

**A Summary of the 2004 TMDL Monitoring for Selected
Pesticides in the Northern San Joaquin Basin, California**

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Introduction

This report describes the results of pesticide monitoring at four locations in California's southern Central Valley associated with storm runoff that occurred during February 2004. The river loading rates of diazinon and chlorpyrifos were also calculated for each sampling event. Monitoring was conducted by staff of the Aquatic Ecosystems Analysis Laboratory (AEAL) of the John Muir Institute of the Environment, University of California, Davis, as authorized under Contract No. 02-210-150 from the Central Valley Regional Water Quality Control Board (CVRWQCB).

Objective

The primary objective of this project was to monitor four sites in the northern San Joaquin River basin during the 2003-04 winter storm season to characterize the sources of diazinon, chlorpyrifos and other pesticides that can cause surface water contamination and toxic conditions to aquatic life. The results of this study will be used to support the development of diazinon and chlorpyrifos TMDLs in the northern San Joaquin basin.

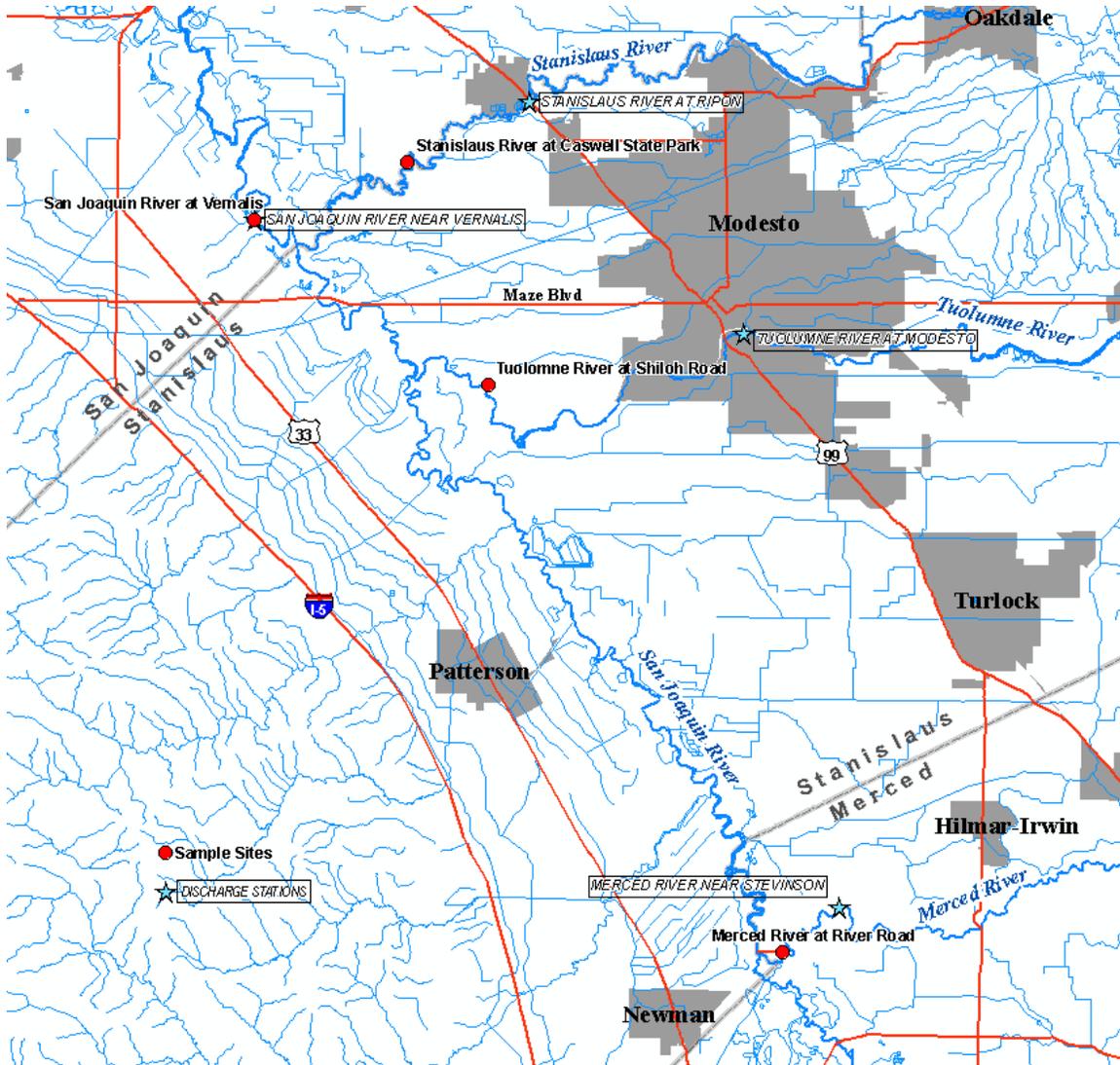
Monitoring Overview

Three sites (Figure 1, Table 1) were monitored twice daily and one site was monitored once daily during and following two separate storm events: 2-5 and 16-19 February 2004. The trigger for initiating a sampling event was a cumulative total of 0.5" of rainfall within the sampling area in a 24-hour period.

