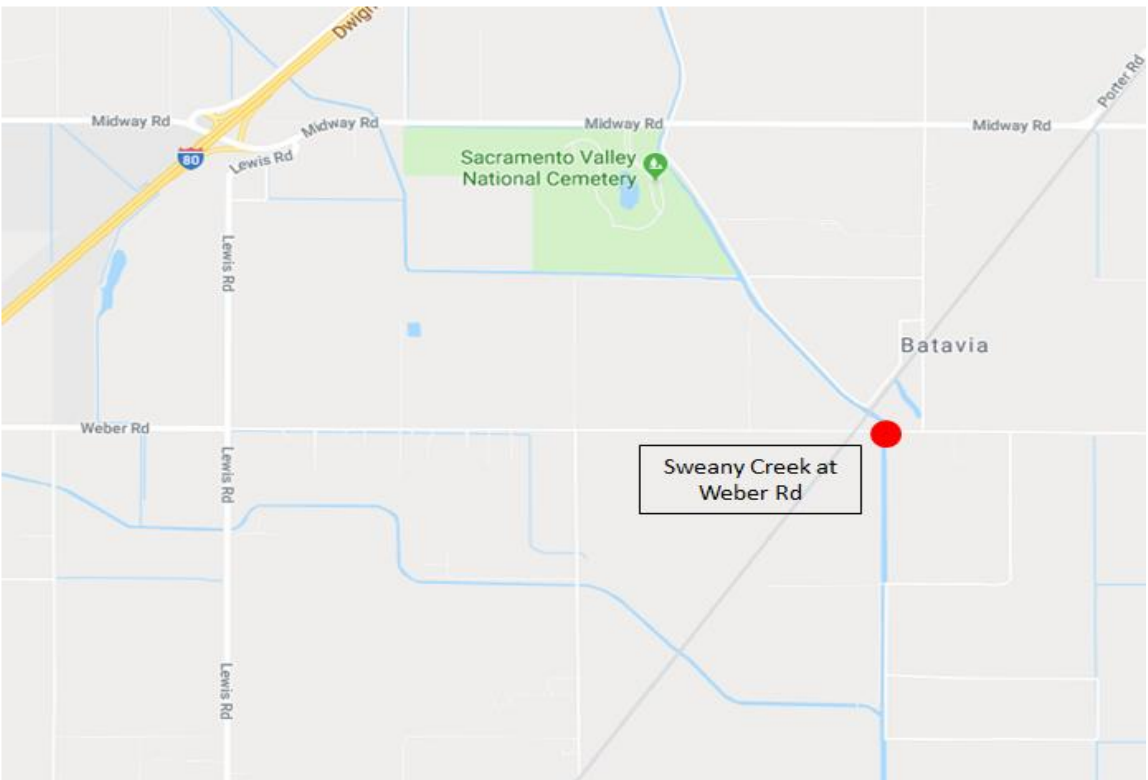

Figure 5. Monitoring site in Solano County, Calif.

Table 2. Description of sampling sites for Northern California in 2018.

Site ID	Site Location	County	Watershed	Latitude	Longitude
Stone Corral Creek	Stone Corral Creek near Maxwell Rd	Colusa	Lower Logan Creek	39.2751	-122.1043
Willow Creek	Willow Creek at Norman Rd		Willow Creek	39.406432	-122.080504
Bounde Creek	Bounde Creek at Norman Rd		Colusa Drain	39.406297	-122.055885
Jack Slough Rd	Jack Slough at Jack Slough Rd	Yuba	Jack Slough	39.180349	-121.571142
Ellis Rd	Simmerly Slough at Ellis Rd			39.198074	-121.578178
CBD	Colusa Basin Drain at County Line Rd	Yolo	Clarks Ditch-Colusa Basin Drain	38.924458	-121.913986
Sycamore Slough	Sycamore Slough at County Line Rd			38.925162	-121.888634
Weber Rd	Sweany Creek at Weber Rd	Solano	Gibson Canyon Creek-Sweany Creek	38.40257	-121.86064

Table 3. Highest scoring pesticides recommended for monitoring using the SWMP model, based on the 2012–2015 pesticide use reports for Lower Logan Creek watershed in Colusa County.

Lower Logan Creek Watershed, Drainage Area= 137 km^2 HUC12: 180201040504				
Active Ingredient	**Use Score**	**Toxicity Score**	**Final Score**	**Does Model Recommend Monitoring?**
PROPANIL	5	3	15	YES
THIOBENCARB	5	3	15	YES
PARAQUAT DICHLORIDE[1]	3	5	15	YES
LAMBDA-CYHALOTHRIN	2	7	14	YES
S-METOLACHLOR	3	4	12	YES
CHLOROTHALONIL[2]	3	4	12	NO
CHLORPYRIFOS	2	6	12	YES
BIFENTHRIN	2	6	12	YES
CARBARYL	2	5	10	YES
AZOXYSTROBIN	3	3	9	YES
PENDIMETHALIN	2	4	8	YES

[1] Analytical method not currently available

[2] Short persistence defined by the prioritization model

Table 4. Highest scoring pesticides recommended for monitoring using the SWMP model, based on the 2012-2015 pesticide use reports for Willow Creek watershed in Colusa County.

