May 1, 2017

Pamela Creedon
Central Valley Regional Water Quality Control Board
11020 Sun Center Drive, #200
Rancho Cordova, CA 95670-6114

Dear Ms. Creedon,

The East San Joaquin Water Quality Coalition (ESJWQC) and Westside San Joaquin River Watershed Coalition (WSJRWC) are submitting the 2016 Water Year Annual Monitoring Report (AMR) for the San Joaquin River Chlorpyrifos and Diazinon TMDL Compliance Monitoring for review by the Central Valley Regional Water Quality Control Board (CVRWQCB).

The attached documents report on the monitoring program for the period of October 1, 2015 through September 30, 2016. The report provides an assessment of compliance with the monitoring objectives as described in the Amendments to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Diazinon and Chlorpyrifos Runoff into the Lower San Joaquin River (finalized October 2005).

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for knowingly submitting false information, including the possibility of fine and imprisonment for violations."

This letter will be mailed to the CVRWQCB with an original signature.

Submitted respectfully,

Parry Klassen
Executive Director
East San Joaquin Water Quality Coalition

Joseph C. McGahan
Westside San Joaquin River Watershed Coalition

San Joaquin River Chlorpyrifos and Diazinon 2016 Water Year Annual Monitoring Report

Prepared by the East San Joaquin Water Quality Coalition and the Westside San Joaquin River Watershed Coalition

Submitted to the Central Valley Regional Water Quality Control Board

Reporting period:
October 1, 2015 – September 30, 2016

Report Submitted:
May 1, 2017

MICHAEL L. JOHNSON LLC
ECOSYSTEMS • CONSULTING

TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS

AI	Active Ingredient
AMR	Annual Monitoring Report
CalPIP	California Pesticide Information Portal
CDEC	California Data Exchange Center
CEDEN	California Environmental Data Exchange Network
CIMIS	California Irrigation Management Information System
COC	Chain of Custody
CV RDC	Central Valley Regional Data Center
DO	Dissolved Oxygen
DWR	(California) Department of Water Resources
EPA	Environmental Protection Agency
ESJWQC	East San Joaquin Water Quality Coalition
FB	Field Blank
FD	Field Duplicate
ILRP	Irrigated Lands Regulatory Program
LCS	Laboratory Control Spike
LCSD	Laboratory Control Spike Duplicate
LSJR	Lower San Joaquin River
MDL	Minimum Detection Limit
MLJ-LLC	Michael L. Johnson, LLC
MPM	Management Plan Monitoring
MPUR	Management Plan Update Report
MRP	Monitoring and Reporting Program Order No R5-2008-0831
MRPP	Monitoring and Reporting Program Plan
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NA	Not Applicable
NONPJ	Non-project
OP	Organophosphorus compounds
PR	Percent Recovery
PUR	Pesticide Use Report
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RL	Reporting Limit
RPD	Relative Percent Difference
SAMR	Semi-Annual Monitoring Report
S	Sum loading capacity
SC	Specific Conductance
SM	Standard Methods for the Examination of Water and Wastewater
SWAMP	Surface Water Ambient Monitoring Program
TIE	Toxicity Identification Evaluation
TMDL	Total Maximum Daily Load
USDA	United States Department of Agriculture

USGS	United States Geological Survey
WSJRWC	Westside San Joaquin River Watershed Coalition
WQO	Water Quality Objective
WY	Water Year

LIST OF UNITS

cm	centimeter
cfs	cubic feet per second
°C	degrees Celsius
L	Liter
µg	microgram
µmhos	micromhos
µS	microsiemens
mg	milligram

LIST OF TERMS

Basin Plan – Water Quality Control Plan for the Sacramento River and San Joaquin River Basins, Fourth Edition

Basin Plan Amendment – Amendments to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Diazinon and Chlorpyrifos Runoff into the Lower San Joaquin River (Final Staff Report October 2005)

Coalitions – East San Joaquin Water Quality Coalition and Westside San Joaquin River Watershed Coalition

Drainage – Water that moves horizontally across the surface or vertically into the subsurface from land

ESJWQC region – The region within the Central Valley in which the East San Joaquin Water Quality Coalition is responsible for implementing the Irrigated Lands Regulatory Program (ILRP) on behalf of its members

Not detected – The concentration of a constituent within a sample is below the minimum detection limit

Regional Board – Central Valley Regional Water Quality Control Board

Waterbody – Standing or flowing water of any size that may or may not move into a larger body of water, including lakes, reservoirs, ponds, rivers, streams, tributaries, creeks, sloughs, canals, laterals and drainage ditches

Water Year – The twelve month period from October through September, designated by the calendar year in which it ends and which includes nine of the twelve months

Watershed – The land area that drains into a stream; the watershed for a major river may encompass a number of smaller watersheds that ultimately combine at a common point. [Environmental Protection Agency (EPA) terms of environment: http://www.epa.gov/OCEPAterms/wterms.html)]

WSJRWC region – The region within the Central Valley in which the Westside San Joaquin River Watershed Coalition is responsible for implementing the ILRP on behalf of its members

EXECUTIVE SUMMARY

The Central Valley Regional Water Quality Control Board (Regional Board) developed the Basin Plan Amendment (finalized in October 2005) to establish a Total Maximum Daily Load (TMDL) for the organophosphorus (OP) pesticides chlorpyrifos and diazinon in the lower reaches of the Lower San Joaquin River (LSJR).

The LSJR is divided into seven major subareas (LSJR upstream of Salt Slough, Grassland, East Valley Floor, Northwest side, Merced River, Tuolumne River, and the Stanislaus River) as described in the Amendments to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Diazinon and Chlorpyrifos Runoff into the LSJR (hereafter Basin Plan Amendment). As part of the Basin Plan Amendment, a surveillance and monitoring program is required. The East San Joaquin Water Quality Coalition (ESJWQC) and Westside San Joaquin River Watershed Coalition (WSJRWC) jointly developed a monitoring strategy to comply with the chlorpyrifos and diazinon TMDL seven Monitoring Objectives:

1. Determine compliance with established water quality objectives (WQOs) and the loading capacity applicable to diazinon and chlorpyrifos in the LSJR.
2. Determine compliance with established load allocations for diazinon and chlorpyrifos.
3. Determine the degree of implementation of management practices to reduce off-site movement of diazinon and chlorpyrifos.
4. Determine the effectiveness of management practices and strategies to reduce off-site migration of diazinon and chlorpyrifos.
5. Determine whether alternatives to diazinon and chlorpyrifos are causing surface water quality impacts.
6. Determine whether the discharge causes or contributes to toxicity impairment due to additive or synergistic effects of multiple pollutants.
7. Demonstrate that management practices are achieving the lowest pesticide levels technically and economically achievable.

The monitoring design for the 2016 Water Year (WY) was the same as the design utilized during 2015 WY. During the 2016 WY, monitoring to determine load capacity compliance and monitoring in tributaries to determine load allocation was conducted at all six of the compliance points on the LSJR. The ESJWQC monitored two of the six compliance points (San Joaquin River at Hills Ferry Road, and San Joaquin River at the Maze Boulevard (Highway 132) Bridge) during the January storm monitoring event and from May through September. As part of ESJWQC's participation in the Delta Regional Monitoring Program (RMP), the ESJWQC received approval from the Regional Board to utilize USGS' monitoring results for samples collected at the San Joaquin River at Airport Way near Vernalis. Utilization of these monitoring results provides the ESJWQC with a method for being in compliance in lieu of performing additional monitoring at that site. The USGS monitoring data is being used to demonstrate compliance with the TMDL monitoring requirements in ESJWQC's WDR. The WSJRWC monitored monthly the other three compliance points (San Joaquin River at Sack Dam, San Joaquin River at Highway 165 near Stevinson, and San Joaquin River at Las Palmas Avenue near Patterson). Tributary monitoring occurred monthly upstream of the LSJR based on each Coalition's approved monitoring plan. The ESJWQC and WSJRWC assess monitoring results based on the seven monitoring objectives described above and submit a report with the combined results per each Coalition on May 1 annually. The six compliance points monitored in the San Joaquin River from upstream to downstream are:

- San Joaquin river at Sack Dam,
- San Joaquin River at Highway 165 near Stevinson,
- San Joaquin River at Hills Ferry Rd,
- San Joaquin River at Las Palmas Avenue near Patterson,
- San Joaquin River at the Maze Boulevard (Hwy 132) Bridge, and
- San Joaquin River at the Airport Way Bridge near Vernalis

Water samples collected from the LSJR were analyzed for chlorpyrifos and diazinon. Habitat information and field data, including dissolved oxygen (DO), pH, specific conductance (SC), and water temperature, were collected at each site during each monitoring event. Discharge was obtained from the Department of Water Resources (DWR) gauge readings posted on the California Data Exchange Center (CDEC) website. The ESJWQC and WSJRWC created a decision tree to guide each Coalition's actions when a non-compliant load is detected in the LSJR.

During the 2016 WY there were no exceedances of the WQO for chlorpyrifos or diazinon at the LSJR compliance sites. There were two exceedances of the chlorpyrifos WQTL in samples collected on two different dates from ESJWQC tributaries. Sediment toxicity did not occur in any samples collected from ESJWQC tributaries during the 2016 WY. Diazinon was not detected in any sample during the 2016 WY. In the WSJRWC region, chlorpyrifos was detected in four water samples (over three different monitoring events), all of which exceeded the load criteria. Diazinon was not detected in any sample during 2016 WY. Eight sediment samples from the WSJRWC region exhibited sufficient sediment toxicity for follow-up pesticide analysis. Of those samples, only one sample resulted in a detection of chlorpyrifos above the reporting limit (RL) and four detections of chlorpyrifos between the method detection limit (MDL) and the RL. All eight samples contained pyrethroids. In all of the samples exhibiting toxicity within the ESJWQC and WSJRWC regions, there was no indication of synergistic effects. Potential alternative pesticides to chlorpyrifos and/or diazinon were detected in both Coalition's regions, but it is unknown if the pesticides were used as an alternative to chlorpyrifos or as part of a rotation to manage specific pests. The management practices implemented by growers in both Coalition regions are achieving the lowest pesticide levels technically and economically feasible.

To address water quality impairments, the ESJWQC developed a management plan for waterways and constituents detected in elevated concentrations in those waterways. The Coalition focuses on constituents applied by agriculture including pesticides and suspended solids. The outreach and education strategy is designed to inform growers of impairments in their watershed and provide information on effective management practices. A key component of the ESJWQC's management strategy is to hold individual member meetings to discuss farm management practices and water quality impairments. The Coalition considers the significant decrease in exceedances of the WQO for chlorpyrifos since outreach began as an important step in demonstrating the effectiveness of its management plan strategy. By demonstrating water quality improvements, the ESJWQC has received approval to remove 75 constituents from 21 site subwatershed management plans. Of those 75 constituents approved for management plan completion, 10 management plans have been reinstated due to exceedances of WQTLs during recent monitoring.

The WSJRWC is also in the process of evaluating management practice implementation and effectiveness which is accomplished through a new, constituent-specific management plan process developed through the WSJRWC's Surface water Quality Management Plan (SQMP - approval pending). To accomplish this, the WSJRWC utilizes its two-pronged strategy guided by the tiered approach described in the WSJRWC Management Plan. Because there is likely an overlap in effect from practices to address a specific constituent, the WSJRWC identified a prioritized, tiered list of actions to be taken to address impairments of the most immediate concern (highest tier constituents), and, presumably, those actions will also benefit some lower prioritized (tiered) constituents. These actions are then employed under two concurrent approaches (prongs) to improve water quality within the region. The SQMP approach identifies and employs a common strategy that can be applied throughout the region. Constituent-Specific Management Plans identify and employ a constituent-specific approach to implement management practices and improve water quality across the entire WSJRWC region according to the priority of the constituent group. Together, these strategies enable the WSJRWC to adequately assess water quality and management practice implementation in its region. Management practices assessments are reported in the WSJRWC Annual Monitoring Reports (SAMRs).

Both Coalitions monitor chlorpyrifos, diazinon, and several other constituents as a part of their tributary monitoring program within their respective regions. Results from ESJWQC and WSJRWC tributary monitoring during the reporting period (October 2015 through September 2016) are discussed as they pertain to the TMDL Monitoring Objectives 1 through 7. Additional details can be found in the ESJWQC Annual Report submitted May 1, 2017, ESJWQC Quarterly Data Submittals submitted on March 1, June 1, September 1, and December 1, and the WSJRWC Annual Monitoring Report (AMR) submitted November 30, 2016 (September 2015 through August 2016 data) and to be submitted November 30, 2017 (September 2016 through August 2017 data).

INTRODUCTION

The Central Valley Regional Water Quality Control Board (Regional Board) developed the Amendments to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Diazinon and Chlorpyrifos Runoff into the LSJR (hereafter Basin Plan Amendment) to establish a Total Maximum Daily Load (TMDL) for the organophosphorus (OP) pesticides chlorpyrifos and diazinon in the lower reaches of the San Joaquin River (LSJR). This Basin Plan Amendment (finalized in October 2005) requires a surveillance and monitoring program to collect information necessary to assess compliance with seven monitoring objectives. The East San Joaquin Water Quality Coalition (ESJWQC) and Westside San Joaquin River Watershed Coalition (WSJRWC) collect monitoring data to assess compliance with the Basin Plan Amendment which is addressed at two levels in this report: 1) assessment of water quality within the LSJR at six TMDL compliance points, and 2) assessment of water quality at tributaries within seven major subareas that drain to the LSJR. In some cases major subareas have been further subdivided into minor subareas to facilitate more effective and focused water quality monitoring and assessment (Bear Creek, Fresno-Chowchilla, Northeast Bank, North Stanislaus, Stevinson, Turlock Area, Greater Orestimba, Westside Creeks, and Vernalis North).

The LSJR and seven major subareas include agricultural drainages monitored under the Irrigated Lands Regulatory Program (ILRP) by the ESJWQC and WSJRWC. Each Coalition conducts a monitoring program designed to assess water quality within their region. In addition, both Coalitions have developed management plans to address exceedances of the water quality objectives (WQOs) for chlorpyrifos and diazinon in specific subwatersheds. To address regulation of discharges of OP pesticides, the ESJWQC and the WSJRWC jointly conducted monitoring at six compliance points in the LSJR during the 2016 WY. This report summarizes the monitoring results of samples collected during the reporting period (October 2015 through September 2016) and compares those results with WQOs outlined in the Basin Plan Amendment. This annual report also includes data to demonstrate how the Coalitions are complying with load allocations for the seven major subareas that drain to the LSJR.

MONITORING OBJECTIVES AND DESIGN

MONITORING OBJECTIVES

The ESJWQC and WSJRWC developed a monitoring strategy to comply with the following seven Monitoring Objectives for the chlorpyrifos and diazinon TMDL program:

1. Determine compliance with established WQOs and the loading capacity applicable to diazinon and chlorpyrifos in the San Joaquin River.
2. Determine compliance with established load allocations for diazinon and chlorpyrifos.
3. Determine the degree of implementation of management practices to reduce off-site movement of diazinon and chlorpyrifos.
4. Determine the effectiveness of management practices and strategies to reduce off-site migration of diazinon and chlorpyrifos.
5. Determine whether alternatives to diazinon and chlorpyrifos are causing surface water quality impacts.
6. Determine whether the discharge causes or contributes to toxicity impairment due to additive or synergistic effects of multiple pollutants.
7. Demonstrate that management practices are achieving the lowest pesticide levels technically and economically achievable.

The chlorpyrifos and diazinon WQOs (Basin Plan, Fourth Edition; Page III-6.01) are used to determine compliance with the concentration based loading capacity for the LSJR and load allocations within the upstream tributaries (Table 1). Loading capacity is the maximum amount of pollution that can be present in a waterbody without violating water quality objectives. Load allocations are the allowable pollutant load among the different pollutant sources in a manner such that water quality standards are maintained. An exceedance of the loading capacity occurs if the measured concentration of either constituent in a sample collected from the LSJR exceeds their respective 4-day average (chronic) maximums WQOs listed in Table 1. An exceedance of the loading capacity occurs if the measured concentration of either constituent in a sample collected from a tributary within one of the seven subareas exceeds the WQO. The chlorpyrifos and diazinon loading capacity or load allocation can also be exceeded if the combined concentrations of chlorpyrifos and diazinon cause the sum (Equation 1) to be greater than one, even if both concentrations are below their respective WQOs.

Table 1. WQOs for chlorpyrifos and diazinon.

Pesticide	Maximum Concentration and Average Period
Chlorpyrifos	0.025 µg/L ; 1-hour average (acute) 0.015 µg/L ; 4-day average (chronic) Not to be exceeded more than once in a three year period.
Diazinon	0.16 µg/L ; 1-hour average (acute) 0.10 µg/L ; 4-day average (chronic) Not to be exceeded more than once in a three year period.

Equation 1. Formula used to calculate chlorpyrifos and diazinon loading capacity in LSJR and load allocation for waterways entering the River.

$$S = \frac{C_D}{WQO_D} + \frac{C_C}{WQO_C} \leq 1.0$$

S = Sum loading capacity. A sum exceeding one indicates that the beneficial use might be impacted.
CD = diazinon concentration in µg/L
CC = chlorpyrifos concentration in µg/L
WQOD = diazinon water quality objective; 0.1 µg/L
WQOC = chlorpyrifos water quality objective; 0.015 µg/L

To assess compliance with Objective 1 (loading capacity), the ESJWQC and WSJRWC conducted monitoring at six designated compliance sites on the LSJR during the 2016 WY. To assess compliance with Objectives 2 (load allocation) through 7, the Coalitions reviewed results from the LSJR monitoring and outreach conducted within their respective Coalition regions as a part of the ILRP. Table 2 is an overview of the ESJWQC and WSJRWC actions and associated reporting documents utilized to assess each of the seven Monitoring Objectives. The Comparison with TMDL Objectives section of this report details each Coalition's strategy to assess compliance with each of the objectives and the outcomes of their strategies during the reporting period.

East San Joaquin Water Quality Coalition

1. Surface Water Quality Management Plan (SQMP)
2. ESJWQC Annual Report
3. ESJWQC Monitoring Plan Update (MPU)
4. ESJWQC Quarterly Data Submittals

Westside San Joaquin River Watershed Coalition

1. WSJRWC Monitoring and Reporting Program Order No R5-2008-0831 (MRP)
2. WSJRWC Quality Assurance Project Plan (QAPP, approved January 7, 2014)
3. WSJRWC Annual Monitoring Reports (AMR) with Management Plan status updates
4. WSJRWC SQMP and Constituent-Specific Management Plans (MP)

Table 2. Monitoring objectives and actions by the ESJWQC and WSJRWC for the control of chlorpyrifos and diazinon discharge to the LSJR.

Objective Number	Coalition Actions	Location of Additional Information
1	-Monitor six compliance sites on the San Joaquin River. -Assess monitoring results to determine compliance with chlorpyrifos and diazinon WQO and loading capacity.	This report
2	-Conduct representative monitoring of the Coalition region(s) according to Monitoring Strategy. -Assess monitoring results to determine compliance with chlorpyrifos and diazinon load allocations.	ESJWQC: SQMP, MPU, Annual Report and Quarterly Submittals; WSJRWC: MRP and MP
3-4	-Adhere to strategy outlined in the Management Plans. -Assess and review results of management plan strategy to determine the degree of implementation and the effectiveness of management practices implemented to reduce off-site movement of chlorpyrifos and diazinon.	ESJWQC: SQMP, MPU, and Annual Report; WSJRWC: MP and AMR
5	-Conduct representative monitoring of Coalition region according to Monitoring Strategy. -Assess monitoring results to determine whether alternatives to diazinon and chlorpyrifos are causing surface water impairments.	ESJWQC: SQMP, MPU, Annual Report and Quarterly Submittals; WSJRWC: MRP and AMR

Objective Number	Coalition Actions	Location of Additional Information
6	-Conduct representative monitoring of Coalition region according to Monitoring Strategy. -Assess monitoring results to assess toxicity and determine if agricultural discharge contributes to toxicity impairment due to additive or synergistic effects of multiple pollutants.	ESJWQC: SQMP, MPU, Annual Report and Quarterly Submittals; WSJRWC: MRP and AMR
7	-Assess the information collected to meet Objectives 3 and 4 to determine if management practices are achieving the lowest pesticides levels technically and economically achievable according to Management Plans.	ESJWQC: SQMP, MPU, and Annual Report; WSJRWC: MP and AMR

MONITORING DESIGN

Monitoring is designed to characterize the concentrations of chlorpyrifos and diazinon in the LSJR. In the March 27, 2012 letter, the Regional Board determined that monitoring for the chlorpyrifos and diazinon TMDL at the six LSJR compliance points should focus on periods of peak applications of pesticides containing chlorpyrifos and diazinon, and during months when the two constituents have been detected above the WQTL in the LSJR or its tributaries.

Monitoring Frequency and Timing

The Coalitions evaluated chlorpyrifos and diazinon use over time using Pesticide Use Report (PUR) data from the California Pesticide Information Portal (CalPIP). Currently, CalPIP data are available through 2014. The Coalitions obtained PUR data through September 2016 directly from the counties in the two Coalition regions. These PUR data are considered preliminary until uploaded in CalPIP. The peak period of diazinon use has changed over time (Figure 1). Before 2008 the peak period of diazinon use was between December and February. Since 2008, January applications of diazinon have decreased substantially, and applications between March and June are more common. In the 2016 WY, the highest amount of applied diazinon was in May (1,476 lbs/ac). The amount of chlorpyrifos use has drastically decreased since 2004 (Figure 2), from an annual average of 259,629 lbs applied in 2004 to 108,013 lbs in 2015. However, the timing of use has remained relatively consistent over time, with chlorpyrifos being applied in both irrigated and dormant seasons.