The measured field parameters included pH, water temperature and electrical conductivity (EC). Discharge measurements for selected sites were obtained from U.S. Geological Survey (USGS) and California Department of Water Resources (DWR) data (Table 2) available on the internet. Water samples were delivered to the California Department of Food and Agriculture (CDFA) laboratory in Sacramento, California for chemical analysis using gas chromatography (GC) and mass spectrometry (MS).

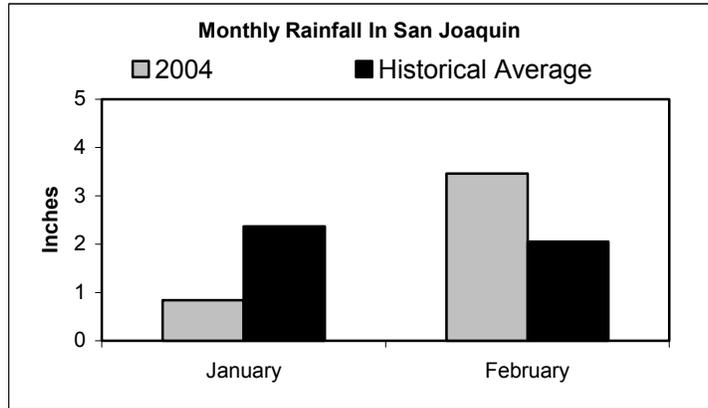
The CDFA laboratory analyzed 17 chemical compounds for each water sample. The list of compounds is provided in Table 3. The detection frequencies, concentrations and calculated instantaneous loading rates for diazinon and chlorpyrifos are presented in Table 4. The detection frequencies and concentrations of the other 10 compounds are listed in Appendix A. The analytical results for all tested compounds, and the physical parameters measured in the field are presented in tabular format on a compact disc appended to this report.

Figure 1. The four sampling sites in the San Joaquin Basin monitored for pesticides during the 2003-04 winter storm season.



Hydrologic Conditions During The Study

There were no storms in the northern San Joaquin basin in January 2004 large enough to trigger a sampling event. Rainfall in the northern San Joaquin basin in January 2004 was much lower than the historical January average, accumulating 0.84 inches of the average 2.37 inches. January rainfall came in the form of several small showers, the largest of which dropped 0.47 inches on January 1st. February rainfalls for the San Joaquin totaled 3.46 inches; 169% of the historical 2.05 inch average.



February was hit with the first major storm event of 2004. Originating as a tropical Pacific storm, it swept into the northern San Joaquin basin on February 2nd and 3rd. The week preceding the first storm was mostly dry (0.11 inches fell on 27 January) and relatively calm, with winds for the week averaging 6.47 mph and a high wind speed of 20.7 mph. Sampling began on 2 February and continued through 5 February. All of the rain for this sampling period fell on the first two days, with 2 February receiving 0.62 inches and 3 February 0.13 inches, for a total of 0.75 inches for the first storm. The remaining 2 days in the sampling period were dry. Winds during this storm were calm, averaging 5.93 mph.

The second storm event to hit the northern San Joaquin basin arrived on 16 February with rain continuing through 18 February. This storm originated as a broad subtropical moisture plume from Hawaii. Sampling for this storm began on the 16 February and continued through 19 February. This storm was preceded by 11 dry days and 0.01 inches of rain on 15 February. Winds during the days before the storm averaged 4.94 mph with high speeds of 23 mph. During this sampling period 1.22 inches of rain fell,

accounting for 60% of the average February rainfall. Daily rainfall totals were: 0.57 inches on 16 February, 0.18 inches on 17 February and 0.47 inches on 18 February. Average wind speeds for this storm were less than 10 mph, with highs of 19.6 mph.

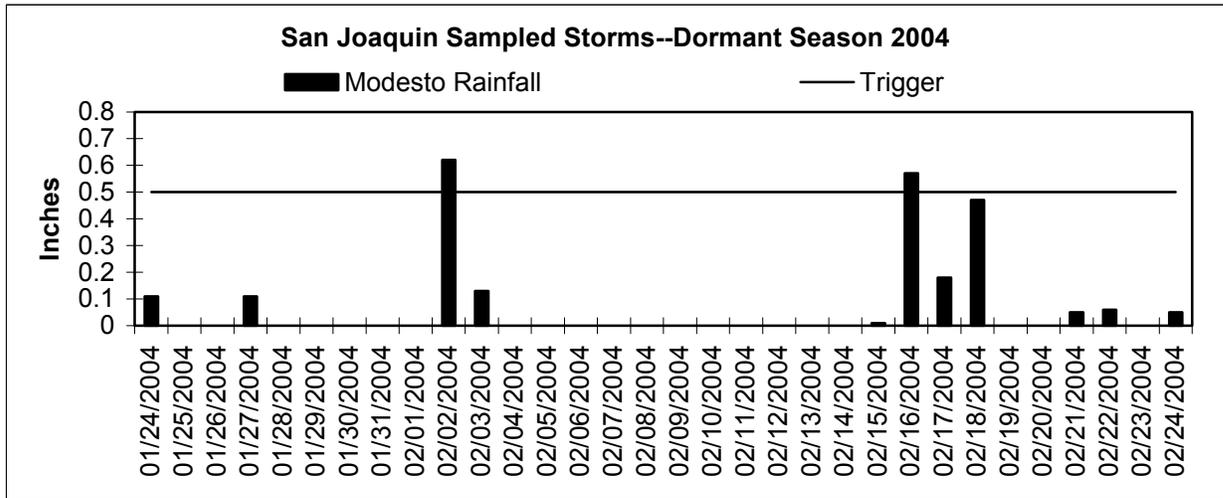


Figure 2. Daily rainfall at Modesto, CA during the 2003-04 winter storm sampling.