Willow Creek Watershed, Drainage Area = 92 km^2 HUC12: 180201040303				
Active Ingredient	**Use Score**	**Toxicity Score**	**Final Score**	**Does Model Recommend Monitoring?**
CHLORPYRIFOS	3	6	18	YES
PROPANIL	5	3	15	YES
THIOBENCARB	5	3	15	YES
MALATHION	3	5	15	YES
PARAQUAT DICHLORIDE[1]	3	5	15	YES
LAMBDA-CYHALOTHRIN	2	7	14	YES
AZOXYSTROBIN	4	3	12	YES
PENDIMETHALIN	3	4	12	YES

[1] Analytical method not currently available

Table 5. Highest scoring pesticides recommended for monitoring using the SWMP model, based on the 2012-2015 pesticide use reports for Colusa Drain watershed in Colusa County.

Colusa Drain Watershed, Drainage Area = 321 km^2 HUC12: 180201040400				
Active Ingredient	**Use Score**	**Toxicity Score**	**Final Score**	**Does Model Recommend Monitoring?**
ZIRAM[1]	5	4	20	NO
CHLORPYRIFOS	3	6	18	YES
CHLOROTHALONIL[1]	4	4	16	NO
PENDIMETHALIN	4	4	16	YES
PROPANIL	5	3	15	YES
THIOBENCARB	5	3	15	YES
PARAQUAT DICHLORIDE[2]	3	5	15	YES
OXYFLUORFEN	3	5	15	YES
MALATHION	2	5	10	YES

[1] Short persistence defined by the prioritization model

[2] Analytical method not currently available

Table 6. Highest scoring pesticides recommended for monitoring using the SWMP model, based on 2012–2015 pesticide use reports for Clarks Ditch-Colusa Basin Drain watershed in Yolo County.

Clarks Ditch-Colusa Basin Drain Watershed, Drainage Area = 152 km^2 HUC12: 180201041003				
Active Ingredient	**Use Score**	**Toxicity Score**	**Final Score**	**Does Model Recommend Monitoring?**
CHLOROTHALONIL[1]	5	4	20	NO
ZIRAM[1]	5	4	20	NO
OXYFLUORFEN	4	5	20	YES
BIFENTHRIN	3	6	18	YES
PENDIMETHALIN	4	4	16	YES
PARAQUAT DICHLORIDE[2]	3	5	15	YES
MANCOZEB[1]	4	3	12	NO
PROPANIL	4	3	12	YES
PYRACLOSTROBIN	3	4	12	YES
TRIFLURALIN	3	4	12	YES

[1] Short persistence defined by the prioritization model

[2] Analytical method not currently available

Table 7. Highest scoring pesticides recommended for monitoring using the SWMP model, based on the 2012–2015 pesticide use reports for Jack Slough watershed in Yuba County.

Jack Slough Watershed, Drainage Area = 134 km^2 HUC12: 180201590501				
Active Ingredient	**Use Score**	**Toxicity Score**	**Final Score**	**Does Model Recommend Monitoring?**
PROPANIL	5	3	15	YES
CARBARYL	3	5	15	YES
LAMBDA-CYHALOTHRIN	2	7	14	YES
THIOBENCARB	4	3	12	YES
CHLOROTHALONIL[1]	3	4	12	NO
PENDIMETHALIN	3	4	12	YES
CLOMAZONE[2]	5	2	10	NO
AZOXYSTROBIN	3	3	9	YES
MALATHION	1	5	5	YES

[1] Short persistence defined by the prioritization model

[2] Low soil runoff potential, based on vapor pressure, as defined by the prioritization model

Table 8. Highest scoring pesticides recommended for monitoring using the SWMP model, based on the 2012–2015 pesticide use reports for Gibson Canyon Creek-Sweany Creek watershed in Solano County.

Gibson Canyon Creek-Sweany Creek, Drainage Area = 46 km^2 HUC12: 180201630502				
Active Ingredient	**Use Score**	**Toxicity Score**	**Final Score**	**Does Model Recommend Monitoring?**
PARAQUAT DICHLORIDE[1]	5	5	25	YES
CHLORPYRIFOS	3	6	18	YES
PENDIMETHALIN	4	4	16	YES
OXYFLUORFEN	3	5	15	YES
ORYZALIN	4	3	12	YES
S-METOLACHLOR	3	4	12	YES
CHLOROTHALONIL[2]	3	4	12	NO
BIFENTHRIN	2	6	12	YES
DIAZINON	2	5	10	YES
MALATHION	1	5	5	YES

[1] Analytical method not currently available

[2] Short persistence defined by the prioritization model

Table 9. Pesticides in the pyrethroid, dinitroaniline and malathion analytical methods used by the CDFA lab.