Figure 1. Pounds of diazinon applied in the LSJR from 2004 through September 2016.
All PUR data after 2013 are considered preliminary; PUR data are incomplete through 2015.

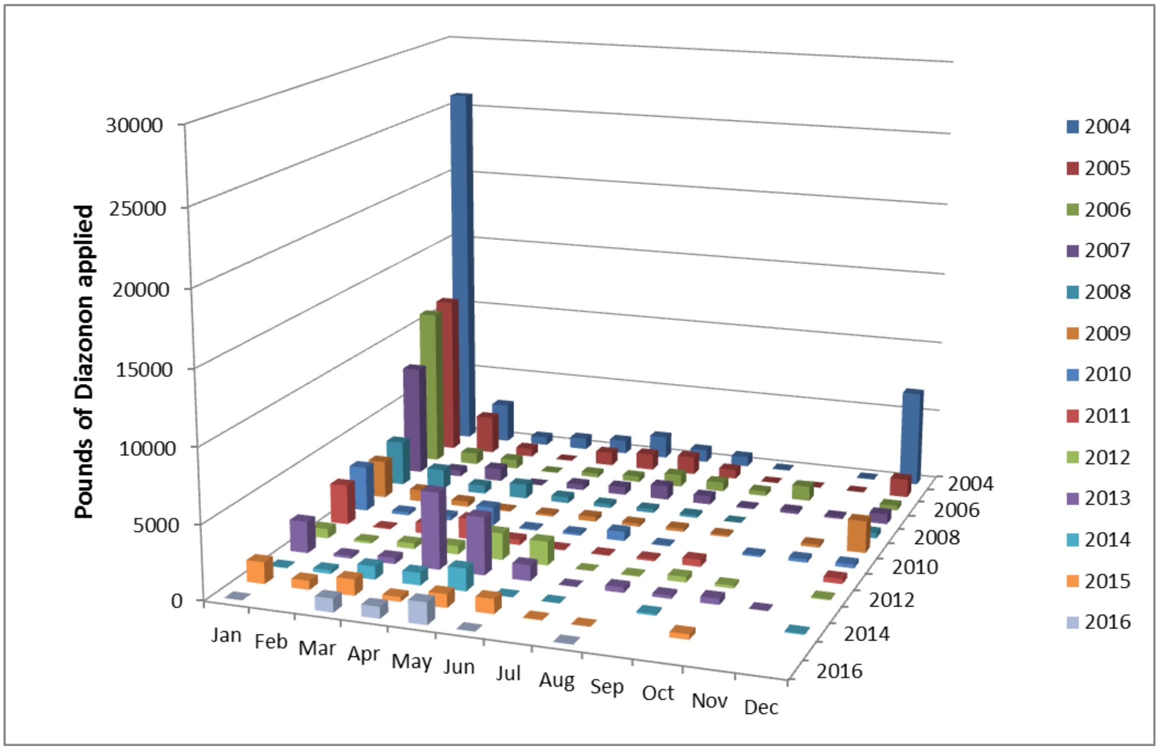
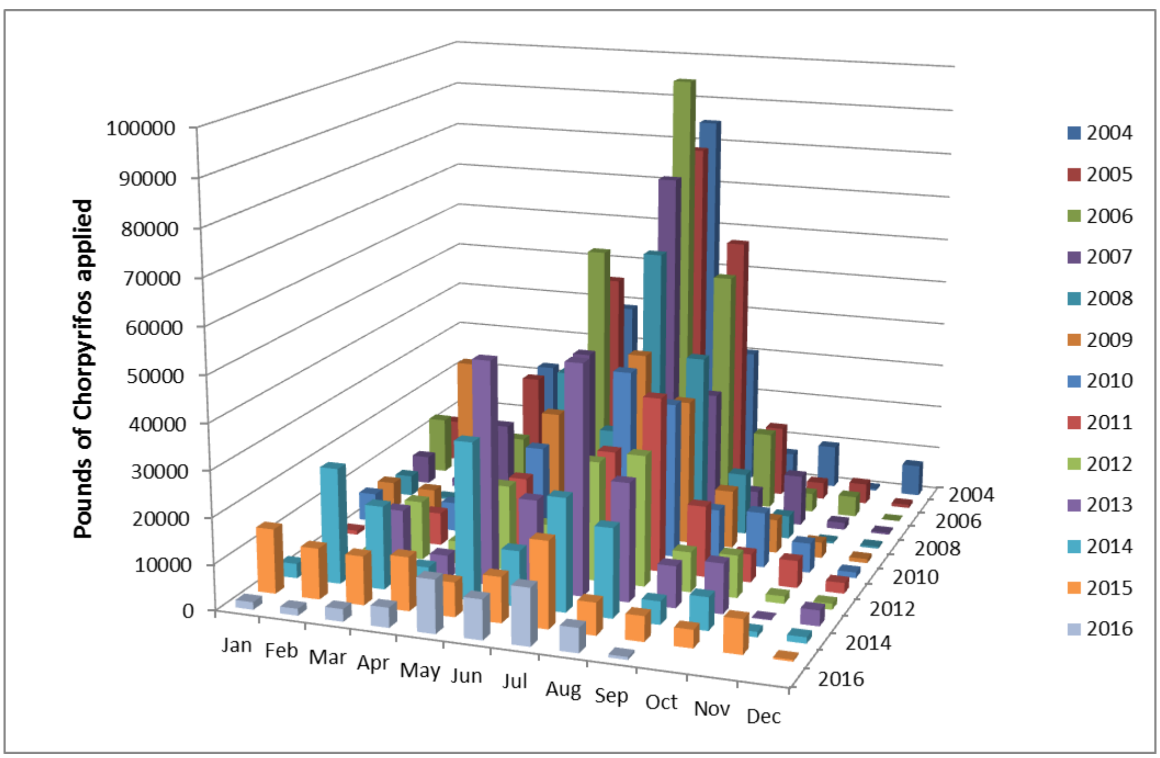


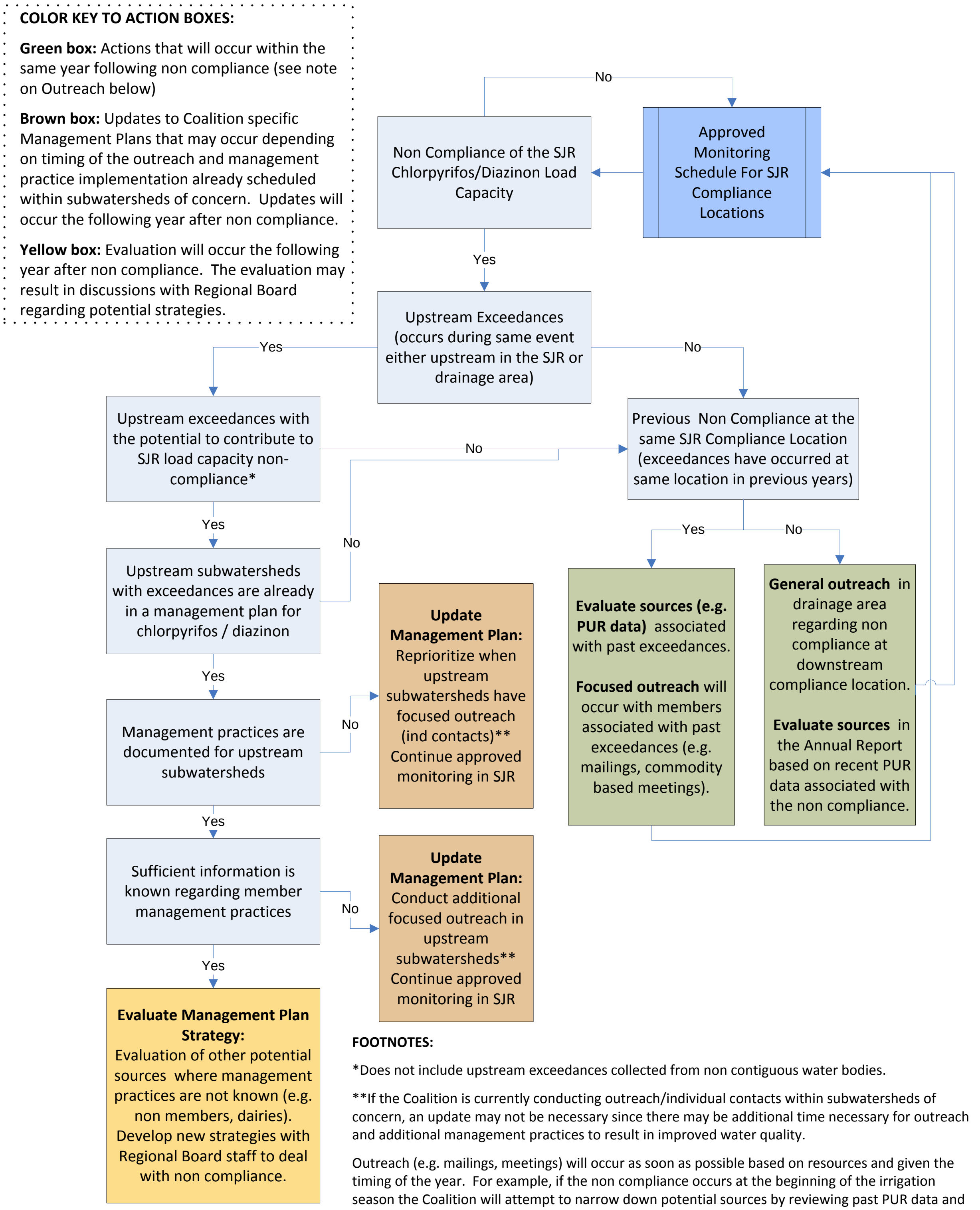
Figure 2. Pounds of chlorpyrifos applied in the LSJR watershed from 2004 through September 2016.
All PUR data after 2013 are considered preliminary; PUR data are incomplete through 2015.



The monitoring design for the 2016 WY was similar to the monitoring design utilized during the 2015 WY. During the 2016 WY, the ESJWQC monitored three of the six compliance points (San Joaquin River at Hills Ferry Road, San Joaquin River at the Maze Boulevard [Highway 132] Bridge, and San Joaquin River at the Airport Way Bridge near Vernalis) once during January storm monitoring and from May through September. The WSJRWC monitored the other three compliance points (San Joaquin River at Sack Dam, San Joaquin River at Highway 165 near Stevinson, and San Joaquin River at Las Palmas Avenue near Patterson) on a monthly basis. The Coalitions typically schedule the TMDL compliance monitoring events with ESJWQC tributary monitoring and WSJRWC tributary monitoring for the second Tuesday of the month but monitoring schedules are adjusted for storm events as necessary.

The Coalitions report chlorpyrifos and diazinon TMDL monitoring results from the previous WY on May 1 annually. This report includes a complete analysis and discussion of all monitoring data collected from October 2015 through September 2016. If a non-compliant load is detected in the LSJR, the Coalitions utilize the decision tree in Figure 3 to guide the Coalition's actions to address water quality impairments in a timely and efficient manner.

Figure 3. Chlorpyrifos and diazinon San Joaquin River TMDL decision tree for compliance monitoring and actions resulting from non-compliance of the San Joaquin River load capacity.



FOOTNOTES:

*Does not include upstream exceedances collected from non contiguous water bodies.

**If the Coalition is currently conducting outreach/individual contacts within subwatersheds of concern, an update may not be necessary since there may be additional time necessary for outreach and additional management practices to result in improved water quality.

Outreach (e.g. mailings, meetings) will occur as soon as possible based on resources and given the timing of the year. For example, if the non compliance occurs at the beginning of the irrigation season the Coalition will attempt to narrow down potential sources by reviewing past PUR data and inform those growers of the non compliance with the goal of improving SJR water quality during the rest of the high use period.

Constituents Monitored

Water samples collected from the six LSJR TMDL compliance monitoring sites were analyzed for chlorpyrifos and diazinon. Habitat information and field parameter measurements, including dissolved oxygen (DO), pH, specific conductivity (SC), and water temperature, were collected at each site during each monitoring event. Discharge calculations were obtained from the Department of Water Resources (DWR) and/or United Stated Geological Survey (USGS) data posted to the California Data Exchange Center (CDEC) website. Samples collected by the WSJRWC during monthly monitoring (January through October) of the LSJR compliance points were also analyzed for additional constituents for compliance with the Coalition's WDR (Waste Discharge Requirements General Order for Growers within the San Joaquin River Watershed that are Members of the Third-Party Group; Order R5-2012-0116-R2) as described in the WSJRWC's MRP (submitted January 15, 2016). The WSJRWC was approved by the Regional Board on October 5, 2015 for reduced monitoring in November and December of 2015 and 2016 in lieu of participating in the Delta Regional Monitoring Program (RMP). Results from ILRP monitoring (of both additional constituents analyzed in the LSJR and tributary monitoring) are reported in the WSJRWC's AMR (submitted November 30 annually) and the ESJWQC's Annual Report (submitted May 1 annually). The sampling procedures and analytical methods are further discussed in the Sampling and Analytical Methods section of this report.

SAMPLE SITE DESCRIPTIONS

The Basin Plan Amendment requires the Coalitions to assess compliance with WQOs and loading capacity for, at a minimum, six designated water quality compliance points on the LSJR. The compliance points (listed from upstream to downstream) are:

- San Joaquin River at Sack Dam,
- San Joaquin River at Highway 165 near Stevinson (USGS 11260815),
- San Joaquin River at Hills Ferry Road,
- San Joaquin River at Las Palmas Avenue near Patterson (USGS 11274570),
- San Joaquin River at the Maze Boulevard (Highway 132) Bridge (USGS 11290500), and
- San Joaquin River at the Airport Way Bridge near Vernalis (USGS 11303500).

These compliance points are not named consistently in all sources used to prepare this report; hence Table 3 provides a crosswalk of the sites as they are named in other data sources.

Additionally, the Basin Plan Amendment specifies that compliance with load allocations for nonpoint source discharges into the LSJR must be determined for the following five groups of minor subareas (listed from upstream to downstream):

- Bear Creek and Fresno-Chowchilla subareas
- Stevinson and Grassland subareas,
- Turlock, Merced, and Greater Orestimba subareas,
- Tuolumne River, Northeast Bank, and Westside Creek subareas, and
- Stanislaus River, North Stanislaus, and Vernalis North subareas.

Monitoring at five of the six compliance points on the LSJR assesses drainage from these subareas (Table 3). Although none of the tributary subareas drain into San Joaquin River at Sack Dam, there is the potential for indirect drainage and spray drift to occur in a small area next to the river upstream of the San Joaquin River at Sack Dam monitoring location (Figure 4). During the 2016 WY, the Coalitions collected samples from 32 tributary monitoring locations (16 in ESJWQC and 16 in WSJRWC regions). The LSJR compliance sites and the associated tributaries that drain to each compliance point are listed in Table 4.

Monitoring results from ESJWQC and WSJRWC tributary monitoring during the 2016 WY are discussed in this report as they pertain to LSJR monitoring. Details of ESJWQC 2016 WY tributary monitoring locations can be found in the ESJWQC Annual Report submitted May 1, 2017. The WSJRWC tributary monitoring locations from October 2015 through August 2016 were reported in the WSJRWC's AMR submitted November 30, 2016. The WSJRWC tributary monitoring locations and results from September 2016 will be reported in the WSJRWC AMR to be submitted November 30, 2017.

Table 3. San Joaquin River chlorpyrifos and diazinon designated Basin Plan Amendment compliance sites, subareas, and site name crosswalk for referencing appendices and electronic files.

Sites listed in order from upstream to downstream.

Site Name	Subareas	USGS ID No.	Appendices Site Name	Appendices Code	CEDEN Site Name	CEDEN Code	Latitude	Longitude	Coalition
San Joaquin River at Sack Dam	Grassland, Fresno-Chowchilla*	NA	SJR @ Sack Dam	SJRSD	SJR @ Sack Dam	541MAD007	36.98361	-120.50028	WSJRWC
San Joaquin River at Highway 165 near Stevinson	Bear Creek, Fresno-Chowchilla	11260815	SJR @ Hwy 165	SJRLA	San Joaquin River at Lander Ave	541MER522	37.29528	-120.85028	WSJRWC
San Joaquin River at Hills Ferry Road	Stevinson, Grassland	NA	SJR @ Hills Ferry	541STC512	SJR @ Hills Ferry	541STC512	37.34250	-120.97722	ESJWQC
San Joaquin River at Las Palmas Avenue near Patterson	Turlock, Merced, Greater Orestimba	11274570	SJR @ Las Palmas Ave	SJRPP	SJR @ Patterson	541STC507	37.49778	-121.08167	ESJWQC
					San Joaquin River at PID Pumps	541XSJRPP	37.49720	-121.08280	WSJRWC
San Joaquin River at the Maze Boulevard (Highway 132) Bridge	Tuolumne River, Northeast Bank, Westside Creek	11290500	SJR @ Maze Blvd	541STC510	San Joaquin River above Maze Boulevard	541STC510	37.64194	-121.22778	ESJWQC
San Joaquin River at the Airport Way Bridge near Vernalis	Stanislaus River, North Stanislaus, Vernalis North	11303500	SJR @ Airport Way	541SJC501	San Joaquin River at Airport Way near Vernalis	541SJC501	37.67556	-121.26417	ESJWQC

* This station is not identified as having drainage from subareas as listed in the Basin Plan amendment. However, this report identifies some drainage possible along the river in the Fresno-Chowchilla and Grassland subareas (see Figure 4).

NA – Not Applicable.

CEDEN – California Environmental Data Exchange Network

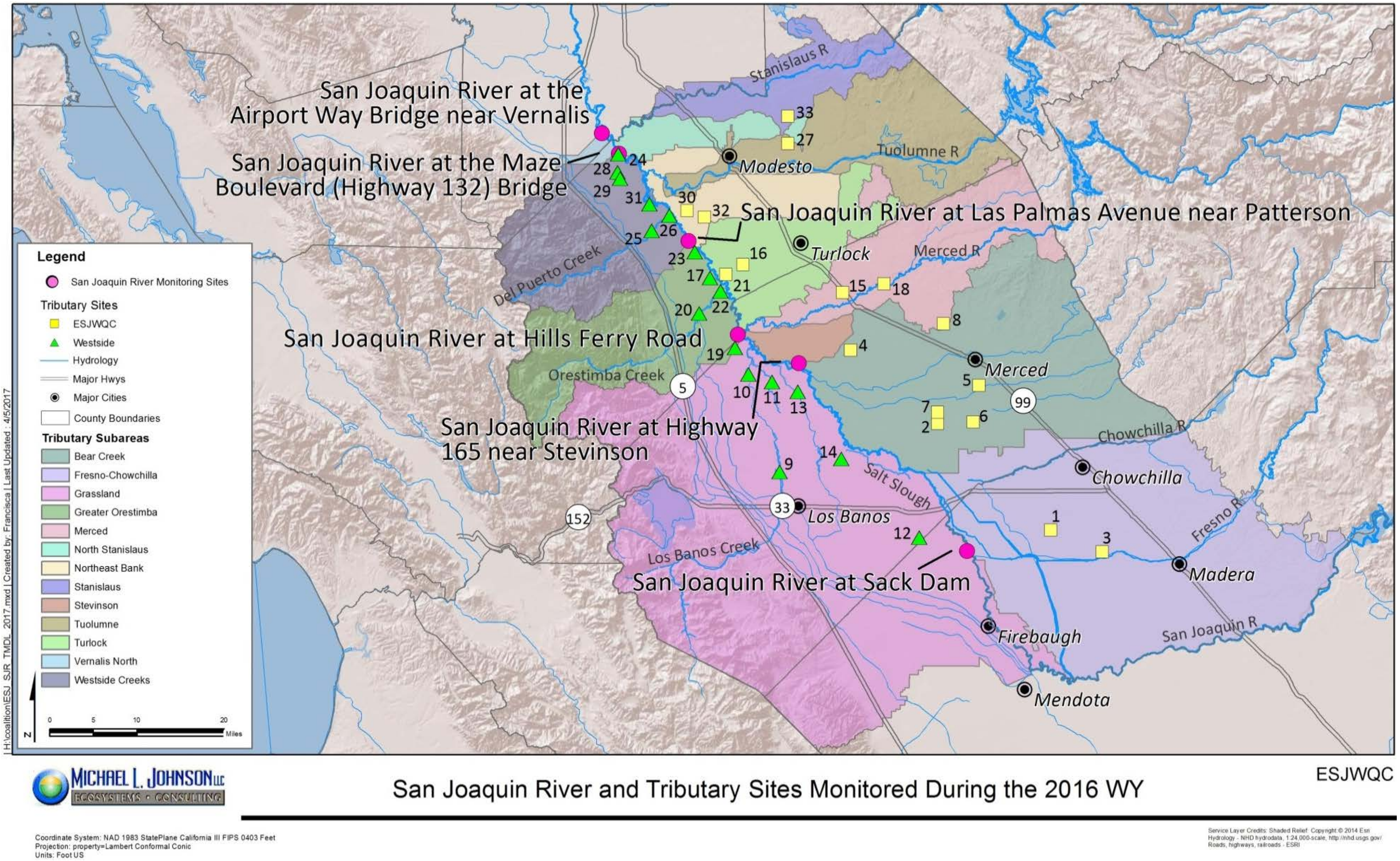
Table 4. The ESJWQC and WSJRWC upstream tributary monitoring during 2016 WY.