Precipitation data for Modesto from MID Public Affairs data base (209) 526-7373
 Wind data for Modesto from www.weatherunderground.com

Sample Collection Methods

All samples were collected by either grab or integrated grab methods (Table 1).

Grab samples were collected by harnessing a 1-liter amber glass bottle to a pole sampler and dipping the bottle into the stream as close to the center of the channel as possible.

Integrated grab samples were collected by lowering a 3-liter PTFE (polytetrafluoroethylene) bottle, strapped in a weighted cage, from a bridge at three equally spaced verticals. At each vertical the bottle was filled approximately ¼ full. The composite sample was then thoroughly agitated and poured into a 1-liter amber glass sample bottle.

Table 1. Sample sites, collection methods and sampling dates

Site #	Site Name	Sample collection Method	Sampling Dates
1	Merced River at River Road	Integrated grab from bridge	February 2-5 & 16-19, 2004
5	Tuolumne River at Shiloh Road	Integrated grab from bridge	February 2-5 & 16-19, 2004
6	San Joaquin River at Vernalis	Integrated grab from bridge	February 2-5 & 16-19, 2004
7	Stanislaus River at Caswell State Park	Grab from bank	February 2-5 & 16-19, 2004

Discharge Sources, Methods and Stream Drainage Characteristics

Discharge estimates were obtained from USGS and DWR gages listed on the California Data Exchange Center (CDEC) <http://cdec.water.ca.gov/> website. At sites where discharge gages were not present, discharge values from the nearest gage on the same stream were used. An explanation of the discharge source and characteristics of the stream drainage are listed below for each site.

Merced River at River Road – Data for this site were obtained from the CDEC gage MST (Merced River at Stevinson) located approximately 3.68 miles upstream. The gage elevation is 59 feet and the sample site elevation is 53 feet. The low gradient (6 feet over 3.68 miles) and the size of the river allowed us to make the assumption that the river rises fairly uniformly under normal conditions, therefore, flow data from the MST gage were used unadjusted. There is one semi-permanent stream between the sample site and the discharge gage. Flows are unknown for this stream and were assumed to be negligible. The river flows through an urban area near Livingston about 20 miles upstream from the sample site.

Tuolumne River at Shiloh Road - The CDEC gage MOD (Tuolumne River at Modesto) was used to obtain discharge measurements for the sampling site. There are no other suitable gages for making any kind of distance-weighted hydrograph, so the data were used as presented on the CDEC website. There are significant urban areas upstream, including Modesto and Waterford. Since we did not measure discharge at this site, and no other measures were taken to determine the applicability of the MOD discharge data, we cannot draw any conclusions about the accuracy of the discharge estimates.

San Joaquin River at Vernalis – USGS and DWR jointly operated discharge station 11303500 (San Joaquin River near Vernalis) was used for this site. The sampling site and gage are both located at the Durham Ferry highway bridge. Data were used unadjusted from the CDEC website. This location is approximately 2.6 miles downstream of the confluence with the Stanislaus River. The drainage area is approximately 13,536 mi² and also incorporates the flows of the Merced and Tuolumne rivers, Orestimba Creek, Del Puerto Creek, Dry Creek and Salt Slough.

Stanislaus River at Caswell State Park - Discharge was obtained from USGS gage 11303000 on the Stanislaus River near Ripon, approximately eight miles upstream of the sampling site. The CDEC data were used unadjusted from the Ripon station. The river flows through an urban area at Ripon and through several urban areas upstream of Ripon.

Table 2. Sampling Sites Discharge Sources

Site Discharge Information							
Site #	Site Name	USGS ID #	CDEC ID #	Agency	Type	Lat	Long
1	Merced River at River Road	---	MST	DWR	Hourly	37°22'16"	120°55'52"
5	Tuolumne River at Shiloh Road	11290000	MOD	USGS/DWR	Hourly	37°37'38"	120°59'11"
6	San Joaquin River at Vernalis	11303500	VNS	USGS	Hourly	37°40'01"	121°16'01"
7	Stanislaus River at Caswell State Park	11303000	RIP	USGS	Hourly	37°43'48"	121°06'32"

Loading Rate Calculations

Instantaneous loading rates of diazinon and chlorpyrifos were calculated by multiplying the stream discharge at the time of sample collection by the measured concentrations of each pesticide by the number of seconds (86,400) in one day. Loading rates were only calculated when the pesticide concentration was above the limit of detection and a discharge estimate was available. For all samples where pesticide concentrations were below the limit of detection, the loading rate was assumed to be zero.

The highest and lowest calculated instantaneous loading rates for diazinon were in the San Joaquin River at Vernalis and the Merced River at River Road, respectively. The highest and lowest calculated instantaneous loading rates for chlorpyrifos were also in the San Joaquin River at Vernalis and the Merced River at River Road, respectively.