Liquid Chromatography Screen (LC) short	Pyrethroid Screen (PYR) for surface water samples	Dinitroaniline Screen (DN)	Pyrethroid Screen for sediment samples
(See Table 10)	Bifenthrin Permethrin cis Permethrin trans Cypermethrin Lambda-cyhalothrin Esfenvalerate/fenvalerate	Benfluralin Ethalfluralin Oryzalin Oxyfluorfen Pendimethalin Prodiamine Trifluralin	Bifenthrin Permethrin cis Permethrin trans Cypermethrin Lambda-cyhalothrin Esfenvalerate/fenval.

Table 10. Analytes included in the LC Screen (short).

Abamectin Atrazine Azoxystrobin Carbaryl Chlorantraniliprole Chlorpyrifos Cyprodinil Diazinon Diflubenzuron	Dimethoate Diuron Hexazinone Imidacloprid Malathion Methidathion Propanil Propargite Propiconazole Pyraclostrobin Pyriproxyfen	Simazine S-Metolachlor Thiobencarb Trifloxystrobin

Table 11. Reporting limit and method detection limit for pesticides monitored in 2018

Analytical Screen	**Analyte**	**Method Detection Limit (µg/L)**	**Reporting Limit (µg/L)**
Liquid chromatography multi-analyte screen (LC)	Abamectin	0.004	0.02
	Atrazine	0.004	0.02
	Azoxystrobin	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
	Hexazinone	0.004	0.02
	Imidacloprid	0.004	0.01
	Malathion	0.004	0.02
	Methidathion	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
	Simazine	0.004	0.02
	S-Metolachlor	0.004	0.02
	Thiobencarb	0.004	0.02
	Trifloxystrobin	0.004	0.02
Pyrethroid Screen (PYR)	Bifenthrin	0.00091	0.001
	Permethrin (cis)	0.00105	0.002
	Permethrin (trans)	0.00106	0.005
	Cypermethrin	0.00154	0.005
	Lambda-cyhalothrin	0.00174	0.002
	Esfenvalerate/fenvalerate	0.00166	0.005
Dinitroaniline Screen (DN)	Benfluralin	0.012	0.05
	Ethalfluralin	0.015	0.05
	Oryzalin	0.021	0.05
	Oxyfluorfen	0.01	0.05
	Pendimethalin	0.012	0.05
	Prodiamine	0.012	0.05
	Trifluralin	0.014	0.05

Table 12. Chemical analysis of pyrethroids in Northern California agricultural monitoring Study 310. The Department of Food and Agriculture will analyze sediment samples.

Pesticide	Method Detection Limit (ng g^{-1} dry weight)	Reporting Limit (ng g^{-1} dry weight)
Bifenthrin	0.1083	1.0
Cypermethrin	0.107	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

Table 13. Analytical cost estimate for agricultural samples for Northern California, 2018.

Analytical Screen	**Total Samples***	**Cost per sample**	**Cost estimate**
LC screen (short)	27	$1,700	$45,900
Pyrethroid screen	27	$600	$16,200
Dinitroaniline screen	27	$840	$22,680
Sediment Pyrethroid screen	4	$600	$2,400
Total cost			$87,180

*QC samples included in the total number of samples

Appendix 1. Listed below are modifications for the 2018 protocol (from 2017 Study 310 protocol, http://www.cdpr.ca.gov/docs/emon/pubs/protocol/study310_protocol_maa_response.pdf).

Change from 2017 protocol	Justification
Discontinue sampling at Meridian Rd.	Pesticide detections at this site were infrequent with low concentrations in 2017; to expand other elements of the study like sediment monitoring, monitoring will no longer be conducted at this site
Discontinue sampling at Midway Rd.	Midway Rd. is just upstream of the Sweany Creek at Weber Rd site. We will continue to monitor at Sweany Creek, thus capturing runoff from agricultural sources in the area.
Add a monitoring event in May	Rice Commission monitoring in 2017 showed that the highest detections of rice herbicides were in May. To capture runoff and water pesticide concentrations associated with peak agricultural inputs, we will add a sampling event in May.
Add sediment monitoring	This element of the study was not included in the 2017 plan and there is interest both within CDPR and in stakeholder groups to monitor for pesticides in sediment.
Add toxicity testing	Much like sediment monitoring, this element of the protocol was not in the 2017 plan, but there is interest in CDPR and from stakeholders to better understand the relationship between pesticide concentrations and toxicity in agricultural receiving waters.