Coalition	Map Key*	Site Name	Station Code	Latitude	Longitude	LSJR Downstream Monitoring Location
ESJWQC	1	Berenda Slough along Ave 18 1/2	545XBSAAE	37.01820	-120.32650	San Joaquin River at Highway 165 near Stevinson
ESJWQC	2	Deadman Creek @ Gurr Rd	535XDCAGR	37.19514	-120.56147	
ESJWQC	3	Dry Creek @ Rd 18	545XDCARE	36.98180	-120.22056	
ESJWQC	4	Livingston Drain @ Robin Ave	535XLDARA	37.31693	-120.74229	
ESJWQC	5	Miles Creek @ Reilly Rd	535XMCARR	37.25830	-120.47524	
ESJWQC	6	Deadman Creek @ Hwy 59	535DMCAHF	37.19755	-120.48763	
ESJWQC	7	Duck Slough @ Gurr Rd	535XDSAGR	37.21408	-120.56126	
ESJWQC	8	Canal Creek @ West Bellevue Rd	535CCAWBR	37.36090	-120.54940	San Joaquin River at Hills Ferry Road
WSJRWC	9	Los Banos Creek at China Camp Road	541XLBCCC	37.1145	-120.8895	
WSJRWC	10	Los Banos Creek at Hwy 140	541MER554	37.2762	-120.9555	

Coalition	Map Key*	Site Name	Station Code	Latitude	Longitude	LSJR Downstream Monitoring Location
WSJRWC	11	Mud Slough Upstream of San Luis Drain	541XMSUSL	37.2639	-120.90611	
WSJRWC	12	Poso Slough at Indiana Ave	541XPSAIA	37.0062	-120.5996	
WSJRWC	13	Salt Slough at Lander Ave	541MER531	37.2479	-120.8522	
WSJRWC	14	Salt Slough at Sand Dam	541XSSASD	37.1366	-120.7619	
ESJWQC	15	Highline Canal @ Hwy 99	535XHCHNN	37.41254	-120.75941	San Joaquin River at Las Palmas Avenue near Patterson
ESJWQC	16	Lateral 5 ½ @ South Blaker Rd	535LFHASB	37.45827	-120.96730	
WSJRWC	17	Marshall Road Drain near River Road	541XMRDRR	37.4363	-121.0362	
ESJWQC	18	Merced River @ Santa Fe	535XMRSFD	37.42705	-120.67353	
WSJRWC	19	Newman Wasteway near Hills Ferry Road	541XNWHFR	37.3204	-120.9834	
WSJRWC	20	Orestimba Creek at Hwy 33	541STC519	37.3772	-121.05812	
ESJWQC	21	Prairie Flower Drain @ Crows Landing Rd	535XPFDCL	37.44187	-121.00331	
WSJRWC	22	Orestimba Creek at River Road	541STC019	37.41389	-121.01417	
WSJRWC	23	Ramona Lake near Fig Avenue	541XROLFA	37.4788	-121.0684	
WSJRWC	24	Blewett Drain at Highway 132	541XVH132	37.6405	-121.2296	San Joaquin River at the Maze Boulevard (Highway 132) Bridge
WSJRWC	25	Del Puerto Creek at Hwy 33	541XDPCHW	37.5142	-121.15875	
WSJRWC	26	Del Puerto Creek near Cox Road	541XDPCCR	37.5394	-121.1221	
ESJWQC	27	Dry Creek @ Wellsford Rd	535XDCAWR	37.66000	-120.87526	
WSJRWC	28	Hospital Creek at River Road	541XHCARR	37.6105	-121.23078	
WSJRWC	29	Ingram Creek at River Road	541STC040	37.6002	-121.22506	
ESJWQC	30	Lateral 2 1/2 near Keyes Rd	535LTHNKR	37.54766	-121.08509	
WSJRWC	31	Westley Wasteway near Cox Road	541XWWNCR	37.5582	-121.1637	
ESJWQC	32	Westport Drain @ Vivian Rd	535XWDAVR	37.53682	-121.04861	
ESJWQC	33	Mootz Drain downstream of Langworth Pond	535XMDDLP	37.70539	-120.87526	San Joaquin River at the Airport Way Bridge near Vernalis

ESJWQC – East San Joaquin Water Quality Coalition
WSJRWC – Westside San Joaquin River Watershed Coalition
*Map Key – reference Figure 4.

Figure 4. San Joaquin River tributary major and minor subareas, chlorpyrifos and diazinon TMDL compliance sites (circles), and tributary sites monitored by ESJWQC (squares) and WSJRWC (triangles) during the 2016 WY.
Refer to Table 4 for tributary site names.



LAND USE ANALYSIS OF SUBAREAS

The Coalitions reviewed land use acreage based on the United States Department of Agriculture (USDA) cropland data from 2016 to better characterize the upstream drainage area for each of the LSJR monitoring compliance points (Table 5 and Table 6). The entire drainage area is estimated to include a little less than three million acres. Agricultural land use in the LSJR basin includes orchards, pasture, rice, row crops, vineyards, and nursery/berries (Table 5).

Table 6 identifies the crop types with the largest acreage within the immediate upstream drainage to each monitoring site on the LSJR. Almonds, alfalfa, corn, and walnuts are among the top four commodities by acreage throughout the region based on 2016 USDA land use data. In the upstream portions of the LSJR, grapes represent the largest amount of acreage, whereas various row crops and orchards are more common downstream (Table 6). Corn, cotton, oats, tomatoes, and winter wheat are also all very common in the LSJR drainage area.

Land use maps for all ESJWQC upstream tributaries can be found in the 2017 Annual Report (Appendix VII). A discussion of land use in the WSJRWC region is located in the November 2016 AMR (Page 13).

Table 5. Estimated land use acreage upstream of the San Joaquin River compliance points.
Stations are listed in order of upstream to downstream from left to right. Subwatershed totals reflect only the immediate upstream acreage within the subareas that drain to each LSJR site (Figure 4).

Land Use	San Joaquin River at Sack Dam	San Joaquin River at Highway 165 near Stevinson	San Joaquin River at Hills Ferry Road	San Joaquin River at Las Palmas Avenue near Patterson	San Joaquin River at the Maze Blvd. (Highway 132) Bridge	San Joaquin River at the Airport Way Bridge
Native	12,400	312,200	494,400	193,100	210,700	30,900
Orchard	24,700	205,300	26,300	101,500	106,100	38,000
Field Crops	3,300	79,700	161,300	38,300	7,100	2,400
Pasture	4,600	89,400	80,400	37,100	27,300	23,800
Developed	3,000	61,900	15,800	25,100	37,700	30,000
Vineyard	10,800	77,400	2,600	12,200	6,800	1,500
Truck/Nursery/Berry	700	28,800	59,600	10,500	9,200	3,300
Grain & Hay	3,000	56,700	13,100	40,500	26,200	13,900
Open Water	4,300	8,900	22,200	3,400	11,000	4,100
Semi-agricultural	800	15,700	5,600	14,000	8,900	4,800
Fallow/Idle Cropland	300	7,300	3,500	3,100	4,200	1,100
Rice	200	4,000	7,800	0	500	400
Estimated Subwatershed Total Acres	**68,100**	**947,300**	**892,600**	**478,800**	**455,700**	**154,200**
Estimated Cumulative Total Acres	**2,104,100**	**1,101,500**	**2,996,700**	**1,580,300**	**2,036,000**	**154,200**

Source: Acreage estimated from 2016 USDA data.

Table 6. Top ten commodities (in order of largest to smallest acreage) upstream of each San Joaquin River sampling site for 2016 WY.

Stations are listed in order of upstream to downstream from left to right. Commodities* are listed in order of largest (first row) to smallest acreage (last row) per each site. Drainage reflects the immediate upstream acreage within the subareas that drains to each LSJR site (Figure 4).

San Joaquin River at Sack Dam	San Joaquin River at Highway 165 near Stevinson	San Joaquin River at Hills Ferry Road	San Joaquin River at Las Palmas Avenue near Patterson	San Joaquin River at the Maze Boulevard (Highway 132) Bridge	San Joaquin River at the Airport Way Bridge near Vernalis
Almonds	Almonds	Cotton	Almonds	Almonds	Almonds
Alfalfa	Alfalfa	Alfalfa	Corn	Corn	Corn
Misc. Deciduous	Corn	Tomatoes (Processing)	Alfalfa	Walnuts	Walnuts
Trees & Shrubs	Pistachios	Corn	Beans	Alfalfa	Alfalfa
Pistachios	Cotton	Melons, Squash and Cucumbers	Dairies	Tomatoes (Processing)	Peaches and Nectarines
Cotton	Tomatoes (Processing)	Almonds	Walnuts	Peaches and Nectarines	Dairies
Walnuts	Figs	Sugar Beets	Tomatoes (Processing)	Beans	Melons, Squash and Cucumbers
Tomatoes (Processing)	Oranges	Beans	Peaches and Nectarines	Apricots	Beans
Oranges	Dairies	Sudan	Sweet Potatoes	Dairies	Flowers, Nursery, Christmas Tree Farms
Corn	Sweet Potatoes	Walnuts	Poultry Farms	Sudan	Tomatoes (Processing)

*Source: Acreage estimated from 2016 USDA data.

RAINFALL RECORDS

Daily rainfall records are provided for cities located in the ESJWQC and WSJRWC regions: Modesto, Los Banos, Merced, and Patterson. Precipitation records were retrieved from the California Irrigation Management Information System (CIMIS). The 2016 WY included a larger number of significant storms compared to the previous three years. However, because those previous years were critically dry, 2016 WY was classified as a dry/below normal year. The first rainfall event with measurable precipitation occurred October 1, 2015, with measurable storm events occurring periodically throughout the winter months all the way to May 2016 (Figure 5 and Figure 6).

From October 2015 through September 2016, storm samples were collected during two rain events. The ESJWQC collected storm samples at tributary sites on November 10, 2015 and March 8, 2016; and at the three LSJR compliance locations on January 7, 2016. Storm samples were collected in the WSJRWC region at both tributary and TMDL compliance locations on January 7, 2016 and March 8, 2016.

Figure 5. Precipitation history from October 1, 2015 through March 31, 2016.
Rainfall data from CIMIS stations located in Modesto, Merced, Los Banos, and Patterson, CA.

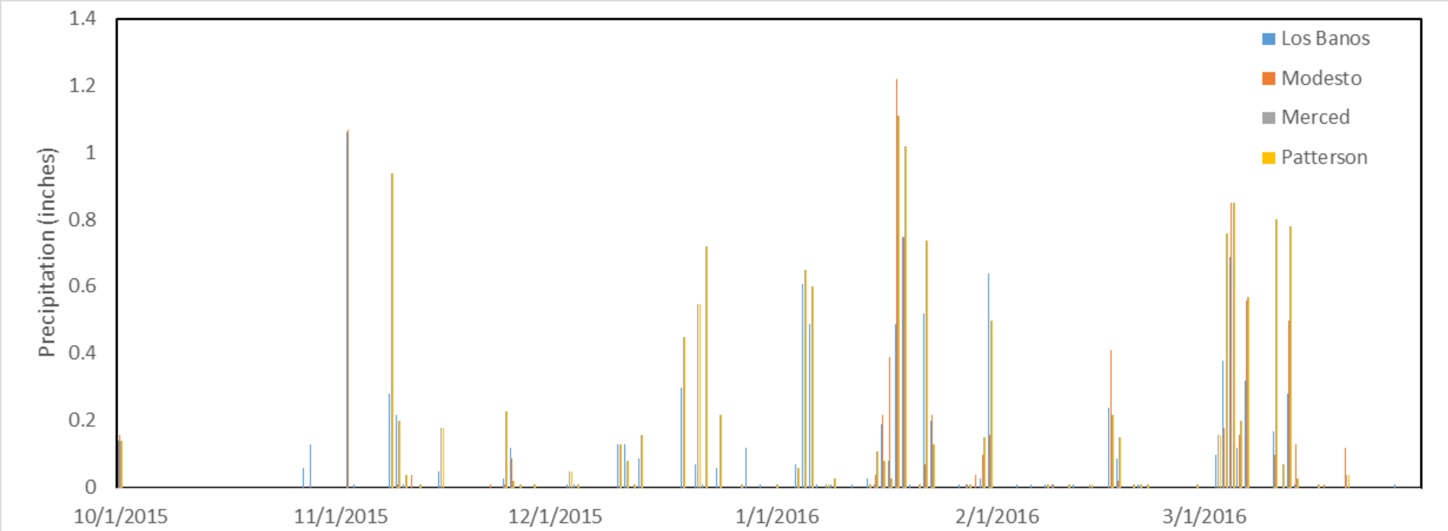
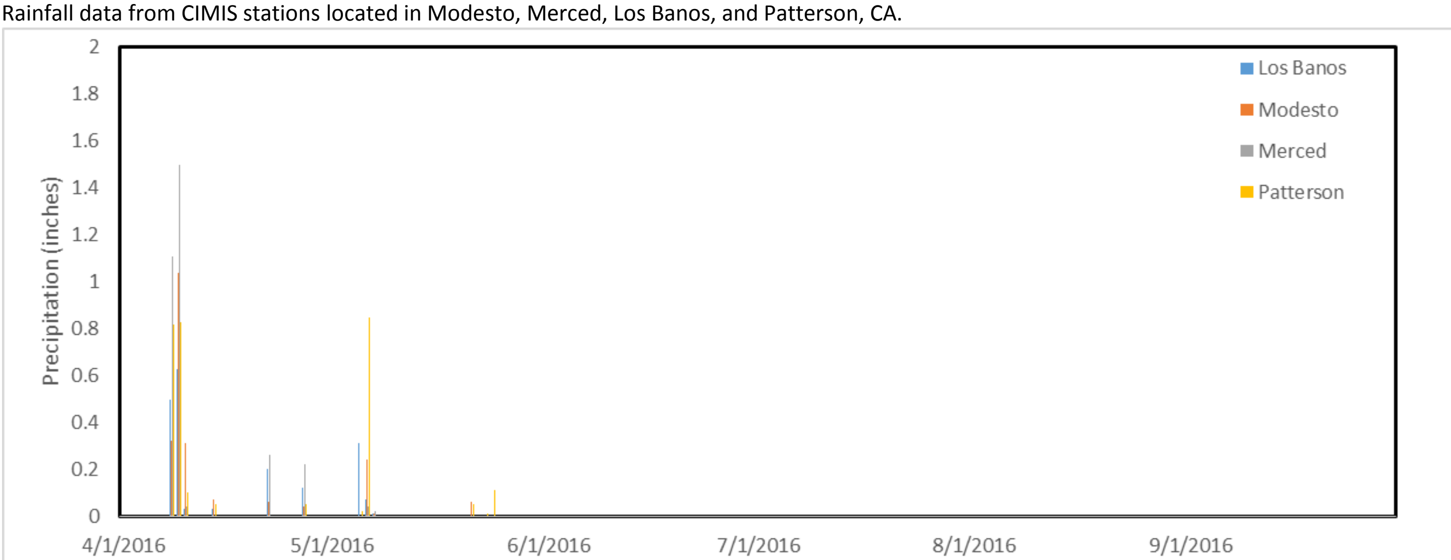


Figure 6. Precipitation history from April 1, 2016 through September 30, 2016.
Rainfall data from CIMIS stations located in Modesto, Merced, Los Banos, and Patterson, CA.



SAMPLING AND ANALYTICAL METHODS

Information on sample collection containers, volumes, preservations and holding times is provided in Table 7; field instrument information is included in Table 8. The methods used for collecting discharge measurements are described for each site in Table 9; analytical methods and reporting limits (RL) are provided in Table 10. Field sampling procedures and methods applied by the ESJWQC and WSJRWC during 2016 WY monitoring are described in the respective Coalition's most up-to-date and approved QAPPs (referenced below). Field sampling procedures and methods applied by the Delta Regional Monitoring Program (Delta RMP) for samples acquired from the San Joaquin River at the Airport Way Bridge near Vernalis site are described in the Delta RMP's approved QAPP (Delta RMP, 2016).

The ESJWQC sampled the San Joaquin River at Hills Ferry Road and San Joaquin River at the Maze Boulevard (Highway 132) Bridge according to field sampling procedures outlined in the standard operating procedures (SOPs) provided in the ESJWQC QAPP (approval on January 8, 2016); provided in Appendices I-X (Pages 65-110). Integrated river water samples were collected using a three liter polytetrafluoroethylene (PFTE) bottle from a bridge crossing. Amber glass bottles were filled from the integrated sample collected in the PFTE bottle.

The WSJRWC sampled the San Joaquin River at Highway 165 near Stevinson, San Joaquin River at Las Palmas Avenue near Patterson, and San Joaquin River at Sack Dam according to the field sampling procedures and methods described in the WSJRWC QAPP (approved January 7, 2014, Pages 24-29). The WSJRWC field samplers collected sample water directly into amber glass bottles from the LSJR bank at each site. Due to safety concerns, WSJRWC samplers avoid sampling from bridges whenever possible.

Samples from both Coalitions were analyzed for chlorpyrifos and diazinon by APPL Inc. according to the Environmental Protection Agency (EPA) 8141A method. The SOPs for the EPA 8141A method were submitted with both Coalitions' QAPPs; as Appendix XIII to the ESJWQC's QAPP (Pages 146-163) and as Appendix D, Attachment 7, to the WSJRWC's QAPP.

In addition to LSJR monitoring data, both Coalitions use tributary monitoring data as applicable to assess compliance with the TMDL program. The ESJWQC performed field sampling procedures and methods, including discharge measurements at tributary sites as outlined in the SOPs outlined in the ESJWQC QAPP (Appendices I-X, Pages 65-110). The laboratory procedures used to analyze samples collected from ESJWQC tributary sites are contained in Appendices XI-XXXIV of the ESJWQC QAPP (Pages 111-393). Any deviations from these procedures are documented in the Precision, Accuracy, and Completeness section of this report.

The WSJRWC conducted field sampling procedures and methods, including discharge measurements, at tributary sites as described in the WSJRWC QAPP (Appendix B); no deviations from these procedures occurred during the monitoring. The laboratory procedures used to analyze samples collected from WSJRWC tributary sites can be found in the WSJRWC QAPP (Appendix D, Attachment 7).

Table 7. Sampling procedures.

Analytical Parameter	Sample Volume[1]	Sample Container	Initial Preservation/Holding Requirements	Holding Time[2]
Organophosphates	1 L	1x L Amber Glass	Store at <6°C; extract within 7 days	40 Days

[1] Additional volume is collected at designated quality control (QC) sites.
[2] Holding time after initial preservation or extraction.

Table 8. Field parameters and instruments used to collect measurements.

Parameter	Instrument
Dissolved Oxygen	YSI Model 556 and Professional Plus
Temperature	YSI Model 556 and Professional Plus
pH	YSI Model 556 and Professional Plus
Specific Conductance	YSI Model 556 and Professional Plus
Discharge	DWR or USGS Gauge/CDEC Website

DWR – California Department of Water Resource
USGS – United States Geological Survey
CDEC – California Data Exchange Center

Table 9. Site specific discharge methods.

Responsible Monitoring Entity	Site Name	Discharge Method	Gauge
WSJRWC	San Joaquin River at Sack Dam	DWR Gauge	CDEC San Joaquin River near Dos Palos (SDP)
WSJRWC	San Joaquin River at Highway 165 near Stevinson	DWR Gauge	CDEC San Joaquin River near Stevinson (SJS)
ESJWQC	San Joaquin River at Hills Ferry Road	USGS and DWR Gauge	CDEC San Joaquin River Near Newman (NEW)
WSJRWC	San Joaquin River at Las Palmas Avenue near Patterson	DWR Gauge	CDEC San Joaquin River near Patterson (SJP)
ESJWQC	San Joaquin River at the Maze Boulevard (Highway 132) Bridge	DWR Gauge	CDEC San Joaquin River at Maze Rd Bridge (MRB)
Delta RMP	San Joaquin River at the Airport Way Bridge near Vernalis	USGS and DWR Gauge	CDEC San Joaquin River near Vernalis (VNS)

DWR – Department of Water Resources
ESJWQC – East San Joaquin Water Quality Coalition
WSJRWC – Westside San Joaquin River Watershed Coalition
Delta RMP – Delta Regional Monitoring Program
USGS – United States Geological Survey

Table 10. Field and laboratory analytical methods.

Constituent	Matrix	Analyzing Lab	RL	MDL	Analytical Method
Physical Parameters					
pH	Water	Field Measure	0.1 pH units	NA	SM 4500-H
Specific Conductance	Water	Field Measure	100 µmhos/cm	NA	EPA 120.1
Dissolved Oxygen	Water	Field Measure	0.1 mg/L	NA	SM 4500-O
Temperature	Water	Field Measure	0.1 °C	NA	SM 2550
Organophosphates					
Chlorpyrifos	Water	APPL Inc.	0.015 µg/L	0.0026 µg/L	EPA 8141A
Diazinon	Water	APPL Inc.	0.02 µg/L	0.004 µg/L	EPA 8141A

EPA - Environmental Protection Agency
MDL – Minimum Detection Limit
NA – Not Applicable
RL – Reporting Limit
SM – Standard Method

MONITORING RESULTS

Monitoring data collected from October 2015 through September 2016 are included in Appendices I-III, in addition to the supplementary data submitted on CD with this report.