Laboratory Analysis Methods

Upon arrival at the CDFA laboratory, the environmental samples were weighed then spiked with 500 μ L of 1.0 μ g/ml chlorpyrifos methyl (0.5 μ g/mL) surrogate spiking solution. Each sample was emptied into a 2-liter separatory funnel and approximately 10-15g of granular sodium chloride was added. Sixty ml of methylene chloride were added and the sample was then mixed for three minutes. The organic fraction was filtered through a bed of granular anhydrous sodium sulfate (approx. 20g). The extraction process was repeated three times and the resultant sample was evaporated to 5-7 ml at 40° C, then evaporated to dryness with an N-evaporator. One ml of methylene chloride and 10 μ L of a 5.0 μ g/mL internal standard solution were added to each sample. Samples were stored in a -5°C freezer until analysis. Samples were analyzed with an Agilent Model 5973 GC-MSD using a HP-5MS or equivalent GC column. Analysis was performed in the selective ion-monitoring mode.

Each sample was analyzed for seventeen compounds. The compounds and their respective limits of quantitation (LOQ) and limits of detection (LOD) are listed in Table 3. The lab reported estimated values when the values were below the LOQ but above the LOD. To ensure the accuracy and precision of the sample analysis, lab spikes, blanks, and a surrogate standard (chlorpyrifos methyl) were used. If the recovery of a spike sample was out of the control range, the water sample was re-analyzed.

Table 3. CDFA Laboratory limits of detection and practical quantitation limits for select pesticides

Compound	Limit of Detection (LOD in µg/L)	Limit of Quantitation (LOQ in µg/L)
Azinphos methyl	0.007	0.050
Bifenthrin	0.007	0.050
Carbaryl	0.007	0.020
Chlorpyrifos	0.004	0.010
Cyanazine	0.007	0.050
Cyfluthrins	0.070	0.200
Cypermethrins	0.070	0.200
Dacthal (DCPA)	0.007	0.050
Diazinon	0.007	0.020
Disulfoton	0.007	0.020
EPTC (Eptam)	0.020	0.050
Esfenvalerate	0.007	0.050
l-Cyhalothrin	0.030	0.100
Methidathion	0.010	0.030
Metolachlor	0.007	0.020
Propargite	0.150	0.500
Simazine	0.005	0.200

Quality Assurance Objectives

Sampling during the 2003-04 winter storm season was conducted under the guidance of a draft Quality Assurance Project Plan (QAPP) (San Joaquin River TMDL Quality Assurance Project Plan Azimi-Gaylon and Reyes, 2002).

Sampling precision and variability are measured through the use of field duplicates. The draft QAPP stated the Quality Assurance Objective (QAO) for precision was a relative percent difference (RPD) of less than 50%. No QAO was stated for accuracy in the draft QAPP. Accuracy is measured by determining the percent recovery of known concentrations of analytes spiked into environmental samples or reagent water before extraction. A 70-130% recovery rate is commonly viewed as acceptable (D. McClure, pers. comm.) and, for the purpose of this report, will be used as the QAO for accuracy in laboratory analytical measurements.

When reporting analytical results it is customary to flag those results that fall outside of the acceptable level of recovery as stated in the QAOs. For the purpose of this report all results outside of the 70-130% recovery range will be flagged as follows: BH = results should be viewed as biased high due to high surrogate recovery in sample.

Results

A total of 56 environmental samples (Table 4) and 9 quality control (QC) samples (Table 5) were collected and analyzed.

Environmental samples

Concentrations of diazinon and chlorpyrifos ranged from below detection to 0.088 parts per billion (ppb) of diazinon in the Tuolumne River on 5 February and 0.054 ppb chlorpyrifos in the Stanislaus River on 19 February (Table 4).

Other pesticides detected in the environmental samples were Carbaryl, Dacthal (DCPA), Methidathion, Metolachlor and Simazine, (Appendix A).

Five environmental samples had surrogate recoveries outside of the QAO acceptance limits – see footnotes in Table 4 and Appendix A.

Environmental Quality Control Samples

Sample quality control was measured through collection of sequential and split duplicates (n=5), field blanks (n=2) and matrix spikes (n=2). Duplicate samples provided a measure of analytical precision; field blanks were used to evaluate possible introduction of contaminants during sample collection, handling and transport to the lab; and matrix spikes were used to evaluate the relative percent recovery of spiked chemicals through extraction from the sample matrix.

The procedures used for collecting the QA/QC samples were based on the draft San Joaquin River TMDL Quality Assurance Project Plan (Azimi-Gaylon and Reyes, 2002)

The QAO for duplicate samples was a relative percent difference (RPD) of < 50% between the duplicate and the corresponding environmental sample concentrations. The RPDs for diazinon ranged from 0 – 22.22% (Table 5). Only one duplicate set of samples had a detection of chlorpyrifos in both the duplicate and environmental sample. The RPD between those samples was 18.18%.

One sample that was scheduled as a matrix spike was not identified as such on the Chain of Custody form and consequently was not spiked. This sample is listed as a duplicate in Table 5 and identified with a footnote.