Appendices I and II contain complete monitoring results from sampling conducted at the compliance points on the LSJR. Appendix I contains the monitoring results for field parameters (DO, SC, pH, temperature, and discharge) and laboratory analyses for chlorpyrifos and diazinon. Monitoring results are evaluated in the Comparison with TMDL Objectives, Objective 1 section of this report. Appendix II contains field and laboratory Quality Assurance/Quality Control (QA/QC) data, including results from field duplicate (FD) and blank (FB), laboratory duplicate and blank, laboratory control spike (LCS), and matrix spike (MS). All QA data are discussed in the Precision, Accuracy, and Completeness section.

Appendix III contains all loading capacity and load allocation calculations for samples collected during the reporting period. Loading capacities and compliance status for samples collected from the LSJR are reported in Appendix III, Table III-1. Load allocations and compliance status for samples collected from each of the five tributary subareas are reported in Tables III-2 through 8. Loading capacities and load allocations are both discussed in the Comparison with TMDL Objectives section of this report (Objective 1 and Objective 2; respectively).

Supplementary data located on the CD submitted with this report contains all original field sheets, site photos, Chain of Custody (COC) forms, and laboratory reports (as pdfs and electronic files).

SAMPLE DETAILS

Table 11 includes sample dates for each LSJR sample location, and tributaries in both Coalition areas. All sampling times for these sites and events are located in Appendix II. During the 2016 WY, the ESJWQC collected storm samples at tributary sites on November 10, 2015, January 7, 2016, and March 8, 2016. Both Coalitions conducted stormwater sampling at LSJR compliance locations in addition to tributary sites on January 7, 2016 (Table 11).

Table 11. Dates of monitoring at San Joaquin River and upstream tributary sites during the 2016 WY.
During the 2016 WY, monitoring occurred during storm, irrigation, and non-irrigation events. Delta RMP monitoring occurred on a monthly basis, and is not reported with storm, irrigation, and non-irrigation designations.

Sampling Date	San Joaquin River above Maze Boulevard	San Joaquin River at Airport Way near Vernalis	LSJR @ Hills Ferry	San Joaquin River at Highway 165 near Stevinson	San Joaquin River at Las Palmas Avenue near Patterson	San Joaquin River at Sack Dam	WSJRWC Tributaries	ESJWQC Tributaries
10/13/2015								ES-NI
10/20/2015				WC-NI	WC-NI	WC-NI	WC-NI	
10/21/2015		Delta RMP						
11/10/2015		Delta RMP						ES-Storm
12/15/2015		Delta RMP						ES-NI
1/7/2016	ES-Storm		ES-Storm	WC-Storm	WC-Storm	WC-Storm	WC-Storm	ES-Storm
1/19/2016		Delta RMP						
2/9/2016				WC-NI	WC-NI	WC-NI	WC-NI	ES-NI

Sampling Date	San Joaquin River above Maze Boulevard	San Joaquin River at Airport Way near Vernalis	LSJR @ Hills Ferry	San Joaquin River at Highway 165 near Stevinson	San Joaquin River at Las Palmas Avenue near Patterson	San Joaquin River at Sack Dam	WSJRWC Tributaries	ESJWQC Tributaries
2/17/2016		Delta RMP						
3/7/2016		Delta RMP						
3/8/2016				WC-Storm	WC-Storm	WC-Storm	WC-Storm	ES-Storm
4/12/2016				WC-Irr	WC-Irr	WC-Irr	WC-Irr	ES-Irr
4/19/2016		Delta RMP						
5/10/2016	ES-Irr		ES-Irr	WC-Irr	WC-Irr	WC-Irr	WC-Irr	ES-Irr
5/18/2016		Delta RMP						
6/14/2016	ES-Irr		ES-Irr	WC-Irr	WC-Irr	WC-Irr	WC-Irr	ES-Irr
6/15/2016		Delta RMP						
7/12/2016	ES-Irr		ES-Irr	WC-Irr	WC-Irr	WC-Irr	WC-Irr	ES-Irr
7/13/2016		Delta RMP						
8/9/2016	ES-Irr		ES-Irr	WC-Irr	WC-Irr	WC-Irr	WC-Irr	ES-Irr
8/17/2016		Delta RMP						
9/13/2016	ES-Irr		ES-Irr	WC-Irr	WC-Irr	WC-Irr	WC-Irr	ES-Irr
9/20/2016		Delta RMP						

ES – East San Joaquin Water Quality Coalition
Delta RMP – Delta Regional Monitoring Program
WC – Westside San Joaquin River Watershed Coalition

Storm – Storm
Irr - Irrigation
NI - Non-irrigation

PRECISION, ACCURACY AND COMPLETENESS

Samples were collected monthly by the Delta RMP for the San Joaquin River at Airport Way near Vernalis according to the Delta RMP's QAPP (Delta RMP, 2016). The precision, accuracy and completeness of the Delta RMP's data set are not evaluated here but have been assessed through an annual quality control report which is currently under review. The Delta RMP's data set was downloaded from the California Environmental Data Exchange Network (CEDEN) (CEDEN, 2017).

The sections below include an assessment of completeness, precision, and accuracy for the data generated for the five remaining TMDL LSJR compliance sites sampled by the ESJWQC and WSJRWC during the 2016 WY. Data set completeness is determined based on whether samples were collected according to the schedule, received and analyzed by the laboratory, and the required QC was performed. Table 12 and Table 13 include counts and percentages for completeness per method and analyte for the 2016 WY.

Precision and accuracy are evaluated based on data quality objectives (DQOs) as outlined in each Coalition's QAPP. Table 14 includes each Coalition's summary of holding time evaluations for samples collected and Table 15 includes counts of each measure of precision and accuracy evaluated for the TMDL LSJR sites. Data generated for the Coalitions must meet DQOs 90% of the time for QC samples within the reporting period. When data do not meet DQOs within the 90% completeness, data are reviewed for overall quality on batch and sample levels for usability. This section details the instances when DQOs did not achieve the 90% requirement and provides rationale for accepting the data.

All results that do not meet DQOs are flagged using CEDEN codes. The Coalition works with the Central Valley Regional Data Center (CV RDC) to ensure that all data remain CEDEN comparable and that all data are suitable to be uploaded to CEDEN. Data generated for the 2016 WY are included in Appendix I and II.

COMPLETENESS

Completeness is assessed on three levels: field and transport completeness, analytical completeness, and batch completeness. Field and transport completeness may be less than 100% due to bottle breakage during sample transport to the laboratory or inability to access a site. Analytical completeness is based on the number of samples successfully analyzed by the laboratory relative to the number of samples collected. Analytical completeness may be less than 100% due to bottles breaking while at the laboratory or if an analysis failed or was not performed due to laboratory error. Batches discussed in this section of the report refer to samples (both field and QC samples) that are analyzed together on the same instrument. Batches include no more than 20 field samples in a single analysis with the associated QC. Batch completeness assesses whether chemistry batches were processed with the required QC samples as prescribed in each Coalition's QAPP.

Field and Transport Completeness

Field and transport completeness is measured by counting the number of sampled sites divided by the number scheduled sites. Monitoring occurred 10 times at the three WSJRWC compliance sites and six times at two of the ESJWQC compliance sites. Both Coalitions coordinated sampling events to occur on the same day. Sample collection was performed according to the SOPs in each Coalition's QAPP.

Measurements for the field parameters, DO, pH, SC, and water temperature were taken at each site sampled. Discharge is measured by utilizing California Data Exchange Center (CDEC) gauges near each sampling location (Table 9). When field sampling is complete, the CDEC website is accessed to record the discharge measured by the gauge that occurred at approximately the same time samples were collected. Field parameter and discharge completeness was 99% for the 2016 WY (Table 12).

Table 12. ESJWQC and WSJRWC field and transport completeness for chlorpyrifos and diazinon samples and field parameters.

Method	Analyte	Environmental Samples Scheduled	Environmental Samples Collected	Field and Transport Completeness
EPA 8141A	Chlorpyrifos	42	42	100.0
EPA 8141A	Diazinon	42	42	100.0
CDEC	Discharge, cfs	42	42	100.0
SM 4500-O	Dissolved Oxygen, mg/L	42	41	97.6
EPA 150.1	pH	42	41	97.6
EPA 120.1	Specific Conductivity, µg/cm	42	42	100.0
SM 2550	Water Temperature, °C°	42	42	100.0
	Total	**294**	**292**	**99.3**

EPA – Environmental Protection Agency
CDEC - California Data Exchange Center
SM – Standard Method

Analytical Completeness

Analytical completeness is assessed by counting the number of samples analyzed divided by the number of sample collected. During the 2016 WY, 74 environmental and field QC samples were collected for the analysis of chlorpyrifos and diazinon. All scheduled samples were collected and analytical completeness was 100% (Table 13).

Environmental, field duplicates, and field blank samples were collected in the field, and received and analyzed by the laboratory. Field QC samples (field duplicates and field blanks) may be collected from tributaries or the LSJR as long as all samples are collected on the same day during the same sampling event. Field blanks and field duplicates must be collected for each monitoring event and make up 5% of the total samples collected. Field blank and field duplicate samples made up 21.6% of the total samples collected by the ESJWQC and WSJRWC sites during the 2016 WY (Table 13). Therefore, field duplicates and field blank samples met the 5% requirement for completeness.

Table 13. ESJWQC and WSJRWC analytical completeness for chlorpyrifos and diazinon samples.

Method	Analyte	Environmental and Field QC Samples Collected	Environmental and Field QC Samples Analyzed	Environmental Sample completeness (%)	Field Blanks Samples	Field Blank Samples (%)	Field Duplicate Samples	Field Duplicate Samples (%)
EPA 8141A	Chlorpyrifos	74	74	100.0	16	21.6	16	21.6
EPA 8141A	Diazinon	74	74	100.0	16	21.6	16	21.6
	Total	**148**	**148**	**100.0**	**32**	**21.6**	**32**	**21.6**

Batch Completeness

Batch completeness is measured to determine if all batch QC samples were analyzed in all TMDL batches. A complete batch must have a minimum of one laboratory blank (method blank), one laboratory duplicate, one LCS, and one MS. Tributary samples ran in the same batch as LSJR TMDL samples can be used to evaluate the accuracy and/or precision of a laboratory batch. When ESJWQC tributary sites are used to fulfill batch requirements for batches containing LSJR samples, they are logged in as non-project samples. However, QC samples collected from WSJRWC tributary sites are logged in as the same project. During the 2016 WY, 16 batches containing LSJR sites were run and all batch requirements were met.

Hold Time Compliance

Samples analyzed for method EPA 8141A must be extracted within 7 days and analyzed within 40 days (Table 14). All samples were extracted and analyzed within hold time (Table 14).

Table 14. ESJWQC and WSJRWC summary of holding time evaluations for environmental, Field Blank, Field Duplicate, and Matrix Spike samples.

Method	Analyte	Data Quality Objective	Number of Samples Analyzed	Samples analyzed within hold time	Acceptability Met (%)
EPA 8141A	Chlorpyrifos	Extract within 7 days, analyze in 40 days	106	106	100.0
EPA 8141A	Diazinon	Extract within 7 days, analyze in 40 days	106	106	100.0
		Total	**212**	**212**	**100.0**

SUMMARY OF PRECISION AND ACCURACY

Data quality objectives (DQOs) are established criteria that QC samples must meet to demonstrate precision and accuracy as well as rule out sources of contamination in procedures conducted in the field and in the laboratory. Accuracy is demonstrated by evaluating the percent recovery (PR) of chlorpyrifos and diazinon in Matrix Spikes (MS), Laboratory Control Spikes (LCS), and surrogate samples. Laboratory precision is demonstrated by evaluating the relative percent difference (RPD) between MS and MSD and LCS and LCSD samples. In turn, field precision is demonstrated by evaluating the RPD between an environmental sample and field duplicate sample collected at the same time. Contamination is assessed by analyzing field blank and laboratory blank samples.

For some chemical constituents, the concentration in the environmental sample may exceed the highest point on the calibration curve and could only be accurately quantified by diluting the sample. The result reported is the concentration of the diluted sample multiplied by the dilution factor to represent the amount of the analyte present in the original sample. Diluted samples are flagged accordingly in the database. The reporting limit (RL) associated with a diluted sample is multiplied by the dilution factor, thereby, increasing the reporting limit. Therefore, for each dilution that occurs, there is a corresponding increase in the limit of quantification.

Results reported above the associated reporting limit (RL) indicate concentrations that are reliably and accurately detected by the instrument. Laboratories report all detections, even when analytes are detected below the RL. Results between the RL and the minimum detection limit (MDL) are "J flagged" in the final laboratory reports and assigned the "DNQ" (Detected but Not Quantifiable) in the water quality database.

Quality Control samples ran in batches with LSJR TMDL samples met DQOs in more than 90% of the samples (Table 15). Therefore, all the data were accepted and are useable.

Table 15. ESJWQC and WSJRWC summary of QC sample evaluations for the 2016 WY.
Samples that did not meet the 90% or greater acceptability requirement are bolded in black.

QC Sample Type	Analyte	Data Quality Objective	Number of Samples	Samples Meeting Acceptability Criterion	Acceptability Met (%)
Field Blank	Chlorpyrifos	<RL or < (env sample/5)	16	16	100.0
Field Blank	Diazinon	<RL or < (env sample/5)	16	16	100.0
		FB Total	**32**	**32**	**100.0**
Field Duplicate	Chlorpyrifos	RPD ≤ 25%	16	16	100.0
Field Duplicate	Diazinon	RPD ≤ 25%	16	16	100.0
		FD Total	**32**	**32**	**100.0**
Laboratory Blank	Chlorpyrifos	<RL	16	16	100.0
Laboratory Blank	Diazinon	<RL	16	16	100.0
		LB Total	**32**	**32**	**100.0**
Surrogate	Tributylphosphate	PR 60%-150%	64	63	98.4
Surrogate	Triphenyl phosphate	PR 56%-129%	64	62	96.9
		Surrogate Total	**128**	**125**	**97.7**
MS	Chlorpyrifos	PR 40%-144%	12	11	91.7
MS	Chlorpyrifos	PR 61%-125%	20	20	100.0
MS	Diazinon	PR 45%-130%	12	11	91.7
MS	Diazinon	PR 57%-130%	20	20	100.0
		MS Total	**64**	**62**	**96.9**
MSD pairs	Chlorpyrifos	RPD ≤ 25%	16	15	93.8
MSD pairs	Diazinon	RPD ≤ 25%	16	15	93.8
		MSD Total	**32**	**30**	**93.8**
LCS	Chlorpyrifos	PR 40%-144%	6	6	100.0
LCS	Chlorpyrifos	PR 61%-125%	10	10	100.0
LCS	Diazinon	PR 45%-130%	6	6	100.0
LCS	Diazinon	PR 57%-130%	10	10	100.0
		LCS Total	**32**	**32**	**100.0**

Corrective Actions

Corrective action is an activity that should be used to stop the re-occurrence of non-conformities. In some cases, the Coalitions will address corrective action options to improve QC measures that are consistently demonstrating failure to meet DQOs. During the 2016 WY, no corrective actions were necessary.

COMPARISON WITH TMDL OBJECTIVES

Monitoring of the six compliance points in the LSJR during the 2016 WY was designed to assess compliance with Objective 1. Objectives 2 through 7 are addressed individually by each Coalition through an assessment of results and outcomes of actions taken (e.g. monitoring and outreach) to meet the specifications of either Coalition's ILRP monitoring program. The following sections assess the ESJWQC's and WSJRWC's compliance with the seven TMDL objectives.

OBJECTIVE 1: DETERMINE COMPLIANCE WITH ESTABLISHED WATER QUALITY OBJECTIVES AND THE LOADING CAPACITY APPLICABLE TO DIAZINON AND CHLORPYRIFOS IN THE LOWER SAN JOAQUIN RIVER

Water Quality Objectives

During 2016 WY, the Coalitions evaluated compliance with the chlorpyrifos and diazinon WQOs (listed in the Monitoring Objectives section of this report in Table 1) by reviewing monitoring results from the LSJR compliance points listed in Table 3. Chlorpyrifos was detected on September 20, 2016 and diazinon was detected on January 19 and May 18, 2016 in the San Joaquin River at Airport Way near Vernalis compliance location in the 2016 WY; however, no exceedances of the WQOs for either chlorpyrifos or diazinon occurred, nor were the combined concentrations in exceedance of the TMDL loading capacity. Chlorpyrifos and diazinon were not detected at any of the remaining LSJR compliance locations. Complete environmental monitoring results are listed in Appendix I; complete quality control monitoring results, including field duplicates, are listed in Appendix II.

Loading Capacity

All samples collected from the LSJR sites during the 2016 WY were in compliance with the chlorpyrifos and diazinon loading capacities (Appendix III, Table III-1).

The Basin Plan Amendment required compliance with the loading capacity for the chlorpyrifos and diazinon TMDL in the LSJR by December 1, 2010. Table 16 includes a tally of the number of samples in compliance with the LSJR loading capacity before and after December 1, 2010. Prior to the compliance date, 13 samples (7%) collected from the LSJR compliance locations were out of compliance with the loading capacity (Table 16). Since the December 1, 2010 compliance date, 99% of the samples collected by the ESJWQC and WSJRWC from the LSJR have been in compliance with loading capacity.

Overall, of the 509 samples collected from the LSJR compliance points since July 2004, a total of 14 samples have been out of compliance and 97% have been in compliance with the load capacity (Table 16).

Table 16. Tally of chlorpyrifos and diazinon TMDL load capacity compliance per site before and after the compliance date of December 1, 2010.

Site Name	Sample Dates	Compliant	Out of Compliance	Total Samples Collected	Percent Compliant
Prior to Compliance Date (Dec. 1, 2010)[1]					
San Joaquin River at Sack Dam	Jul 2004 - Nov 2010	37	3	40	93%
San Joaquin River at Highway 165 near Stevinson	Jul 2004 - Nov 2010	82	2	84	98%
San Joaquin River at Hills Ferry Road	Mar 2010 - Oct 2010	4	0	4	100%
San Joaquin River at Las Palmas Avenue near Patterson	Apr 2008 - Nov 2010	28	8	36	78%
San Joaquin River at the Maze Boulevard (Highway 132) Bridge	Mar 2010 - Oct 2010	4	0	4	100%
San Joaquin River at the Airport Way Bridge near Vernalis	Jan 2006 - Aug 2006	32	0	33	97%
	Total	**187**	**13**	**201**	**93%**
After Compliance Date (Dec. 1, 2010)					
San Joaquin River at Sack Dam	Dec 2010 - Sep 2016	67	0	67	100%
San Joaquin River at Highway 165 near Stevinson[2]	Dec 2010 - Sep 2016	64	0	64	100%
San Joaquin River at Fremont Ford[2]	Dec 2010 - Feb 2012	4	0	4	100%
San Joaquin River at Hills Ferry Road	Dec 2010 - Sep 2016	33	0	33	100%
San Joaquin River at Las Palmas Avenue near Patterson	Dec 2010 - Sep 2016	67	1	68	99%
San Joaquin River at the Maze Boulevard (Highway 132) Bridge	Dec 2010 - Sep 2016	33	0	33	100%
San Joaquin River at the Airport Way Bridge near Vernalis	Dec 2010 - Sep 2016	39	0	39	100%
	Total	**307**	**1**	**308**	**99%**
	Grand Total	**494**	**14**	**509**	**97%**

[1] Data before December 2010 are from the WSJRWC ILRP monitoring program and from the monitoring conducted by the Regional Board to support the development and implementation of the chlorpyrifos and diazinon TMDL in the LSJR (Organophosphate TMDL Monitoring for the San Joaquin River (Region 5) project).

[2] Compliance monitoring occurred at the San Joaquin River at Fremont Ford site from November 2011 through February 2012 because road construction prevented access to the San Joaquin River at Highway 165 near Stevinson site.

OBJECTIVE 2: DETERMINE COMPLIANCE WITH ESTABLISHED LOAD ALLOCATIONS FOR DIAZINON AND CHLORPYRIFOS.

The ESJWQC and WSJRWC are required to assess compliance with load allocations for agricultural discharges to the LSJR for each of the five subareas (Table 3). The two Coalitions each characterize and assess water quality within their respective regions through their own strategies of representative monitoring at tributary sites (described in the ESJWQC approved 2016 WY MPU and the WSJRWC MRP). The following sections include a review of monitoring results from both Coalitions' respective tributary monitoring during the 2016 WY. The formula in Equation 1 is applied to tributary monitoring results to assess compliance with chlorpyrifos and diazinon load allocations.

ESJWQC Load Allocation Compliance

The ESJWQC monitored 16 tributary sites for chlorpyrifos and/or diazinon from October 2015 through September 2016 for a total of 108 monitoring events (Table 17). Of those 108 events, sites were dry 15 times (no water or insufficient flow volume to collect samples); these sites were considered 'dry' and no samples were collected. Dry sites count as a monitored event in the total number of sites monitored.