The QAO acceptance limit for field blanks was “less than the reporting limit”. Both field blanks met the acceptance limits with no detections of any pesticides in either blank.

The QAO acceptance limits for matrix spikes were 70-130% for both chlorpyrifos and diazinon. Both matrix spikes met the QAO objectives for recovery. Recoveries ranged from 99-108% for chlorpyrifos and 98-100% for diazinon.

Laboratory Quality Control Samples

The QAO acceptance limits for laboratory blanks and laboratory control matrix spikes were recoveries of 70-130% for chlorpyrifos, diazinon and the surrogate (chlorpyrifos methyl). All laboratory quality control samples met the quality assurance objectives.

Recovery in lab blanks ranged from 79-118% (Appendix B). Recoveries in laboratory control matrix spikes ranged from 82-106%, 87-110% and 92-118% for chlorpyrifos, diazinon and chlorpyrifos methyl, respectively (Appendix C).

A summary of the environmental data is presented in Table 4 and Appendix A. A summary of the lab blank and spike data are presented in Appendices B and C.

Table 4. Summary of environmental data collected on diazinon and chlorpyrifos concentrations and instantaneous loading rates for sites in the San Joaquin River Basin, California. February 2004.

Stream flow is in cubic feet per second. J: the reported concentrations were below the quantitative limit and are considered estimates; BH: should be viewed as biased high due to high surrogate recovery in sample. NA: not available; ND: Not detected; g a.i./d: grams active ingredient per day; µg/L: microgram per liter.

Site number	Site name	Site identification number	Date (month/day/year)	Time (24 hr)	Stream flow (cfs)	Chlorpyrifos concentration (µg/L)	Chlorpyrifos instantaneous loading rate (g a.i./d)	Diazinon concentration (µg/L)	Diazinon instantaneous loading rate (g a.i./d)
1	Merced R @ River Rd	11273500	02/02/04	18:40	246	ND	NA	(0.010 J)	6.02
			02/03/04	12:00	246	(0.004 J)	2.41	(0.016 J)	9.63
			02/04/04	12:00	260	ND	NA	ND	NA
			02/05/04	12:10	297	(0.004 J)	2.91	(0.009 J)	6.54
			02/16/04	14:40	266	ND	NA	ND	NA
			02/17/04	12:50	272	ND	NA	ND	NA
			02/18/04	12:30	276	ND	NA	ND	NA
			02/19/04	12:40	297	(0.006 J)	4.36	ND	NA
5	Tuolumne River at Shiloh Road	11290000	2/2/2004	17:20	388	(0.006 J)	5.70	(0.016 J)	15.19
			2/2/2004	21:00	350	(0.004 J)	3.43	0.021	17.98
			2/3/2004	11:00	337	0.015	12.37	0.13	107.18
			2/3/2004	15:40	334	0.014	11.44	0.06	49.03
			2/4/2004	10:50	316	(0.007 J)	5.41	0.042	32.47
			2/4/2004	15:30	316	(0.008 J)	6.18	0.041	31.70
			2/5/2004 ¹	11:20	403	BH (0.011)	10.85	BH (0.060)	59.16
			2/5/2004	14:50	400	0.011	10.76	0.088	86.12
			2/16/2004	13:30	363	ND	NA	ND	NA
			2/16/2004	17:30	339	(0.006 J)	4.98	(0.013 J)	10.78
			2/17/2004	11:00	365	ND	NA	(0.014 J)	12.50
			2/17/2004 ²	15:30	308	BH (0.004 J)	3.01	BH (0.011 J)	8.29
			2/18/2004	11:30	361	(0.004 J)	3.53	(0.007 J)	6.18
			2/18/2004	15:40	347	(0.006 J)	5.09	0.03	25.47
			2/19/2004	11:50	1160	(0.005 J)	14.19	(0.012 J)	34.06
2/19/2004	15:20	1360	ND	NA	(0.008 J)	26.62			

¹Surrogate recovery (132%) was outside of QAPP acceptance limits. Results should be viewed as biased high.

² Surrogate recovery (131%) was outside of QAPP acceptance limits. Results should be viewed as biased high.

Table 4. Summary of environmental data collected on diazinon and chlorpyrifos concentrations and instantaneous loading rates for sites in the San Joaquin River Basin, California. February 2004.

Stream flow is in cubic feet per second. J: the reported concentrations were below the quantitative limit and are considered estimates; BH: should be viewed as biased high due to high surrogate recovery in sample. NA: not available; ND: Not detected; g a.i./d: grams active ingredient per day; µg/L: microgram per liter.

Site number	Site name	Site identification number	Date (month/day/year)	Time (24 hr)	Stream flow (cfs)	Chlorpyrifos concentration (µg/L)	Chlorpyrifos instantaneous loading rate (g a.i./d)	Diazinon concentration (µg/L)	Diazinon instantaneous loading rate (g a.i./d)
6	San Joaquin River at Vernalis	11303500	02/02/04	16:50	1470	(0.005 J)	17.98	(0.011 J)	39.56
			02/02/04	20:50	1460	(0.008 J)	28.58	(0.015 J)	53.58
			02/03/04	10:20	1550	(0.006 J)	22.75		197.19
			02/03/04	14:40	1580	ND	NA	0.052	201.00
			02/04/04	10:10	1570	(0.005 J)	19.21	0.043	165.16
			02/04/04	14:50	1590	(0.005 J)	19.45	0.054	210.06
			02/05/04	10:20	1610	(0.007 J)	27.57	0.048	189.07
			02/05/04	14:20	1620	(0.007 J)	27.74	0.049	194.20
			02/16/04	13:00	1760	ND	NA	ND	NA
			02/16/04	17:00	1760	(0.004 J)	17.22	ND	NA
			02/17/04	10:30	1820	ND	NA	(0.015 J)	66.79
			02/17/04 ³	14:50	1810	BH (0.004 J)	17.71	BH (0.021)	92.99
			02/18/04	11:00	1840	ND	NA	(0.010 J)	45.02
			02/18/04	15:00	1840	(0.006 J)	27.01	(0.009 J)	40.51
			02/19/04	11:10	2020	0.024	118.61	0.023	113.66
02/19/04	15:00	2050	(0.009 J)	45.14	0.022	110.34			
7	Stanislaus River at Caswell S.P.	374209121103800	02/02/04	14:20	298	ND	NA	0.028	20.41
			02/02/04	20:10	281	0.017	11.69	0.28	192.49
			02/03/04	9:40	296	0.015	10.86	0.11	79.66
			02/03/04	14:10	292	ND	NA	0.042	30.00
			02/04/04	9:30	324	(0.007 J)	5.55	0.13	103.05
			02/04/04	14:10	326	(0.007 J)	5.58	0.08	63.80
			02/05/04	9:30	306	(0.006 J)	4.49	0.03	22.46
			02/05/04	13:40	301	(0.006 J)	4.42	0.03	22.09
			02/16/04	12:20	493	0.006	7.24	0.039	47.04
			02/16/04	16:20	493	(0.004 J)	4.82	0.028	33.77
02/17/04 ⁴	9:50	487	ND	NA	BH (0.022)	26.21			

³ Surrogate recovery (133%) was outside of QAPP acceptance limits. Results should be viewed as biased high.

Table 4. Summary of environmental data collected on diazinon and chlorpyrifos concentrations and instantaneous loading rates for sites in the San Joaquin River Basin, California. February 2004.

Stream flow is in cubic feet per second. J: the reported concentrations were below the quantitative limit and are considered estimates; BH: should be viewed as biased high due to high surrogate recovery in sample. NA: not available; ND: Not detected; g a.i./d: grams active ingredient per day; µg/L: microgram per liter.

Site number	Site name	Site identification number	Date (month/day/year)	Time (24 hr)	Stream flow (cfs)	Chlorpyrifos concentration (µg/L)	Chlorpyrifos instantaneous loading rate (g a.i./d)	Diazinon concentration (µg/L)	Diazinon instantaneous loading rate (g a.i./d)
7	Stanislaus River at Caswell S.P.	374209121103800	02/17/04	14:20	487	ND	NA	(0.013 J)	15.49
	<i>continued</i>		02/18/04	10:10	519	0.006	7.62	0.021	26.66
			02/18/04	14:20	522	(0.008 J)	10.22	0.027	34.48
			02/19/04	10:30	664	0.054	87.72	(0.014 J)	22.74
			02/19/04	14:10	664	(0.010 J)	16.24	(0.019 J)	30.87

⁴ Surrogate recovery (131%) was outside of QAPP acceptance limits. Results should be viewed as biased high.

Table 5. Summary of diazinon and chlorpyrifos concentrations quality-control data for sites in the San Joaquin River Basin, California, February 2004.

NA: not applicable - cannot be calculated because of "less than" concentration; µg/L: microgram per liter; J: the reported concentrations were below the quantitative limit and are considered estimates; <: less than						
Site identification number	Site name	Date and time (month/day/year 24-hour time)	Chlorpyrifos (ug/L)	Relative percent difference OR percent recovery (chlorpyrifos)	Diazinon (ug/L)	Relative percent difference OR percent recovery (diazinon)
DUPLICATES¹						
11273500	Merced River at River Road	2/2/2004 18:40 2/2/2004 18:43	<0.004 (0.004 J)	NA	(0.010 J) (0.008 J)	22.22%
11273500	Merced River at River Road	2/19/2004 12:40 2/19/2004 12:43	(0.006 J) <0.004	NA	<0.007 <0.007	NA
11303500	San Joaquin River at Vernalis	2/2/2004 16:50 2/2/2004 16:59 ²	(0.005 J) (0.006 J)	18.18%	(0.011 J) (0.011 J)	0%
11303500	San Joaquin River at Vernalis	2/16/2004 17:00 2/16/2004 17:03	(0.004 J) <0.004	NA	<0.007 <0.007	NA
374209121103800	Stanislaus River at Caswell State Park	2/3/2004 14:10 2/3/2004 14:13	<0.004 <0.004	NA	0.042 0.038	10.00%
BLANKS						
11290200	Tuolumne River at Shiloh Road	2/4/2004 10:51	<0.004		<0.007	
374209121103800	Stanislaus River at Caswell State Park	2/17/2004 9:51	<0.004		<0.007	
SPIKES^{3,4}						
11273500	Merced River at River Road	2/5/2004 12:10 2/5/2004 12:19	(0.004 J)	99%	(0.009 J)	100%
11290200	Tuolumne River at Shiloh Road	2/18/2004 15:40 2/18/2004 15:49	(0.006 J)	108%	0.030	98%

¹ Sequential duplicate collected at Stanislaus River at Caswell State Park; all other sites were split duplicates.