In total, 106 of the 108 tributary monitoring events during the 2016 WY were in compliance with load allocation (including dry sites). There were two exceedances of WQTLs for chlorpyrifos during ESJWQC tributary monitoring (Table 18). Further information concerning all exceedances of the WQTL for chlorpyrifos can be obtained in the ESJWQC Annual Report (submitted May 1, 2017).

The calculation of load allocations for all tributaries sampled during the 2016 WY is included in Appendix III (Tables III-2 -III-8). Concentrations of chemicals in Appendix III include only environmental samples collected. Samples not collected because the waterbody was considered dry (15 events) are not included in Appendix III. To identify the sources contributing to the exceedances of the WQOs in these samples, the PUR database was queried for applications of the constituents to parcels within the associated site subwatersheds four weeks prior to each exceedance.

Table 17. ESJWQC tributary monitoring schedule for chlorpyrifos (C) and diazinon (D) during the 2016 WY.

Subarea	Tributary Site Name	Monitoring Type	10/13/2015	11/10/2015	12/15/2015	1/7/2016	2/9/2016	3/8/2016	4/12/2016	5/10/2016	6/14/2016	7/12/2016	8/9/2016	9/13/2016
Bear Creek, Fresno-chowchilla	Berenda Slough along Ave 18 1/2	MPM								C	C	C		
	Deadman Creek @ Gurr Rd	MPM		C			C	C	C				C	C
	Dry Creek @ Rd 18	CSM	*	C,D	C,D	C,D	C,D	C,D	C,D	C,D	C,D	C,D	C,D	C,D
	Livingston Drain @ Robin Ave	MPM					C				C	C	C	
	Miles Creek @ Reilly Rd	CSM, MPM	*	*	C,D	C,D	C,D	C,D	C,D	C,D	C,D	C,D	C,D	C,D
	Deadman Creek @ Hwy 59	MPM	C				C		C				C	C
	Duck Slough @ Gurr Rd	MPM						C				C		
	Canal Creek @ West Bellevue Rd	CSM	C,D	C,D	C,D	C,D	C,D	C,D	C,D	C,D	C,D	C,D	C,D	C,D
Stanislaus	Mootz Drain downstream of Langworth Pond	MPM			C									
Turlock, Merced	Highline Canal @ Hwy 99	CSM, MPM	*	*	C,D	C,D	C,D	C,D	C,D	C,D	C,D	C,D	C,D	C,D
	Lateral 5 ½ @ South Blaker Rd	CSM	C,D	C,D	C,D	C,D	C,D	C,D	C,D	C,D	C,D	C,D	C,D	C,D
	Merced River @ Santa Fe	MPM	C	C								C	C	C
	Prairie Flower Drain @ Crows Landing Rd	MPM					C	C	C	C	C	C	C	C
Tuolumne River, Northeast Bank	Dry Creek @ Wellsford Rd	CSM, MPM	C,D	*	C,D	C,D	C,D	C,D	C,D	C,D	C,D	C,D	C,D	C,D
	Lateral 2 1/2 near Keyes Rd	MPM							C	C	C	C	C	
	Westport Drain @ Vivian Rd	MPM				C						C	C	

* - No monitoring due to Delta RMP contribution
CSM – Core Site Monitoring
MPM – Management Plan Monitoring
RSM – Represented Site Monitoring

Table 18. Chlorpyrifos and diazinon load allocation calculations for tributary sites in the ESJWQC out of compliance during the 2016 WY.

LSJR Subarea	Site Name	Sample Date	Chlorpyrifos	Diazinon	Load	Load Allocation Compliance
Turlock, Merced	Highline Canal @ Hwy 99	1/07/2016	0.018 µg/L	<0.004 µg/L	1.2	Out of compliance
Turlock, Merced	Merced River @ Santa Fe	11/10/2015	0.028 µg/L	<0.004 µg/L	1.9	Out of compliance

The concentration of chlorpyrifos in the sample collected during the storm sampling event from Merced River @ Santa Fe on November 10, 2015 was above the 0.015 µg/L WQTL (0.28 µg/L; Table 18). Prior to the November 2015 exceedance, the last exceedance of the WQTL for chlorpyrifos occurred in the Merced River @ Santa Fe site subwatershed on November 11, 2008. The PUR data associated with the November 2015 exceedance indicate eight applications of chlorpyrifos totaling 1,577 lbs of active ingredient (AI) were on 839 acres of grapes applied from November 4 through 6, 2015. The waterbody was flowing at 294 cfs at the time of collection.

The concentration of chlorpyrifos in the sample collected during the storm sampling event from Highline Canal @ Hwy 99 on January 7, 2016 was above the 0.015 µg/L WQTL (0.018 µg/L; Table 18). The waterbody was flowing at 4.89 cfs at the time of collection. The last exceedance of the WQTL for chlorpyrifos to occur in the Highline Canal @ Hwy 99 site subwatershed was on January 13, 2015. The PUR data associated with the January 2016 exceedance indicate three applications of chlorpyrifos occurred from January 1 through 2, 2016 and totaled 65 lbs of AI on 44 acres of peaches.

During the 2016 WY, 98% of the samples were compliant (Table 19) with load allocation. None of the exceedances of the WQTL for chlorpyrifos in the ESJWQC tributaries affected load compliance in the LSJR. Overall, 95% of samples collected from ESJWQC tributaries have been compliant with load allocations since the inception of TMDL monitoring in January 2010. Further information about exceedances from the 2016 WY is included in the ESJWQC Annual Report (submitted May 1, 2017).

Table 19. Tally of ESJWQC chlorpyrifos and diazinon TMDL load allocation compliance for each subarea since inception of San Joaquin River monitoring (January 2010 through September 2016).

Subarea	WY	In Compliance	Out of compliance	Samples Collected	Percent in Compliance
Bear Creek, Fresno-Chowchilla	2010	19	5	24	79%
	2011	56	3	59	95%
	2012	34	0	34	100%
	2013	49	1	50	98%
	2014	67	1	68	99%
	2015	59	1	60	98%
	2016	41	0	41	100%
Stanislaus River, North Stanislaus	2010	9	0	9	100%
	2011	10	0	10	100%
	2012	12	0	12	100%
	2013	9	0	9	100%
Stevinson, Grassland	2013	10	0	10	100%
	2014	2	0	2	100%
Tuolumne River, Northeast Bank	2010	7	3	10	70%
	2011	12	0	12	100%
	2012	3	0	3	100%

Subarea	WY	In Compliance	Out of compliance	Samples Collected	Percent in Compliance
	2013	4	1	5	80%
	2014	19	2	21	90%
	2015	21	0	21	100%
	2016	19	0	19	100%
Turlock, Merced	2010	12	1	13	92%
	2011	34	0	34	100%
	2012	29	0	29	100%
	2013	32	0	32	100%
	2014	38	0	38	100%
	2015	29	7	36	81%
	2016	32	2	34	94%
Totals					
2010 WY		47	9	56	84%
2011 WY		112	3	115	97%
2012 WY		78	0	78	100%
2013 WY		104	2	106	98%
2014 WY		126	3	129	98%
2015 WY		109	8	117	93%
2016 WY		92	2	94	98%
Grand Total		**450**	**22**	**472**	**95%**

WSJRWC Load Allocation Compliance

The WSJRWC collected monthly samples from tributary sites entering the LSJR from October 2015 through September 2016 in accordance with its MRP (Table 20). Due largely to the preceding dry years, the 2016 WY was categorized as a below-normal year for rainfall, although there were a number significant storm events during the non-irrigation season. The WSJRWC collected storm samples from tributary sites on January 7, 2016 and March 8, 2016.

Table 20. WSJRWC tributary monitoring schedule during the 2016 WY.

Monitoring Site	Non-Irrigation Season			Irrigation Season						N.I.
	Event 128	Event R18	Event 129	Event R19	Event 130	Event 131	Event 132	Event 133	Event 134	Event 135
	Oct	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept
Hospital Cr at River Road	NP	NF	NP	S	NF	S	S	S	S	NP
Ingram Cr at River Road	NF	S	NF	S	S	S	S	S	S	S
Westley Wasteway near Cox Road	NF	NA	NF	NA	NF	S	S	S	S	S
Del Puerto Cr near Cox Road	S	NF	NF	S	S	S	S	S	S	S
Del Puerto Cr at Hwy 33	NP	NF	NP	S	NP	NP	NP	NP	NP	NP
Ramona Lake near Fig Avenue	NF	NA	NF	NF	NF	NF	NF	NF	NF	S
Marshall Road Drain near River Road	NF	S	NF	S	NF	NF	NF	S	NF	NF
Orestimba Cr at River Road	NF	NF	NF	S	NF	NF	NF	NF	NF	NF
Orestimba Cr at Hwy 33	NP	NF	NP	S	NF	NF	NF	NF	NF	NP
Newman Wasteway near Hills Ferry Road	S	S	S	S	S	S	S	S	S	S
Mud Slough u/s San Luis Drain	S	S	S	S	S	S	S	S	S	S
Salt Slough at Lander Avenue	S	S	S	S	S	S	S	S	S	S

Monitoring Site	Non-Irrigation Season			Irrigation Season						N.I.
Salt Slough at Sand Dam	NP	S	NP	S	S	S	S	S	S	NP
Los Banos Creek at Highway 140	S	S	S	S	S	S	S	S	S	S
Los Banos Creek at China Camp Road	S	S	S	S	S	S	S	S	S	S
Blewett Drain near Highway 132	NF	NF	NF	NA	NA	S	S	S	S	NF
Poso Slough at Indiana Avenue	S	NF	NF	S	S	S	S	S	S	S
Delta Mendota Canal at Del Puerto WD	S	S	S	S	S	S	S	S	S	S

N.I. – Non-Irrigation Season
NA -- Not Sampled due to lack of safe access
NF -- Not sampled due to lack of flow
NP -- Not planned for sampling
S -- Sampled

Although there were no exceedances of either the chlorpyrifos or diazinon WQTL in the LSJR samples, chlorpyrifos was detected in four samples collected from three tributary sites (spanning three different monitoring events). All of these detections exceeded the chlorpyrifos WQO and were in excess of the load criteria. There were no detections of diazinon in any of the water samples for this monitoring period.

Table 21 lists the sites and dates where chlorpyrifos was detected. The WSJRWC's November 2016 AMR includes a discussion of these detections, as well as other pesticide detections. A tabulation of load allocations for all tributary results is included in Appendix III.

Table 22 provides load allocations for WSJRWC tributaries for each subarea. Overall, the percentage of load allocations in compliance during the 2016 WY (95%) indicates continued improvement over 2015 WY (93%) and 2014 WY (89%) and since the 2010 (January – September; 79%) when implementation of the TMDL program first began.

Table 21. Chlorpyrifos and diazinon load allocation calculations for tributary sites in the WSJRWC out of compliance during the 2016 WY.

Main Stem Monitoring Point	Tributary Site	Sample Date	Sample Event	Flow (cfs)	Chlorpyrifos (µg/L)	Diazinon (µg/L)	Load	Load Allocation Compliance
Greater Orestimba	Marshall Road Drain near River Road	1/7/2016	R18	0.2	0.017	<0.004	1.13	Out of compliance
	Marshall Road Drain near River Road	7/12/2016	133	Low	0.025	<0.004	1.67	Out of compliance
Stevinson, Grassland	Los Banos Creek at China Camp Road	1/7/2016	R18	9	0.022	<0.004	1.47	Out of compliance
	Salt Slough at Sand Dam	8/9/2016	134	46	0.058	<0.004	3.87	Out of compliance
Westside Creek	No Detections	-	-	-	-	-	-	-

Table 22. Tally of WSJRWC chlorpyrifos and diazinon TMDL load allocation compliance per each of the subareas.

Subarea	WY	In Compliance	Out of compliance	Samples Collected	Percent in Compliance
Greater Orestimba	2010	18	12	30	60%
	2011	26	7	33	79%
	2012	30	1	31	96%
	2013	16	3	19	84%
	2014	19	1	20	95%
	2015	16	0	16	100%
	2016	3	2	5	60%
Stevinson, Grassland	2010	70	4	74	95%
	2011	87	3	90	97%
	2012	87	4	91	96%
	2013	65	6	71	92%
	2014	61	11	72	85%
	2015	71	1	72	99%
	2016	54	2	56	96%
Westside Creeks	2010	18	13	31	58%
	2011	30	6	36	83%
	2012	36	5	41	88%
	2013	19	6	25	76%
	2014	31	2	33	94%
	2015	37	8	45	82%
	2016	28	0	28	100%
Totals					
2010 WY		106	29	135	79%
2011 WY		143	16	159	90%
2012 WY		153	10	163	94%
2013 WY		100	15	115	87%
2014 WY		111	14	125	89%
2015 WY		124	9	133	93%
2016 WY		85	4	89	95%
Grand Total		**822**	**97**	**919**	**89%**

Data in the table represents complete data sets for 2010 through 2016 WY.

The PUR data listed in Table 23 were provided by the county agricultural commissioners and are summarized for the sites listed in Table 21. The PUR data summary is organized by site and material AI, and includes the number of treatments and total acres treated of each commodity. Available PUR data identified 9 separate pesticide applications within subwatersheds where chlorpyrifos was detected during sampling. However, it is worth noting that no chlorpyrifos applications were reported within 60 days of the January 7, 2016 sample event when chlorpyrifos was detected at both Marshall Road Drain and Los Banos Creek at China Camp Road.

Table 23. Chlorpyrifos and diazinon applications made four weeks prior in subwatersheds with exceedances in the WSJRWC region.

Only listed applications based on available PUR data are shown.

Tributary Name	Material	Application Month	Commodity	Number of Applications*	Acres Treated*
Marshall Road Drain	Chlorpyrifos	June	Walnuts	1	30
Salt Slough at Sand Dam	Chlorpyrifos	August	Alfalfa	8	516

*PUR data are provisional and subject to change.

OBJECTIVE 3: DETERMINE DEGREE OF IMPLEMENTATION OF MANAGEMENT PRACTICES AND STRATEGIES TO REDUCE OFF-SITE MOVEMENT OF DIAZINON AND CHLORPYRIFOS

Each Coalition developed their own management practice tracking and evaluation strategies suitable for their regions and members (ESJWQC Management Plan submitted September 30, 2008 and WSJRWC Management Plan and Focused Management Plan submitted October 23, 2008). The ESJWQC revised the Surface Water Quality Management Plan (SQMP) on May 1, 2014 (resubmitted March 10, 2015 and approved November 4, 2015). The WSJRWC submitted the SQMP on August 15, 2016, revised on April 14, 2017 (approval pending). The Coalitions reviewed results of their respective strategies to determine the degree of implementation of management practices and strategies to reduce the offsite movement of chlorpyrifos and diazinon.

Management Practices Implemented in ESJWQC to Reduce the Off-Site Movement of Chlorpyrifos and Diazinon

When one exceedance of the WQO for chlorpyrifos or diazinon occurs at a tributary monitoring location in the ESJWQC region, a management plan for the site subwatershed is initiated. The Coalition's Management Plan Strategy involves source identification, focused outreach, and management plan evaluation through monitoring. The Coalition will conduct Focused Outreach within three years of an exceedance of chlorpyrifos and diazinon in a site subwatershed. The ESJ WDR requires management plans be complete within the shortest amount of time as practical and the compliance date must not exceed 10 years from the date the management plan is reported to the Regional Board. When a site subwatershed is scheduled for focused outreach, the ESJWQC develops a three year process designed to document current management practices (Year 1), encourage and document the implementation of new management practices (Years 1 and 2), and evaluate the effectiveness of outreach in the site subwatershed via Management Plan Monitoring (MPM) for management plan constituents (Years 1-3). Members with the greatest potential to influence water quality are targeted for focused outreach. These are growers with the potential for direct drainage and growers with past applications of management plan constituents (i.e. chlorpyrifos or diazinon). The focused outreach and management practice documentation rotates to additional site subwatersheds annually.

The ESJWQC outreach activities and actions to address water quality exceedances during the 2016 WY are documented in the ESJWQC May 1, 2017 Annual Report. A major goal of ESJWQC outreach is to assist members in identifying management practices that can be implemented to eliminate the offsite movement of agricultural constituents. Below are five categories of management practices identified as being effective in reducing the offsite movement of chlorpyrifos and diazinon:

- Irrigation Water Management
- Storm Drainage Management
- Erosion and Sediment Management
- Pest Management
- Dormant Spray Management

The ESJWQC has completed its focused outreach strategy in the first through seventh priority site subwatersheds which included documenting all current and newly implemented management practices for targeted member parcels. The ESJWQC has completed individual meetings with targeted growers and documenting new management practices for 2016 Focused Outreach site subwatersheds (Dry Creek @ Wellsford Rd, Duck Slough @ Gurr Rd, Highline Canal @ Hwy 99, and Prairie Flower Drain @ Crows Landing Rd) and is in the process of following up with growers to inquire if recommended management practices were implemented. In addition, the Coalition is in the process of contacting targeted growers for 2017 Focused Outreach in the Dry Creek @ Rd 18, Lateral 2 ½ near Keyes Rd, Livingston Drain @ Robin Ave, and Miles Creek @ Reilly Rd site subwatersheds. None of the 2017 Focused Outreach sites are in a management plan for chlorpyrifos and the management plan for diazinon at Miles Creek was included in the management plan completion request sent to the Regional Board on December 7, 2016. More information on focused outreach and the status of management plans is included in the ESJWQC May 1, 2017 Annual Report.

Targeted growers in the first through seventh priority site subwatersheds indicated they implemented management practices within each of the above categories before focused ESJWQC outreach. Several growers implemented new management practices in each of these categories following outreach. Figure 7 includes the acreage associated with management practices implemented before ESJWQC outreach (previously implemented) and after ESJWQC focused outreach (newly implemented) in the first through seventh priority site subwatersheds. The acreage represented in Figure 7 is associated with at least one management practice per each of the five categories, but acreage may have multiple practices implemented within a category (acreage is only counted once per each category). The majority of the targeted acres have at least one management practice designed to address erosion and sediment management, irrigation management, and pest management. The newly implemented practices are focused on irrigation management, pest management, and storm drainage management.

Within each of the five categories, growers implemented various management practices (Table 24). Table 24 lists all the acreage associated with applicable management practices; therefore, acreage associated with a certain grower may be represented more than once. Pest management practices such as adjusting spray nozzles to match crop canopy profile and using nozzles that provide the largest effective droplet size to minimize drift are utilized by almost every targeted grower. Other common practices include laser leveling fields and planting or allowing vegetation to grow along ditches.

Figure 7. Acreage with one or more implemented management practice per each category in the ESJWQC first through seventh priority subwatersheds. Targeted acreage associated with grower displayed if one or more practice(s) are implemented per category. Several practices serve multiple purposes and fall into more than one category, but practices are counted only once with their primary category.

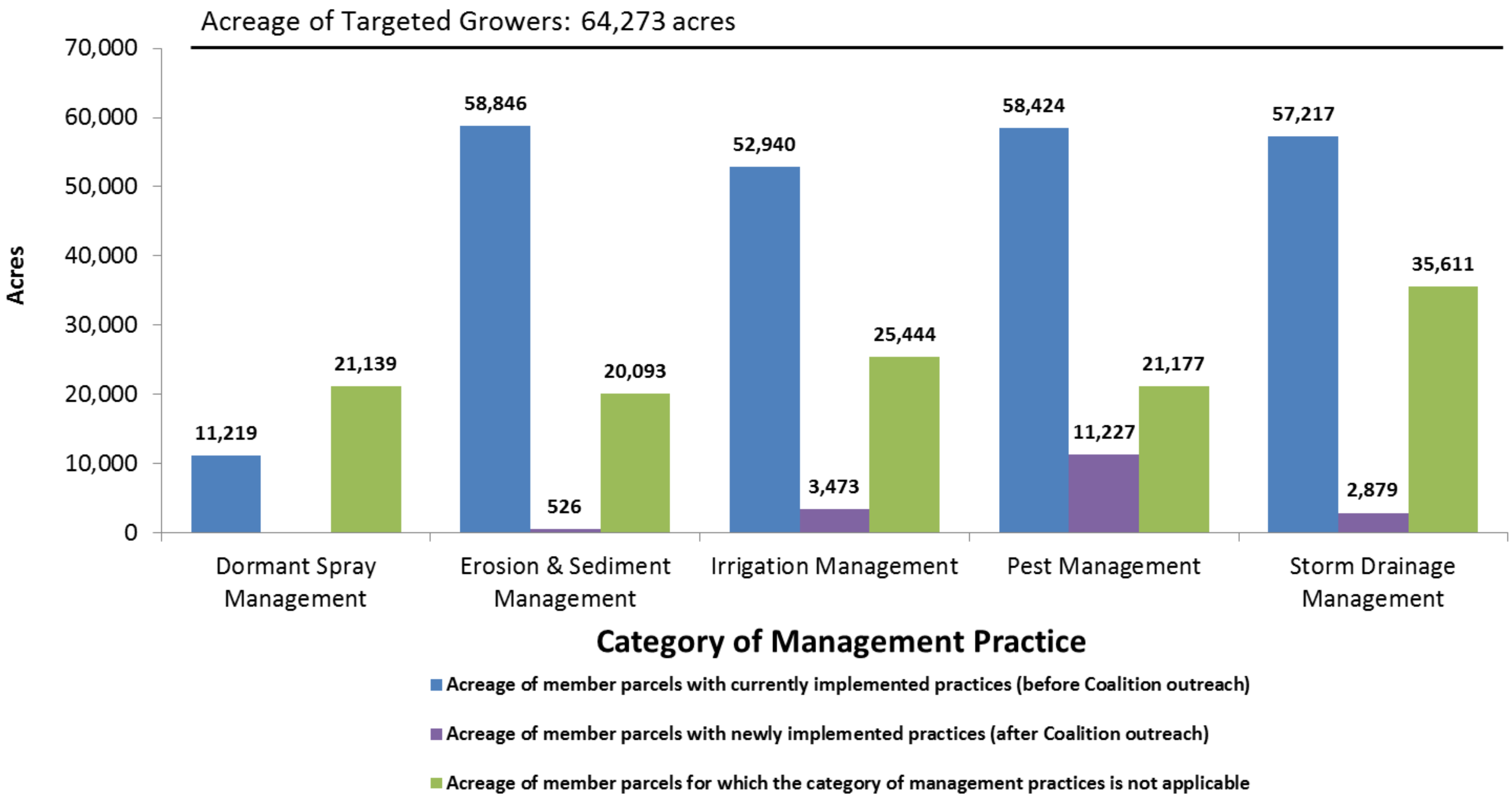


Table 24. Current and newly implemented management practices designed to reduce offsite movement of chlorpyrifos and diazinon in the first through seventh priority site subwatersheds of the ESJWQC region.