² Sample was scheduled as a matrix spike but accidentally collected as a duplicate.

³ Spiked samples were injected with 0.05 ug/L of chlorpyrifos; 0.10 ug/L of diazinon.

⁴ First sample in each pair is the environmental sample; second sample is the spike.

Sources Cited

Azimi-Gaylon, S., and E. Reyes. 2002. Quality Assurance Project Plan for Monitoring Organophosphorous Pesticides in the Lower San Joaquin Basin. CVRWQCB-Sacramento, California.

Acknowledgements

Monitoring water quality during the 2003-04 winter storm season required working long hours, often in adverse weather conditions. Field staff were Karen Gonzalves and Tim Tadlock from the University of California, Davis. Their hard work and commitment was vital to collecting the data used in this report.

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Thanks to Stephen Siegel and staff from the California Department of Food and Agriculture Lab for their unwavering enthusiasm and cheerfulness in processing hundreds of water quality samples.

We would like to offer a special thank you to Jennifer Nickell of the John Muir Institute at UC Davis for her tireless efforts in processing numerous purchases, and handling all personnel matters.

Appendices

Appendix A. Pesticide results (excluding diazinon and chlorpyrifos).

(Concentrations are in units of µg/L. ND: Not detected; J: the reported concentrations were below the quantitative limit and are considered estimates; BH: should be viewed as biased high due to high surrogate recovery in sample. Each sample was also analyzed for Azinphos methyl, Bifenthrin, Cyanazine, Cyfluthrins, Cypermethrins, Disulfoton, EPTC (Eptam), Esfenvalerate, Propargite and I-Cyhalothrin which were not present at detectable levels).

Site	Date	Time	Carbaryl	Dacthal (DCPA)	Methidathion	Metolachlor	Simazine
Merced River at River Rd.	02/02/04	18:40	ND	ND	ND	ND	ND
Merced River at River Rd.	02/03/04	12:00	ND	ND	ND	ND	ND
Merced River at River Rd.	02/04/04	12:00	ND	ND	ND	ND	ND
Merced River at River Rd.	02/05/04	12:10	ND	ND	ND	ND	(0.044 J)
Merced River at River Rd.	02/16/04	14:40	ND	ND	ND	ND	(0.007 J)
Merced River at River Rd.	02/17/04 ¹	12:50	ND	ND	ND	ND	BH (0.006 J)
Merced River at River Rd.	02/18/04	12:30	ND	ND	ND	ND	(0.031 J)
Merced River at River Rd.	02/19/04	12:40	ND	ND	ND	ND	ND
Tuolumne River at Shiloh Rd.	2/2/2004	17:20	ND	ND	ND	ND	ND
Tuolumne River at Shiloh Rd.	2/2/2004	21:00	ND	ND	ND	ND	(0.021 J)
Tuolumne River at Shiloh Rd.	2/3/2004	11:00	ND	ND	ND	ND	0.23
Tuolumne River at Shiloh Rd.	2/3/2004	15:40	ND	ND	ND	ND	(0.16 J)
Tuolumne River at Shiloh Rd.	2/4/2004	10:50	ND	ND	ND	ND	(0.031 J)
Tuolumne River at Shiloh Rd.	2/4/2004	15:30	ND	ND	0.066	ND	(0.036 J)
Tuolumne River at Shiloh Rd.	2/5/2004 ²	11:20	ND	ND	BH (0.098)	ND	BH (0.082 J)
Tuolumne River at Shiloh Rd.	2/5/2004	14:50	ND	ND	0.061	ND	(0.12 J)
Tuolumne River at Shiloh Rd.	2/16/2004	13:30	ND	ND	(0.022 J)	ND	(0.015 J)
Tuolumne River at Shiloh Rd.	2/16/2004	17:30	ND	ND	ND	ND	(0.026 J)
Tuolumne River at Shiloh Rd.	2/17/2004	11:00	ND	ND	ND	ND	(0.061 J)
Tuolumne River at Shiloh Rd.	2/17/2004 ³	15:30	ND	ND	ND	ND	BH (0.031 J)
Tuolumne River at Shiloh Rd.	2/18/2004	11:30	ND	ND	ND	ND	(0.011 J)
Tuolumne River at Shiloh Rd.	2/18/2004	15:40	ND	ND	ND	ND	(0.036 J)
Tuolumne River at Shiloh Rd.	2/19/2004	11:50	ND	ND	ND	ND	(0.025 J)
Tuolumne River at Shiloh Rd.	2/19/2004	15:20	ND	ND	ND	ND	(0.015 J)
San Joaquin River at Vernalis	02/02/04	16:50	ND	ND	ND	ND	ND
San Joaquin River at Vernalis	02/02/04	20:50	ND	ND	ND	ND	(0.039 J)
San Joaquin River at Vernalis	02/03/04	10:20	ND	ND	ND	(0.007 J)	0.7
San Joaquin River at Vernalis	02/03/04	14:40	ND	ND	ND	ND	(0.15 J)
San Joaquin River at Vernalis	02/04/04	10:10	ND	ND	ND	ND	(0.10 J)
San Joaquin River at Vernalis	02/04/04	14:50	ND	ND	ND	(0.009 J)	(0.053 J)
San Joaquin River at Vernalis	02/05/04	10:20	ND	ND	ND	(0.008 J)	0.28
San Joaquin River at Vernalis	02/05/04	14:20	ND	ND	ND	(0.009 J)	0.23
San Joaquin River at Vernalis	02/16/04	13:00	ND	ND	ND	ND	0.029
San Joaquin River at Vernalis	02/16/04	17:00	ND	ND	ND	(0.007 J)	ND
San Joaquin River at Vernalis	02/17/04	10:30	ND	ND	ND	ND	(0.051 J)