Site subwatersheds listed by TMDL subarea.

Category	Management Practice	Bear Creek, Fresno-Chowchilla		Tuolumne River, Northeast Bank		Turlock, Merced		Total	
		Growers	Acres	Growers	Acres	Growers	Acres	Growers	Acres
Dormant Spray Management	Check weather conditions prior to spraying (i.e. storm status)	25	8,416	7	532	13	3,777	45	12,724
	Do not apply dormant spray when moisture is at field capacity	8	3,301	4	302	9	3,056	21	6,659
	Maintain setback zones	25	8,416	5	281	10	2,824	40	11,520
	Vegetation cover and/or disked	16	5,565	10	712	3	201	29	6,478
Erosion & Sediment Management	Constructed wetlands	2	363	2	2,515	2	921	6	3,799
	Grass Row Centers (Orchards, Vineyards)	122	30,182	43	7,075	37	12,375	202	49,632
	Maintain vegetated filter strips around field perimeter at least 10' wide	122	26,700	27	6,435	39	10,195	188	43,329
	Riparian vegetation / fences prevents livestock access to water	6	640	2	53	-	-	8	693
	Vegetation is planted along or allowed to grow along ditches	105	27,620	27	6,740	28	12,103	160	46,463
Irrigation Management	Determine Irrigation Schedule by Actual Moisture Levels in Soil/Crop Needs	164	37,007	24	5,753	42	10,602	230	53,362
	Drainage basins (sediment ponds)	38	13,863	8	3,376	14	4,605	60	21,845
	Drip irrigation, other	6	408	1	77	37	6,765	44	7,250
	Laser leveled fields	131	27,556	48	7,553	26	9,264	205	44,373
	Microirrigation	101	27,624	25	6,721	3	269	129	34,614
	Polyacrylamide (PAM)	1	15	1	2,450	18	8,062	20	10,527
	Recirculation - Tailwater return system	54	15,834	9	4,181	7	1,010	70	21,025
	Reduce Amount of Water Used in Surface Irrigation	12	1,903	1	162	4	317	17	2,382
Pest Management	Adjust spray nozzles to match crop canopy profile	159	36,923	55	8,847	58	16,094	272	61,864
	Calibrate spray equipment prior to each application	146	33,551	69	9,832	48	12,382	263	55,765
	Shut off outside nozzles when spraying outer rows next to sensitive sites	157	35,423	53	8,716	59	16,596	269	60,735
	Spray areas close to waterbodies when the wind is blowing away from them	168	37,423	54	8,679	68	17,021	290	63,123
	Use air blast applications when wind is between 3-10 mph and upwind of a sensitive site	103	19,079	34	6,559	31	7,594	168	33,232
	Use electronic controlled sprayer nozzles	13	2,085	3	2,555	8	807	24	5,447
	Use nozzles that provide largest effective droplet size to minimize drift	167	38,689	54	8,749	64	15,995	285	63,433
Storm Drainage	Berms Between Field & Waterway	26	4,942	5	641	15	8,428	46	14,011
	Device Controls Timing of Pump/Drain into Waterway	22	6,389	2	3,147	8	1,445	32	10,981
	No Storm Drainage	31	8,560	6	327	58	21,736	95	30,622
	Recirculation - Tailwater return system	35	12,046	4	209	6	1,223	45	13,478
	Settling Pond	31	13,374	5	2,624	12	5,140	48	21,139

WSJRWC Implementation of Management Practices to Reduce Offsite Movement of Diazinon and Chlorpyrifos

In 2008, the WSJRWC adopted a Management Plan to address water quality exceedances detected by the monitoring order. Although the Management Plan outlined area specific measures based on the exceedances in that region, identified management practices for pesticides (including chlorpyrifos and diazinon) are uniform for the entire WSJRWC region. These measures include:

- Construct sediment basins to intercept tailwater.
- Install high-efficiency irrigation systems such as sprinkler or drip irrigation, tailwater recirculation, gated pipes, shorter runs, etc., where warranted by the crops that are grown.
- Implement additional use of polyacrylamide (PAM) to address sedimentation discharge.
- Reduce use of pesticides, or incorporate use of pesticides that are less likely to be transported to the State waterways, or which breakdown quickly and are less likely to impact water quality.
- Calibrate ground spray rigs utilized on farmed acres to address possible overspray.
- Address potential aerial overspray by identifying the sensitive regions for all aerial applicators, or elimination of this as an acceptable application procedure.
- Increase size of vegetated buffer zones along the perimeters waterways.

As a mechanism to encourage and track the implementation of management practices, the WSJRWC has implemented an aggressive outreach program that includes meetings with individual growers, workshops, sponsorship of integrated pest management programs (such as the Sustainable Cotton Program) and a detailed management practice inventory survey (through the Farm Evaluation Plan) to determine what management practices have already been implemented. A status update of management plan implementation is included in Attachment 6 of each AMR. Table 25 summarizes the pesticide management practice data for the WSJRWC region submitted through the 2015 Farm Evaluation plans. In addition to these actions, a staff person from the WSJRWC travels through the Coalition area frequently to review irrigation activities, drainage conditions, and meet with growers to review management practice implementation. All of these management practices are implemented at the farm-level and driven by a variety of factors, including water supply, crop values, soil quality, and regulatory pressures.

The WSJRWC performed targeted outreach for chlorpyrifos exceedances during this monitoring period, and meet with specific growers within the watersheds with exceedances.

Table 25. Management practice inventory data for subwatersheds in the WSJRWC region (2015 FE data). The values are the percent of irrigated acreage.

Practice	Blewett Drain	Del Puerto Creek	Hospital Creek	Ingram Creek	Los Banos Creek	Marshall Road Drain	Mud Slough	Newman Wasteway	Orestimba Creek	Ramona Lake	Salt Slough	SJR at Lander Ave	Spanish Land Grant Drain	Westley Wasteway
Attend Trainings	99%	93%	98%	76%	37%	81%	19%	80%	89%	96%	82%	100%	90%	92%
Avoid Surface Water When Spraying	100%	99%	100%	93%	37%	96%	19%	75%	90%	98%	82%	100%	98%	96%
County Permit Followed	100%	100%	98%	100%	38%	98%	19%	92%	98%	97%	84%	98%	100%	96%
End of Row Shutoff When Spraying	100%	97%	92%	100%	37%	95%	18%	73%	73%	97%	73%	73%	98%	96%
Follow Label Restrictions	100%	100%	100%	100%	38%	99%	19%	90%	95%	98%	84%	100%	98%	97%
Monitor Rain Forecasts	100%	98%	100%	94%	36%	88%	11%	67%	87%	97%	74%	95%	91%	96%
Monitor Wind Conditions	100%	100%	100%	100%	38%	98%	19%	78%	91%	98%	83%	98%	98%	97%
Reapply Rinsate to Treated Field	60%	71%	92%	84%	27%	75%	15%	41%	31%	95%	62%	51%	73%	48%
Sensitive Areas Mapped	49%	44%	27%	55%	36%	44%	18%	45%	49%	27%	43%	41%	49%	59%
Target Sensing Sprayer used	63%	15%	14%	0%	4%	24%	9%	13%	11%	10%	29%	19%	13%	5%
Use Appropriate Buffer Zones	100%	91%	99%	78%	25%	88%	12%	64%	82%	97%	76%	92%	74%	91%
Use Drift Control Agents	100%	91%	80%	84%	36%	91%	19%	59%	61%	96%	78%	96%	96%	96%
Use PCA Recommendations	100%	100%	100%	100%	37%	98%	12%	80%	93%	97%	79%	94%	91%	96%
Use Vegetated Drain Ditches	49%	65%	49%	49%	13%	49%	5%	28%	46%	87%	21%	16%	29%	63%

OBJECTIVE 4: DETERMINE DEGREE OF EFFECTIVENESS OF MANAGEMENT PRACTICES AND STRATEGIES TO REDUCE OFF-SITE MOVEMENT OF DIAZINON AND CHLORPYRIFOS

The Coalitions review management practice effectiveness at the site subwatershed level within their regions to demonstrate management practice effectiveness. This evaluation is in addition to demonstrating improved water quality in the LSJR.

ESJWQC Effectiveness of Management Practices to Reduce Offsite Movement of Diazinon and Chlorpyrifos

The ESJWQC uses monitoring results to evaluate the effectiveness of current and newly implemented management practices. The following evaluation is based on the monitoring results from 2016 WY.

The ESJWQC began conducting focused outreach in 2008. The result of focused outreach has been the implementation of new management practices designed to address the offsite movement of agricultural constituents, including chlorpyrifos and diazinon, in site subwatersheds across the ESJWQC region (Figure 7 and Table 24). Results from MPM during months of past exceedances and months of high pesticide use, in addition to monthly monitoring at Core sites, indicate focused outreach and the implementation of new management practices since outreach began through the 2016 WY coincide with an overall decrease in chlorpyrifos and diazinon exceedances (Table 26).

In 2008, prior to focused outreach and implementation of new management practices, the number of exceedances of the WQTLs for chlorpyrifos and diazinon were 22 and two (2), respectively. For chlorpyrifos, the 22 exceedances of the WQTL for chlorpyrifos equates to 11% of samples collected in that year in the first through seventh priority subwatersheds (Table 26). With the implementation of focused outreach and new management practices, the average percentage of samples resulting in an exceedance of the chlorpyrifos WQTL has decreased. In the 2016 WY, there were two (2) exceedances of the WQTL for chlorpyrifos or 2% of the samples collected. Only three exceedances of the WQTL for diazinon have occurred in total since 2008 (two in 2008 and one in 2013), with none occurring in the 2016 WY (Table 26). Seven out of the nine years monitored since 2008 have included no exceedances of the WQTL for diazinon. Overall, the average percentage of samples resulting in an exceedance of the diazinon WQTL has decreased from 1% to below 1% since 2008.

Two exceedances of the WQTL for chlorpyrifos occurred during the 2016 WY in site subwatersheds where focused outreach occurred previously (Highline Canal @ Hwy 99 and Merced River @ Santa Fe). The ESJWQC established a management plan for chlorpyrifos in the Highline Canal @ Hwy 99 site subwatershed in 2007 and targeted growers in the site subwatershed for focused outreach from 2010 through 2012. In 2012, chlorpyrifos was approved for management plan completion due to improved water quality. However, due to an exceedance of the WQTL for chlorpyrifos during the 2015 WY, the management plan was reinstated for the 2016 WY and growers in the site subwatershed were targeted for 2016 Focused Outreach (2016 through 2018). During the 2016 WY, the January 7, 2016 sampling event resulted in an exceedance of the WQTL for chlorpyrifos. The PUR data associated with the exceedance indicate three applications occurred on January 1 and January 2, 2016. Applications were made by a Coalition member who indicated on their most recent FEP that they have no potential to discharge to surface waters. This member was not targeted for focused outreach in 2010 or 2016 because the parcels have no direct drainage and the proximity to the waterbody was greater than 250 yards. Coalition staff utilized Google Earth to further investigate the likelihood of stormwater runoff entering Highline Canal and concluded it is highly unlikely applications of chlorpyrifos on this member's property contributed to the exceedance as there is no drainage connection to Highline canal. It is more likely that the source of this exceedance came from non-reported applications or non-members.

Members in the Merced River @ Santa Fe site subwatershed were targeted during fifth priority focused outreach from 2013 through 2015. The ESJWQC established a management plan for chlorpyrifos in the Merced River @ Santa Fe site in 2008. In 2015, the chlorpyrifos management plan was approved for completion due to improved water quality. However, due to the recent exceedance of the WQTL for chlorpyrifos in samples collected from Merced River on November 10, 2015, the management plan was reinstated in the 2017 WY. The November 2015 exceedance of the chlorpyrifos WQTL was the first to occur in the site subwatershed since 2008. Samples were collected after a significant storm event that occurred from November 8 through November 10, 2015, producing 0.36 inches of precipitation in Merced. All applications associated with the exceedance were made by one member. The Coalition immediately informed the grower of the exceedance and provided information about the concentration of the exceedance, pesticide use information, and a map showing the parcels that received applications prior to the storm.

Overall, management practices implemented by growers in site subwatersheds in the ESJWQC have been effective in improving water quality. Of the 83 samples analyzed for chlorpyrifos during the 2016 WY, two exceedances of the WQTL occurred (2.5% of the total samples collected) (Table 26). The ESJWQC will continue to conduct general outreach in all site subwatersheds and inform growers of the water quality and concerns through mailings and meetings in the ESJWQC region.

On December 4, 2015, the ESJWQC received approval for management plan completion of 12 constituents in seven site subwatersheds, including two chlorpyrifos management plans. On March 25, 2016, the ESJWQC received approval for management plan completion of 10 constituents, including one chlorpyrifos management plan. The completion of these management plans indicates effective management practices were implemented by members of the ESJWQC resulting in improved water quality. On April 14, 2017 the ESJWQC received approval for the management plan completion of 10 constituents in eight site subwatersheds, including four for chlorpyrifos and one for diazinon. The April 2017 completed management plans represent sites within both the Tuolomne River/Northeast Bank/Westside Creek and Bear Creek/Fresno-Chowchilla TMDL tributary subareas. A total of 15 chlorpyrifos management plans (68% of the 22 chlorpyrifos management plans initiated or reinitiated) and one diazinon management plan (33% of the three diazinon management plans initiated) have been approved for completion in the first through seventh priority site subwatersheds since outreach began (four chlorpyrifos management plans have been reinstated due to recent exceedances, as discussed above).

Table 26. Count of exceedances and samples collected for high priority pesticides in first through seventh priority subwatersheds.

Year	Chlorpyrifos				Diazinon			
	Count of Exceedances	Count of Samples[1]	% Exceedance	Lbs. Applied[2]	Count of Exceedances	Count of Samples[1]	% Exceedance	Lbs. Applied[2]
2008	22	193	11%	71,490	2	182	1%	2,748
2009	4	81	5%	139,101	0	65	0%	2,179
2010	8	73	11%	91,035	0	55	0%	1,149
2011	3	122	2%	61,194	0	107	0%	1,109
2012	0	40	0%	57,302	0	30	0%	414
Jan-Sept 2013	1	64	2%	94,278	1	32	3%	376
2014 WY	3	114	3%	55,606	0	71	0%	611
2015 WY	8	151	5%	48,181	0	93	0%	315
2016 WY	2	83	2%	34,757	0	42	0%	270
Total	**53**	**921**	**6%**	**652,944**	**3**	**677**	**<1%**	**9,171**

[1]Refers to all samples scheduled for constituent analysis (dry sites are included).

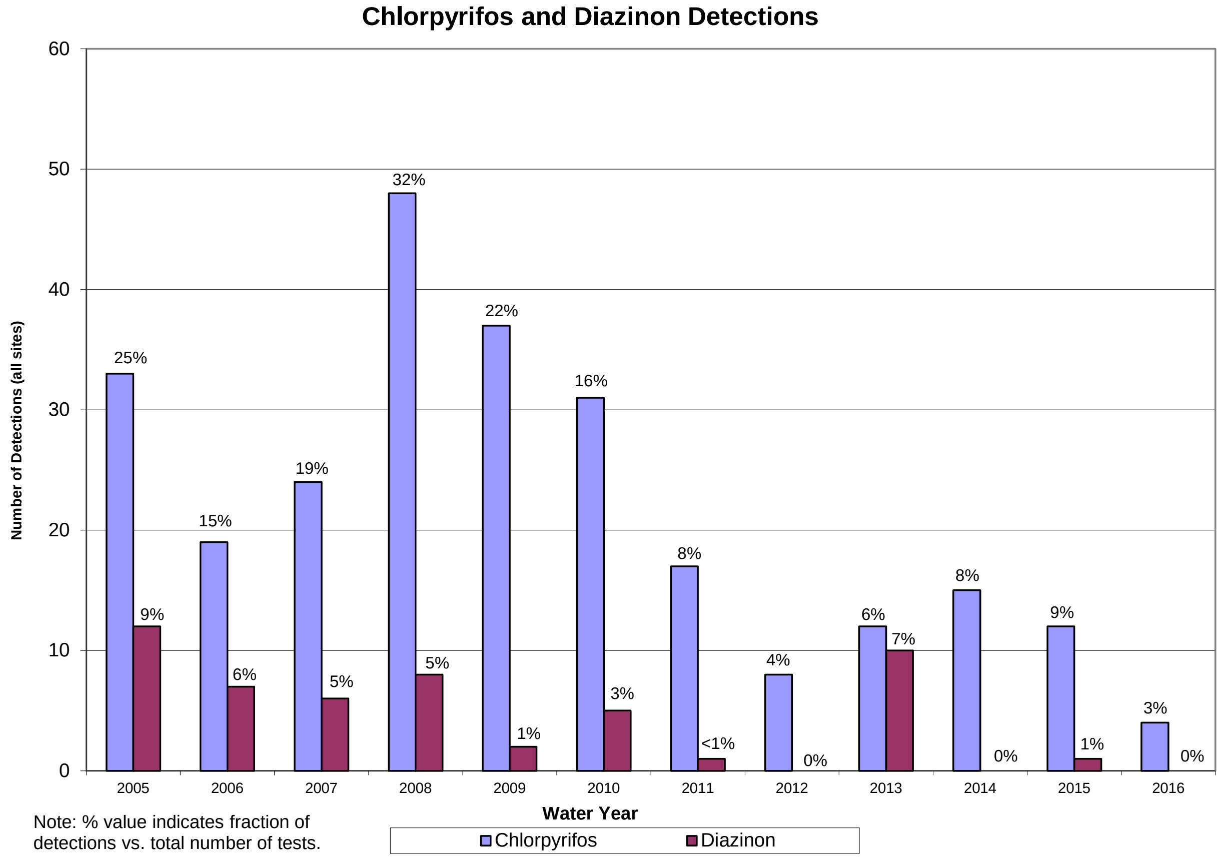
[2]All PUR data are considered preliminary until received from California Pesticide Information Portal (CalPIP); CalPIP data are available online through December 2014.

WSJRWC Effectiveness of Management Practices to Reduce Offsite Movement of Diazinon and Chlorpyrifos

The WSJRWC continues to deal with chlorpyrifos exceedances at tributary monitoring sites. Since 2010, the WSJRWC has mailed more than 600 notices regarding chlorpyrifos and diazinon exceedances and followed up with field visits to review water quality impairments and farming activities with individual growers.

A review of chlorpyrifos and diazinon detections since the beginning of the WSJRWC's monitoring program indicates a promising trend. Figure 8 shows the number of detections of both materials since 2005. The numbers of chlorpyrifos detections are substantially lower when compared to monitoring results prior to the implementation of the WSJRWC Management Plan (2010 and prior).

Figure 8. Count of chlorpyrifos and diazinon detections from 2006 through 2016 in the WSJRWC tributaries



OBJECTIVE 5: DETERMINE WHETHER ALTERNATIVES TO DIAZINON AND CHLORPYRIFOS ARE CAUSING SURFACE WATER QUALITY IMPACTS

Since 2004, the use of chlorpyrifos and diazinon in the LSJR watershed has declined. Chlorpyrifos continues to be a widely-used pesticide due to 1) the large number of crops for which it is registered, 2) its relatively low cost, and 3) its effective control of a variety of pest species even when pest pressures are high. However, chlorpyrifos was designated a restricted material in California effective July 1, 2015. Growers are aware of the water quality implications arising from discharges and there is evidence suggesting that they have been using alternative products throughout the WY to reduce pest pressures.

During grower outreach, ESJWQC and WSJRWC representatives encourage growers to switch to products that are lower risk alternatives to chlorpyrifos and diazinon, and workshops are offered to educate growers about the selection of these alternatives. The use of alternatives to chlorpyrifos and diazinon depend on many factors including but not limited to registration and commodity type, pest pressure, cost, and timing of pest control. In addition, pesticides have to be rotated to prevent insects from developing resistance. The Coalitions do not analyze for all pesticides due to a lack of analytical methods and, in many cases, relatively limited use. However, PUR data can provide insight to the products being applied and how pesticide use changes over time.

ESJWQC Assessment of Alternatives to Diazinon and Chlorpyrifos

Figure 9 details the significant decline in chlorpyrifos and diazinon use since the 2005 WY across the ESJWQC region. The PUR data available from the counties in the ESJWQC region are preliminary through the 2016 WY until they are received from CalPIP, but the current PUR data seem to follow the same trend of previous years. As depicted in Figure 9 both chlorpyrifos and diazinon use has declined since the 2005 WY. During the 2016 WY, 51,073 lbs of chlorpyrifos was applied and total of 1,967 lbs of diazinon was used during the 2016 WY. The use of chlorpyrifos has declined at a lower rate compared to diazinon; however, in the 2016 WY chlorpyrifos use was much lower than in the 2005 WY with applications reaching only 27% of the amount applied in 2005 WY. The use of diazinon has continued to decline and in the 2016 WY, diazinon use was also lower than in 2005 WY with applications reaching only 9% of the amount applied in 2005 WY (Figure 9). The discussion below includes an analysis of the crops with the highest use of pesticides (>1% pounds applied) for chlorpyrifos and diazinon.

To evaluate the use of alternatives to chlorpyrifos and diazinon, the Coalition reviewed 1) the commodities with the most use of chlorpyrifos or diazinon in the region, 2) the highest priority pests associated with those commodities, and 3) the pesticides available to control them. The commodities in the ESJWQC region with the most pounds of chlorpyrifos applied from 2004 through September 2016 include (listed in order of highest to lowest): almonds, walnuts, alfalfa, grapes, corn, orange, and sweet potato (Table 27). The commodities in the ESJWQC region with the largest applications of diazinon from 2004 through September 2016 include (listed in order of highest to lowest): almonds, peaches, plum/prunes, apple, watermelon, nectarine, and grapes (Table 27). Finally, the commodities in the ESJWQC region with the largest total pounds of chlorpyrifos and diazinon applied from 2004 through September 2016 include (listed in order of highest to lowest): almonds, walnut, alfalfa, grapes, corn, citrus, peach and sweet potato (Table 27).

The highest priority pests are defined as pests that are of major concern for the commodity and are geographically widespread in the ESJWQC region. The ESJWQC reviewed alternative pesticides and other management strategies (i.e. applications of insect growth regulators) recommended for each pest of concern per each commodity (Elliott et al., 2004; IRAC, 2005; Rice et al., 1972; Summers et al., 2007; UC ANR, 2013; Zalom et al., 1999) (Table 28).

Figure 9. Pounds of chlorpyrifos and diazinon applied in the ESJWQC region from 2005 WY through the 2016WY.
All PUR data are considered preliminary until received from CalPIP; CalPIP data are available online through December 2014. The PUR data for the 2016 WY are complete.

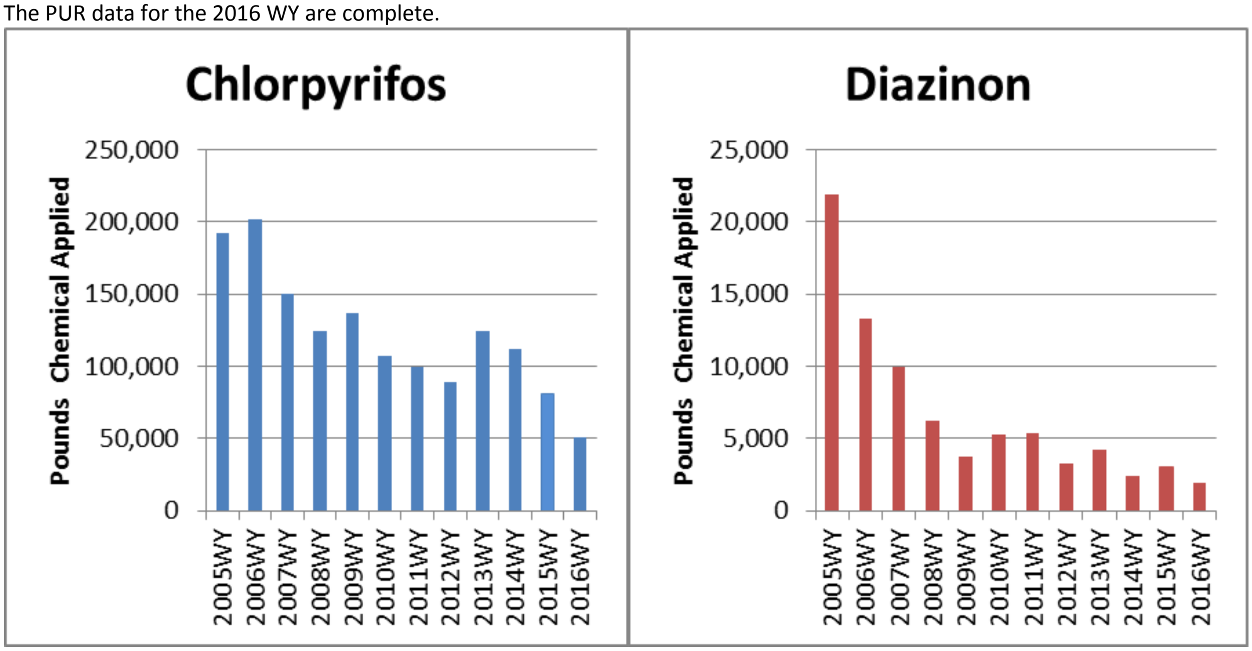


Table 27. Commodities with the most pounds of chlorpyrifos and diazinon use in the ESJWQC region from 2004 through September 2016.
The PUR data for the 2016 WY are complete. All PUR data are considered preliminary until received from CalPIP. CalPIP data are available online through December 2014.

	Total Pounds Chemical Applied and Percent of Total Chemical Applied (>1%) since January 2004					
Commodity	Chlorpyrifos	% of Total	Diazinon	% of Total	Chlorpyrifos + Diazinon	% of Total
ALFALFA	213,050	13%	-	-	213,050	12%
ALMOND	743,668	45%	42,492	39%	786,160	44%
APPLE	-	-	9,084	8%	-	-
CITRUS*	-	-	-	-	74,841	4%
CORN	119,813	7%	-	-	119,950	7%
GRAPE	166,563	10%	1,760	2%	168,323	10%
NECTARINE	-	-	2,750	3%	-	-
ORANGE	54,120	3%	-	-	-	-
PEACH	-	-	20,014	18%	35,989	2%
PLUM/PRUNE	-	-	22,368	20%	-	-
SWEET POTATO	27,038	2%	-	-	27,038	2%
WALNUT	271,476	16%	-	-	271,655	15%
WATERMELON	-	-	3,517	3%	-	-
Total	**1,595,728**	**96%**	**101,985**	**93%**	**1,697,006**	**96%**

*Citrus – Combined values for citrus fruits (all or unspecified), nectarine, orange, tangerine, tangelo.

Table 28. High concern pests for those commodities using the highest combined amount of the applied insecticides chlorpyrifos and diazinon in the ESJWQC region, with the top alternative pesticides recommended for those pests.

Based on the Integrated Pest Management (IPM) Program1 of the Department of Agriculture and Natural Resources, University of California.

Commodity	Pest	Pesticide Class[2]	Active Ingredient
Alfalfa	Alfalfa weevil	Organophosphate	Chlorpyrifos, Malathion, Phosmet
		Oxadiazine	Indoxacarb
		Pyrethroid	Lambda-cyhalothrin, Cyfluthrin
	Blue and pea aphid	Botanical	Azadirachtin
		Organophosphate	Chlorpyrifos, Dimethoate
		Pyrethroid	Pyrethrin
	Spotted alfalfa aphid	Botanical	Azadirachtin
		Organophosphate	Chlorpyrifos, Dimethoate
		Pyrethroid	Pyrethrin
Almond	Navel orange worm	Avermectin	Emamectin benzoate
		Bacterium	Bacillus thuringiensis
		Diacylhydrazine	Methoxyfenozide
		Diamide	Chlorantraniliprole, Flubendiamide
		Organophosphate	Chlorpyrifos, Diazinon, Phosmet
		Pyrethroid	Bifenthrin, Esfenvalerate, Fenpropathrin, Lambda-cyhalothrin
		Spinosyn	Spinetoram, Spinosad
		Unclassified	Buprofezin
	Peach twig borer	Avermectin	Emamectin benzoate
		Bacterium	Bacillus thuringiensis
		Benzoylurea	Diflubenzuron
		Diacylhydrazine	Methoxyfenozide
		Diamide	Chlorantraniliprole, Flubendiamide
		Neonicotinoid	Acetamiprid
		Organophosphate	Chlorpyrifos, Diazinon
		Pyrethroid	Bifenthrin, Esfenvalerate, Lambda-cyhalothrin, Cyfluthrin,
		Spinosyn	Spinetoram, Spinosad
		Unclassified	Buprofezin
	San Jose scale	Carbamate	Carbaryl
		Hormone	Pyriproxyfen
		Organophosphate	Chlorpyrifos, Diazinon, Methidathion
		Unclassified	Buprofezin
Citrus	Asian citrus psyllid	Organophosphate	Chlorpyrifos
		Pyrethroid	Beta-Cyfluthrin, Cyfluthrin, Fenpropathrin, Zeta-cypermethrin
		Neonicotinoid	Thiamethoxam
	California red scale	Biological control (parasite)	*Aphytis melinus*
		Lightweight Horticultural Oil	Narrow Range Oil
		Unclassified	Buprofezin
		Hormone	Pyriproxyfen
	Citrus Red Spider Mite	Carbazate	Bifenazate
		Diphenyl oxazoline	Etoxazole
		Lightweight Horticultural Oil	Narrow Range Oil
		Quinoline	Acequinocyl
		Unclassified	Hexythiazox, Pyridaben
		Pyrazole	Fenproximate
		Organosulfite	Propargite
		Organotin	Fenbutatin oxide
		Tetronic acid	Spirodiclofen
		Organochlorine	Dicofol
Corn	Corn earworm	Bacterium	Bacillus thuringiensis

COMMODITY	PEST	PESTICIDE CLASS[2]	ACTIVE INGREDIENT
		Carbamate	Methomyl
		Organophosphate	Chlorpyrifos
		Pyrethroid	Esfenvalerate, Permethrin
		Spinosyn	Spinosad, Spinetoram
Grape	Vine mealybug	Carbamate	Methomyl
		Neonicotinoid	Acetamiprid, Imidacloprid
		Organophosphate	Chlorpyrifos, Dimethoate
		Unclassified	Buprofezin
Peach	Apricot scale (lecanium)	Organophosphate	Diazinon
	Peach twig borer	Bacterium	*Bacillus thuringiensis*
		Benzoylurea	Diflubenzuron
		Diacylhydrazine	Methoxyfenozide
		Diamide	Chlorantraniliprole, Flubendiamide
		Organophosphate	Diazinon
		Pyrethroid	Esfenvalerate, Permethrin
		Spinosyn	Spinetoram, Spinosad
		Unclassified	Buprofezin
	San Jose scale	Carbamate	Carbaryl
		Hormone	Pyriproxyfen
		Organophosphate	Diazinon
		Unclassified	Buprofezin
Sweet Potato	Flea Beetle	Neonicotinoid	Dinotefuran, Imidacloprid
		Organochlorine	Endosulfan
		Organophosphate	Methamidophos
		Carbamate	Carbaryl
	Wireworm	Organophosphate	Ethoprop, Chlorpyrifos, Diazinon
Walnut	Codling moth	Avermectin	Emamectin benzoate
		Benzoylurea	Diflubenzuron
		Carbamate	Carbaryl
		Diacylhydrazine	Methoxyfenozide
		Diamide	Chlorantraniliprole, Flubendiamide
		Organophosphate	Chlorpyrifos, Phosmet
		Pyrethroid	Bifenthrin, Cyfluthrin, Esfenvalerate, Lambda-cyhalothrin, Permethrin
		Spinosyn	Spinetoram, Spinosad
	Walnut husk fly	Neonicotinoid	Imidacloprid
		Organophosphate	Chlorpyrifos, Malathion, Phosmet
		Pyrethroid	Cyfluthrin, Esfenvalerate
		Spinosyn	Spinetoram, Spinosad

[1] Pesticide alternatives listed are ranked as having the greatest IPM value listed first—the most effective and least harmful to natural enemies, honey bees, and the environment (http://ipm.ucanr.edu/PMG/crops-agriculture.html).
[2] For organization purposes, Pesticide Class includes categories that are not pesticides, such as bacterium.
Sources: (California Department of Water Resources, 2015; Daane, et al., 1993; Elliott, et al., 2004; Insecticide Resistance Action Committee, 2005; Zalom, et al., 1999; Summers, et al., 2007; Rice et al., 1972; University of California Agriculture and Natural Resources, [online][2]; University of California Agriculture and Natural Resources, 2014; Zehnder, 1998).

To assess the use of alternatives to chlorpyrifos and diazinon, the ESJWQC reviewed PUR data for pesticides listed in Table 28 for each commodity. Total pounds of chlorpyrifos, diazinon, and alternative pesticide applied during the 2016 WY are included in Figure 10. These data indicate the amounts of each pesticide used in the region by crop; however, they cannot be used to distinguish 1) if pesticides were used in place of chlorpyrifos or diazinon or if they were applied in response to the presence of a different pest, 2) applied during a different phase of the life cycle of a common insect pest, or 3) applied as part of a program of chemical rotation to avoid resistance.

During the 2016 WY, the ESJWQC monitored 13 tributary sites for several alternative pesticides in addition to chlorpyrifos and diazinon (Table 29). Monitoring for these constituents typically coincide with water column and sediment toxicity monitoring which could indicate the presence of alternative pesticides. However, no toxicity monitoring was scheduled at Unnamed Drain @ Hogin Rd during the 2016 WY (Table 29).

During the 2016 WY, there was only one exceedance of an alternate pesticide in the ESJWQC region, i.e. malathion. A single sample collected from Highline Canal @ Hwy 99 on May 10, 2016 resulted in a detection of malathion (0.031 µg/L) (Table 30). Since there is a prohibition of discharge of malathion for all growers except for members of the Rice Coalition and any detection of malathion is considered an exceedance. Highline Canal @ Hwy 99 was monitored for the full suite of constituents monthly and malathion was monitored during every event. This is the first exceedance of the WQTL for malathion at Highline Canal @ Hwy 99 since monitoring began at the site in 2006. The PUR data associated with the May exceedance indicate there were seven applications of malathion from March 1 through 23, 2016. These applications totaled 123 lbs AI across 86 acres of alfalfa and were made by ground methods.

Figure 10. Pounds of pesticides applied to the top eight commodities with the most chlorpyrifos and/or diazinon applications during the 2016 WY.
All PUR data for the 2016 WY are complete for all Counties through September 2016.

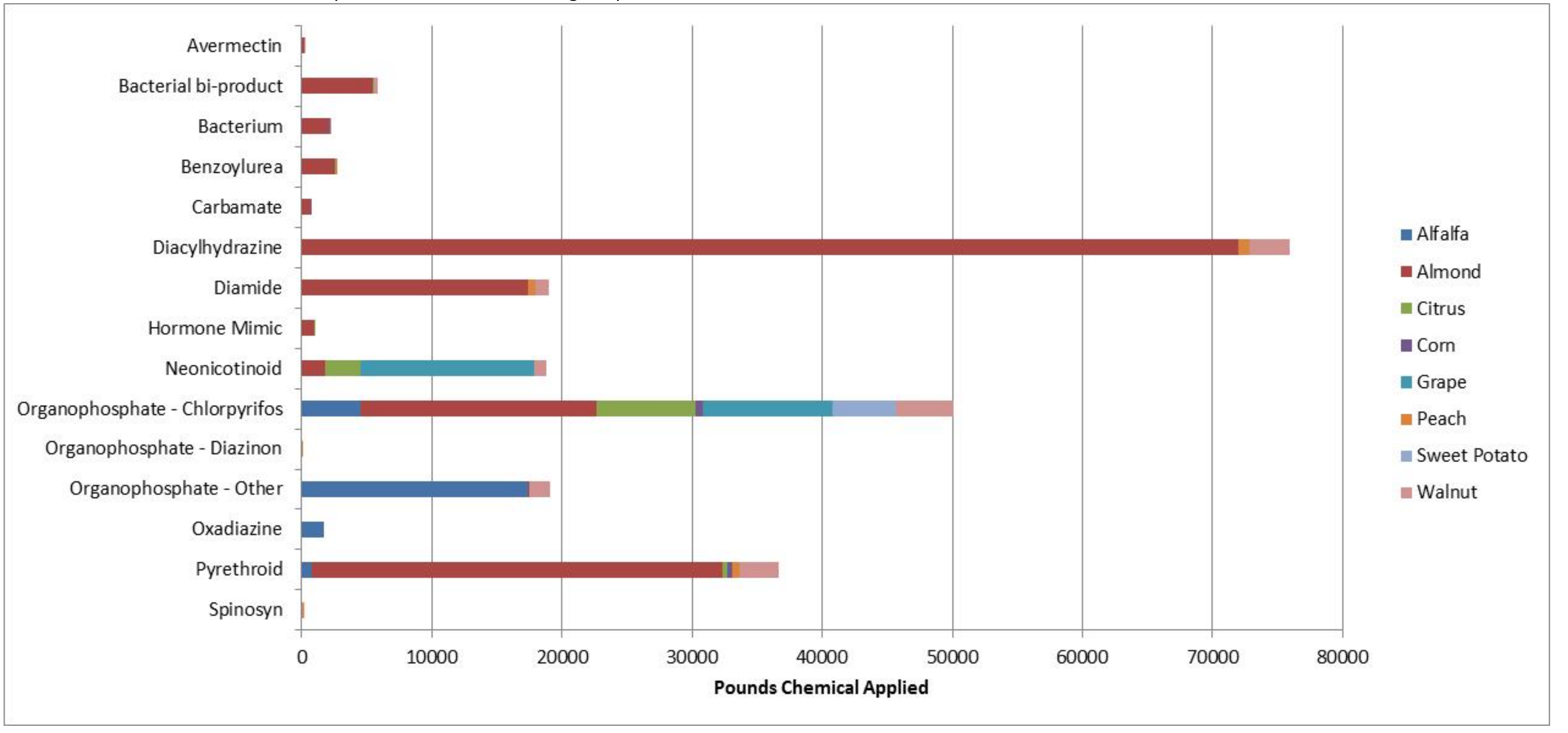


Table 29. The ESJWQC tributary monitoring schedule for potential alternatives to chlorpyrifos and diazinon and toxicity during the 2016 WY.
Those sites monitored solely for chlorpyrifos and/or diazinon are not included as the table below lists those sites monitored for alternative pesticides and indicative toxicity. **X**'s marked in **bold** indicate an exceedance of their respective WQTLs occurred at that site.

Subarea	Site Name	Site Type	Organophosphates											Carbamates						Toxicity		
			Azinphos-methyl	Dichlorvos	Dimethoate	Demeton-s	Disulfoton	Malathion	Methamidophos	Methidathion	Parathion, methyl	Phorate	Phosmet	Aldicarb	Carbaryl	Carbofuran	Methiocarb	Methomyl	Oxamyl	*C. dubia*	*P. promelas*	*H. azteca*[1]
Bear Creek, Fresno-chowchilla	Canal Creek @ West Bellevue Rd	C	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Deadman Creek @ Gurr Rd	R																		X*	X*	
	Dry Creek @ Rd 18	C	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Duck Slough @ Gurr Rd	R						X*												X*	X*	X*
	Miles Creek @ Reilly Rd	C	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Tuolumne River, Northeast Bank, Westside Creek	Dry Creek @ Wellsford Rd	C	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Turlock, Merced, Greater Orestimba	Hatch Drain @ Tuolumne Rd	R																		X		X*
	Highline Canal @ Hwy 99	C	X	X	X	X	X	**X**	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Hilmar Drain @ Central Ave	R																				X*
	Lateral 5 1/2 @ South Blaker Rd	C	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Levee Drain @ Carpenter Rd	R																		X*		X*
	Prairie Flower Drain @ Crows Landing	R			X*															X*		X*
	Unnamed Drain @ Hogin Rd	R			X																	

X - Monitoring occurred during the 2016 WY

C - Core site; R-Represented site; X*- Monitoring due to a management plan.

[1] If *H. azteca* survival is less than 80% compared to the control, the following pesticides are analyzed: bifenthrin, cyfluthrin, cypermethrin, deltamethrin, esfenvalerate, lambda-cyhalothrin, permethrin, fenpropathrin, and chlorpyrifos. Sediment samples are only collected twice a year.

Table 30. Water column detections of potential alternative pesticides in ESJWQC tributaries during the 2016 WY.

Bold indicates results in exceedance of the associated WQTL.

Subarea	Site Name	Sample Date	Analyte Name	Result (µg/L)	WQTL (µg/L)
Turlock, Merced, Greater Orestimba	Highline Canal @ Hwy 99	5/10/2016	Malathion	**0.031**	> 0

Since the ESJWQC monitoring scheme may or may not include analysis of the full suite of constituents at each site with exceedances or toxicity, additional chemistry results are utilized when available from Phase I and Phase III Toxicity Identification Evaluations (TIEs) on surface water samples and additional chemistry analysis on sediment samples. Monitoring in the 2016 WY resulted in 11 instances of toxicity, all to *S. capricornutum*. These are not relevant to this analysis as algae toxicity is associated with herbicides, not with insecticides that can be used as alternatives to chlorpyrifos or diazinon.

In summary, monitoring results from the 2016 WY indicate malathion was present in a single ESJWQC tributary (Table 30). Of the pesticides applied to the crops listed in Figure 10, diacylhydrazine and pyrethroid pesticides are among the top alternatives applied. In the 2016 WY, the combined use of diacylhydrazine pesticides exceeded the combined use of all organophosphate pesticides (75,939 lbs vs. 69,164 lbs, respectively). No TIEs were performed for non-algal species in the ESJWQC region during the 2016 WY and there were zero instances of sediment toxicity to *Hyalella azteca*.

WSJRWC Assessment of Alternatives to Diazinon and Chlorpyrifos

The WSJRWC tests collected samples for a variety of carbamate, OP, and organochlorine insecticides (depending on the site). During the 2016 WY, there were 18 detections of insecticides at sites monitored by the WSJRWC. Of these, 7 represented legacy insecticides that are no longer in use (DDE). Of the remaining detections, 9 were OP insecticides (4 detections of chlorpyrifos, 4 of dimethoate, and 1 malathion), and 2 were carbamates (methomyl).

The WSJRWC collects water samples for targeted aquatic toxicity testing during the irrigation season and rain events. During the 2016 WY, toxicity to *C. dubia* (the species most likely to be affected by chlorpyrifos or diazinon) was observed only once (out of 104 tests), with chlorpyrifos the likely cause.

The WSJRWC collects sediment samples for toxicity testing in March and September of 2016, and sediment pesticide analyses are performed as a follow-up to observations of sediment toxicity with a difference from control of greater than 20%. During the 2016 WY, ten samples were collected (including one duplicate) and tested for toxicity to *H. azteca* on March 7th and April 11, 2016. Statistically significant toxicity was measured at three sites. Follow-up analyses included a variety of pyrethroids, legacy organochlorines, and selected OP insecticides. On September 12th, 2016 eleven sediment samples were collected and tested for sediment toxicity (including one duplicate). Of these, five showed significant toxicity and were tested for selected pesticides. Of the eight sediment samples tested for pesticides (over both events), chlorpyrifos was detected above the RL in one sample, and in four samples where chlorpyrifos was detected above the detection limit but below the reporting limit. Sediment toxicity and pesticide detections are discussed in greater detail in Section 8 and Attachment 4 of the WSJRWC AMR.

The WSJRWC also reviewed available PUR data to evaluate applications of insecticides. Table 31 lists the most applied insecticides (based on total application area, October 2015 to September 2016).

Table 31. Pesticide applications within the WSJRWC in order of highest application area.
An * indicates an herbicide.

FRESNO COUNTY	MERCED COUNTY	STANISLAUS COUNTY
Glyphosate*	Glyphosate*	Glyphosate*
Paraquat Dichloride*	Paraquat Dichloride*	Azoxystrobin
Ethyl-Pyraflufen	Abamectin	Abamectin
Oxyfluorfen*	Mepiquat Chloride*	Methoxyfenozide
Dimethoate	Oxyfluorfen*	Oxyfluorfen*
Abamectin	Flonicamid	Paraquat Dichloride*
Imidacloprid	Imidacloprid	Difenoconazole
Chlorantraniliprole	Flubendiamide	Bifenthrin
Trifluralin*	Ethyl-Pyraflufen	Lambda-Cyhalothrin
Mepiquat Chloride*	Carfentrazone-Ethyl	Pendimethalin
Indoxacarb	Indoxacarb	Pyraclostrobin
Methoxyfenozide	Trifluralin*	Dimethoate
Pendimethalin	Chlorantraniliprole	Propiconazole
Postassium N-Methyldithiocarbamate	Dimethoate	Boscalid
Spinetoram	Pendimethalin	Saflufenacil*
Flonicamid	S-Metolachlor*	Chlorantraniliprole
Glufosinate-Ammonium*	Diuron*	Iprodione
S-Metolachlor*	Methoxyfenozide	Chlorothalonil
Chlorpyrifos	Thidiazuron*	Metconazole
Bifenthrin	Bifenthrin	Esfenvalerate

Summary of Alternatives Detected

The ESJWQC and WSJRWC detected several pesticides that are alternatives to chlorpyrifos and/or diazinon, including alternatives recommended by the Pest Control Advisors for use on grapes, almonds, and walnuts. Some of these alternative pesticides were found to impair water quality by either exceeding their respective WQOs or contributing to toxicity. Below is a brief description of the detected pesticides:

- Bifenthrin is a pyrethroid insecticide used to treat a variety of insects in orchards and field crops such as alfalfa, cotton, tomatoes, and corn but also has significant residential use.
- Carbaryl is a wide-spectrum carbamate insecticide used to control a wide range of insects in citrus, fruit, nuts, cotton, corn, and other vegetable crops.
- Cyfluthrin is a pyrethroid insecticide used to treat a variety of insects in orchards and field crops such as alfalfa, corn, tomatoes, and cotton.
- Cypermethrin is a pyrethroid insecticide used to treat a variety of insects in field crops such as alfalfa, cotton, onions, and cabbage.
- Dimethoate is an OP pesticide used to control a wide range of insects. It is used on a variety of field crops including alfalfa, beans, tomatoes, and cotton.
- Esfenvalerate/Fenvalerate is a pyrethroid insecticide which is used on a wide range of pests on vegetable crops, tree fruits, and nut crops. It may be mixed with a wide variety of other types of pesticides such as carbamate compounds or organophosphates

- Lambda cyhalothrin is a pyrethroid insecticide used to treat a variety of insects in orchards and field crops such as corn, tomatoes, and cotton.
- Malathion is an OP insecticide used on a variety of crops including alfalfa, walnuts, lettuce, grapes, and cotton.
- Methomyl is a carbamate insecticide used to control a variety of pests on vegetable, fruit, and field crops.
- Methoxyfenozide is a diacylhydrazine pesticide used to control a variety of pests on tree fruit and nut crops. It mimics the molting hormone of Lepidotpertous larvae, causing an incomplete and premature molt.
- Permethrin is a pyrethroid insecticide used to treat a variety of insects in orchards and field crops such as corn, tomatoes, and cotton and is also used for mosquito and residential insect control.

Although the Coalitions detected ten different insecticides in waterways during this reporting period, it is not possible to determine with certainty if any of these materials were selected as an alternative to chlorpyrifos or diazinon, or were used as part of a grower's pesticide management rotation. Pesticide Control Advisors are recommending the use of some of these pesticides, but the PUR and monitoring data do not provide sufficient information for the Coalitions to establish if the detected pesticides were indeed from applications of pesticides used in an alternative capacity. It is a necessary cultural practice to rotate pesticide selection through specific modes of action (i.e. pyrethroids to organophosphates to carbamates) in order to minimize the risk of pesticide resistance. As a result of this practice, a material other than chlorpyrifos or diazinon may be selected simply because it was next in the rotation rather than as a specific alternative. Based on the Coalition's conversations with growers and Pest Control Advisors, regulatory pressure on diazinon use has phased that material out of the pest management rotation. Chlorpyrifos continues to be a preferred material due to its wide range of allowable use and effectiveness. The Coalitions continue to educate growers through outreach of other applicable alternatives to chlorpyrifos.

OBJECTIVE 6: DETERMINE WHETHER THE DISCHARGE CAUSES OR CONTRIBUTES TO TOXICITY IMPAIRMENT DUE TO ADDITIVE OR SYNERGISTIC EFFECTS OF MULTIPLE POLLUTANTS.

The formula used to calculate loading capacity and load allocation (Equation 1) for chlorpyrifos and diazinon is based on current understanding of the two pesticides' additive effects. As part of each Coalition's tributary monitoring strategies, the ESJWQC and WSJRWC sample for a wide range of pesticides and toxicity. The TIEs are conducted on toxic water samples to determine the cause of toxicity (if survival is 50% or less compared to the control). Toxic sediment samples are subject to further analysis for chlorpyrifos, piperonyl butoxide (PBO), and pyrethroids (if survival is less than 80% compared to the control and statistically significant). From these results, the Coalitions are able to analyze the additive and/or synergistic effects of multiple pollutants.

ESJWQC Evaluation of Toxicity Impairment Due to Additive or Synergistic Effects of Multiple Pollutants

To assess if toxicity occurred due to the additive or synergistic effects of a combination of chlorpyrifos or diazinon and another pollutant, the ESJWQC reviewed toxicity results for *C. dubia* and *P. promelas* in the water column and *H. azteca* in sediment samples. During the 2016 WY, no samples were toxic to *C. dubia*, *P. promelas*, or *H. Azteca* at those sites monitored by the ESJWQC.

The Delta RMP reported toxicity results for *C. dubia* and *P. promelas* in the 2016 WY on CEDEN. No results were listed as significantly lower than controls for survival for either of the toxicity test species at the San Joaquin River at the Airport Way Bridge near Vernalis site. No TIE results were available in the data downloaded from CEDEN. There were no exceedances of the WQTLs and no loading capacities that were out of compliance for either chlorpyrifos or diazinon during the 2016 WY at the San Joaquin River at the Airport Way Bridge near Vernalis site.

WSJRWC Evaluation of Toxicity Impairment Due to Additive or Synergistic Effects of Multiple Pollutants

The WSJRWC reviewed aquatic and sediment toxicity results to assess if toxicity occurred due to the additive or synergistic effects of chlorpyrifos or diazinon and another pollutant. During the 2016 WY, one sample was toxic to *S. capricornutum*, one sample was toxic to *C. dubia*, and eight sediment samples were toxic to *H. azteca*. All of the samples exhibiting toxicity were from tributary sites and not the San Joaquin River. Table 32 and Table 33 provide details regarding the survival, follow-up testing, and apparent causes of these toxicity events. Diuron was present in the sample exhibiting aquatic toxicity to *S. capricornutum.* Chlorpyrifos was detected in the sample that was toxic to *C. dubia.* TIEs were completed on both samples and, in both cases; pesticides were determined to be the likely cause – a conclusion supported by the analytical results.

Table 32. WSJRWC tributary water column toxicity exceedance summary for 2016 WY.

Station Name	Sample Date	Reactive Species	Results	Units	TIE Comments	Apparent Cause
Marshall Road Drain @ River Rd	1/7/2016	*S. capricornutum*	96	% Difference	TIE indicates pesticides are the likely cause	Diuron (76 µg/L)
Poso Slough @ Indiana Ave.	8/9/2016	*C. dubia*	0	% Survival	TIE indicates pesticides are the likely cause	Chlorpyrifos (0.35 µg/L)

Evaluation of Detected Sediment Pesticides

March 2016 Sediment Toxicity Follow Up

Sediment toxicity tests were performed on nine samples and one duplicate sample for sediment Event 130 (March 3 and April 11, 2016). Statistically significant toxicity was measured at three sites. Follow up pesticide testing was performed on the three samples exhibiting severe toxicity <80% survival (Table 35). These results were compared to literature values for the purpose of determining the probable cause of toxicity in each sample. In all cases pesticides were present in sufficient quantity to have caused the toxicity.

- **Hospital Creek at River Road** (0.0% Survival): 9.7 TUs were calculated, with bifenthrin 8.53 TUs, and lambda cyhalothrin 0.63 TUs, esfenvalerate 0.42 TUs, permethrin 0.1. TUs, and chlorpyrifos accounted for 0.01 TUs.
- **Ingram Creek at River Road** (0.0% Survival): A total of 6.0 TUs were calculated with bifenthrin 3.08 TUs, cyfluthrin 0.07 TU's, lambda cyhalothrin 2.06 TUs, cypermethrin 0.25 TU's, esfenvalerate 0.53 TUs, and chlorpyrifos accounted for 0.01 TUs.
- **Orestimba Creek at River Road** (15.0% survival): 1.6 TUs were calculated, with bifenthrin 1.47 TUs, lambda cyhalothrin 0.12 TUs, esfenvalerate 0.02, and chlorpyrifos accounted for 0.01 TUs.

September 2016 Sediment Toxicity Follow-Up

Sediment toxicity tests were performed on nine samples (including one duplicate) collected in September 2016 (Event 135). Statistically significant toxicity was measured at five sites and was sufficient to require follow-up pesticide analysis (Table 33). These results were compared to literature values for the purpose of determining the probable cause of toxicity in each sample.

The Blewett Drain at Highway 132 sample had a total of 5.56 TUs, with bifenthrin accounting for 2.38 TUs, and Esfenvalerate accounting for 3.06 TUs. Chlorpyrifos accounted for 0.12 TUs. There were sufficient pyrethroid TUs to account for the 6.25% survival observed.

The Hospital Creek sample had a total of 3.02 TUs. Bifenthrin accounted for 2.46 TUs, and lambda-cyhalothrin accounted for 0.4 TUs. Chlorpyrifos accounted for 0.04 TUs. There were sufficient pyrethroid TUs to account for the 57.5% survival observed.

The Ingram Creek sample had a total of 17.1 TUs, with bifenthrin accounting for 12.3 TUs, lambda-cyhalothrin accounting for 2.23 TUs, and esfenvalerate accounting for 1.24 TUs. Chlorpyrifos was not detected in this sample. There were sufficient pyrethroid TUs to account for the 0% survival observed in the sample.

The Del Puerto Creek near Cox Road sample had a total of 8.66 TUs, with bifenthrin accounting for 8.59TUs, and lambda-cyhalothrin accounting for 0.08TUs. Chlorpyrifos was not detected in this sample. There were sufficient pyrethroid TUs to account for the 0% survival observed in the sample.

The Westley Wasteway at Cox Road sample had a total of 2.51 TUs, with bifenthrin accounting for 2.41 TUs and lambda-cyhalothrin accounting for 0.09 TUs. Chlorpyrifos was not detected in this sample. There were sufficient pyrethroid TUs to account for the 37.5% survival observed in the sample.

In each of the sediment samples where follow-up pesticide analyses were performed, at least one pyrethroid insecticide was detected at a level sufficient to cause the observed toxicity itself and the toxic unit contribution from chlorpyrifos was insignificant (or not present). Hence, synergistic effects between chlorpyrifos and other materials were unlikely.

Table 33. WSJRWC tributary sediment toxicity exceedance summary for the 2016 WY.

Station Name	Sample Date	Reactive Species	% Survival	Detected Pesticides
Hospital Creek @ River Rd	4/11/2016	*H. azteca*	0	Bifenthrin (36ng/g), Chlorpyrifos (0.19j ng/g), Lambda-cyhalothrin (2.3), DDE (72 ng/g), Es/Fenvalerate (5.3 ng/g), Permethrin (8.7 ng/g)
Ingram Creek @ River Rd	4/11/2016	*H. azteca*	0	Bifenthrin (15 ng/g), Chlorpyrifos (0.14j ng/g), Cyfluthrin (0.73 ng/g), Lambda-cyhalothrin (8.7 ng/g), Cypermethrin (0.89 ng/g), DDE (76 ng/g), Es/Fenvalerate (7.6 ng/g), Fenpropathrin (0.085j ng/g)
Orestimba Creek @ River Rd	4/11/2016	*H. azteca*	15	Bifenthrin (7.2 ng/g), Chlorpyrifos (0.16j ng/g), Lambda-cyhalothrin (0.51 ng/g), DDE (83 ng/g), Es/Fenvalerate (0.31j ng/g), Permethrin (0.2j ng/g)
Blewett Drain @ Hwy 132	9/12/2016	*H. azteca*	6.25	Bifenthrin (1.1 ng/g), Chlorpyrifos (0.19j ng/g), Esfenvalerate (4.2 ng/g)
Hospital Creek @ River Rd	9/12/2016	*H. azteca*	57.5	Bifenthrin (7.1 ng/g), Chlorpyrifos (0.4 ng/g), Lambda-cyhalothrin (1 ng/g), DDD (5.4 ng/g), DDE (34 ng/g), DDT (4.8 ng/g), Esfenvalerate (0.96 ng/g), Permethrin (0.68 ng/g)
Ingram Creek @ River Rd	9/12/2016	*H. azteca*	0	Bifenthrin (28 ng/g), Cyfluthrin (3.6 ng/g), Lambda-cyhalothrin (4.4 ng/g), Cypermethrin (1j ng/g), DDD (7 ng/g), DDE (140 ng/g), DDT (9.7 ng/g), Esfenvalerate (8.4 ng/g)
Del Puerto Creek near Cox Rd	9/12/2016	*H. azteca*	0	Bifenthrin (110 ng/g), Lambda-cyhalothrin (0.88j ng/g), DDD (0.93j ng/g), DDE (22 ng/g)
Westley Wasteway near Cox Rd	9/12/2016	*H. azteca*	37.5	Bifenthrin (27 ng/g), Lambda-cyhalothrin (0.91j ng/g), DDD (2j ng/g), DDE (44ng/g)

OBJECTIVE 7: DEMONSTRATE THAT MANAGEMENT PRACTICES ARE ACHIEVING THE LOWEST PESTICIDE LEVELS TECHNICALLY AND ECONOMICALLY ACHIEVABLE

Technical and economic feasibility needs at the individual farm level is expected to vary with the specific operation and commodity farmed. The goal of the ESJWQC and WSJRWC is for their members to have no discharge of pesticides to surface waters. Economic feasibility is determined by factors outside the control of the Coalitions. Profitable operations can afford to implement management practices such as constructing sediment basins or installing pressurized irrigation, both of which can significantly reduce the runoff of irrigation and stormwater carrying agricultural discharges. Marginally profitable operations may not be able to afford these practices. Consequently, efforts by the ESJWQC and WSJRWC to obtain additional funding for growers have been important to achieving the Coalitions' goal. Both Coalitions have been instrumental in helping growers obtain AWEP funding and publicizing the current funding available. Through the 2016 WY farmers from the two Coalitions had access to funds from NRCS and internal grant/loan funding provided by local water agencies. These programs offer several million dollars towards the implementation of structural management practices within their respective regions. However, there remain many growers in the eastside drainage area of the LSJR who are not members of either Coalition and are not able to take advantage of the Coalitions' efforts.

It is technically feasible to eliminate all discharges of chemicals to surface waters, although it could require steps that are not economically feasible for even the most profitable operations. Given the success in the ESJWQC and WSJRWC regions in the 2016 WY, it seems possible to reduce discharges to surface waters to the point that they do not impair beneficial uses.

During the 2016 WY, there were fewer exceedances of the WQTLs of both chlorpyrifos and diazinon in samples collected from tributary subareas compared to the 2015 WY. Although new membership enrollment in ESJWQC has increased in the last several years, there are still numerous non-members in both ESJWQC and the WSJRWC regions that could be contributing to exceedances and who have not received focused outreach. Until each Coalition reaches 100% grower membership it's not entirely possible to determine who is discharging and therefore it is not possible to determine if growers in the ESJWQC or the WSJRWC are achieving the lowest pesticide levels achievable. However, the management practices implemented by members of each Coalition appear to be resulting in a reduction of discharges, and are in the process of achieving the lowest pesticide levels technically and economically feasible.

CONCLUSIONS AND RECOMMENDATIONS

The ESJWQC and WSJRWC assessed compliance with the seven Monitoring Objectives of the chlorpyrifos and diazinon TMDL program by evaluating results collected from their joint chlorpyrifos and diazinon TMDL monitoring program and their individual Coalition tributary monitoring programs. During the 2015 WY there were no exceedances of the WQO for chlorpyrifos in samples collected from the LSJR TMDL monitoring locations.

There were two detections of chlorpyrifos above the WQO in samples collected from ESJWQC tributaries during the 2016 WY. There were no detections of diazinon in samples collected from ESJWQC tributaries during the 2016 WY. In the WSJRWC region, chlorpyrifos was detected in four samples (over three different monitoring events), all of which were in excess of the load criteria. There were no detections of diazinon during this report period. All three tributaries with chlorpyrifos exceedances during the 2016 WY are already included in a management plan. Highline Canal @ Hwy 99 and Merced River @ Santa Fe were the tributaries with a chlorpyrifos exceedance in the ESJWQC region and both are under management plans for chlorpyrifos during the 2016 WY.

Both Coalitions determined the degree of implementation and evaluated the effectiveness of management practices designed to reduce the off-site movement of chlorpyrifos and diazinon. The ESJWQC and WSJRWC evaluated alternatives to chlorpyrifos and diazinon, the use of these alternatives within the two Coalition regions and water quality impairments due to other pesticides. Alternative pesticides may be impairing water and sediment quality. However, due to the lack of available monitoring data it is not possible to determine if synergistic and/or additive effects are occurring in ESJWQC and WSJRWC tributaries.

The PUR data indicate chlorpyrifos and diazinon use has declined. Growers are routinely informed of water quality concerns related to OP pesticides and implement management practices to prevent off-site movement of chlorpyrifos and diazinon. Both Coalitions include discussions of chlorpyrifos, diazinon, as well as all water quality impairments during focused outreach to growers. Successful completions of management plans demonstrate the success of efforts made by the Coalitions to prevent chlorpyrifos and diazinon from impairing the water quality of adjacent waterbodies.

The monitoring frequency of the chlorpyrifos and diazinon TMDL program was originally designed to occur quarterly in the LSJR and monitoring would occur during one month of each quarter to coincide with the greatest applications (2010 WY). Beginning on the 2011 WY, monitoring frequency was increased to include monthly samples for three of the six compliance points, and beginning on the 2012 WY frequency was increased to six times a year for the other three compliance points. Despite the four-fold increase in monitoring frequency since 2010, there has been only one exceedance of chlorpyrifos and no detections of diazinon in samples collected from the LSJR.

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