¹ Surrogate recovery (133%) was outside of QAPP acceptance limits. Results should be viewed as biased high.

² Surrogate recovery (132%) was outside of QAPP acceptance limits. Results should be viewed as biased high.

³ Surrogate recovery (131%) was outside of QAPP acceptance limits. Results should be viewed as biased high.

Appendix A. Pesticide results (excluding diazinon and chlorpyrifos).

(Concentrations are in units of µg/L. ND: Not detected; J: the reported concentrations were below the quantitative limit and are considered estimates; BH: should be viewed as biased high due to high surrogate recovery in sample. Each sample was also analyzed for Azinphos methyl, Bifenthrin, Cyanazine, Cyfluthrins, Cypermethrins, Disulfoton, EPTC (Eptam), Esfenvalerate, Propargite and I-Cyhalothrin which were not present at detectable levels).

Site	Date	Time	Carbaryl	Dacthal (DCPA)	Methidathion	Metolachlor	Simazine
San Joaquin River at Vernalis	02/17/04 ⁴	14:50	ND	ND	ND	BH (0.007 J)	BH (0.067 J)
San Joaquin River at Vernalis	02/18/04	11:00	ND	ND	ND	(0.016 J)	(0.040 J)
San Joaquin River at Vernalis	02/18/04	15:00	ND	ND	ND	(0.012 J)	(0.12 J)
San Joaquin River at Vernalis	02/19/04	11:10	ND	(0.007 J)	ND	(0.018 J)	(0.066 J)
San Joaquin River at Vernalis	02/19/04	15:00	ND	ND	ND	(0.018 J)	(0.11 J)
Stanislaus River at Caswell State Park	02/02/04	14:20	ND	ND	ND	ND	(0.029 J)
Stanislaus River at Caswell State Park	02/02/04	20:10	ND	ND	0.04	(0.014 J)	2.6 *
Stanislaus River at Caswell State Park	02/03/04	9:40	ND	(0.017 J)	(0.030 J)	ND	0.29
Stanislaus River at Caswell State Park	02/03/04	14:10	ND	ND	ND	ND	(0.13 J)
Stanislaus River at Caswell State Park	02/04/04	9:30	ND	ND	ND	ND	0.35
Stanislaus River at Caswell State Park	02/04/04	14:10	ND	ND	ND	ND	0.68
Stanislaus River at Caswell State Park	02/05/04	9:30	ND	ND	ND	ND	0.39
Stanislaus River at Caswell State Park	02/05/04	13:40	ND	ND	ND	ND	0.4
Stanislaus River at Caswell State Park	02/16/04	12:20	ND	ND	ND	ND	0.22
Stanislaus River at Caswell State Park	02/16/04	16:20	ND	ND	ND	ND	0.26
Stanislaus River at Caswell State Park	02/17/04 ⁵	9:50	ND	ND	ND	ND	BH (0.095 J)
Stanislaus River at Caswell State Park	02/17/04	14:20	ND	ND	ND	ND	(0.093 J)
Stanislaus River at Caswell State Park	02/18/04	10:10	ND	ND	ND	ND	0.35
Stanislaus River at Caswell State Park	02/18/04	14:20	ND	ND	ND	ND	0.37
Stanislaus River at Caswell State Park	02/19/04	10:30	ND	ND	ND	ND	0.29
Stanislaus River at Caswell State Park	02/19/04	14:10	0.1	ND	ND	ND	0.58

* 1/20th dilution

⁴ Surrogate recovery (133%) was outside of QAPP acceptance limits. Results should be viewed as biased high.

⁵ Surrogate recovery (131%) was outside of QAPP acceptance limits. Results should be viewed as biased high.

Appendix B. Lab Blank Data

(No pesticides were present at detectable levels. The pesticides include azinphos methyl, bifenthrin, carbaryl, chlorpyrifos, cyanazine, cyfluthrins, cypermethrins, dacthal (DCPA), diazinon, disulfoton, EPTC (Eptam), esfenvalerate, methidathion, metolachlor, propargite, l-Cyhalothrin and simazine)

Date Extracted	Chlorpyrifos Methyl (Surrogate) Recovery
2/4/2004	106%
2/5/2004	98%
2/6/2004	79%
2/10/2004	107%
2/18/2004	84%
2/19/2004	100%
2/20/2004	97%
2/24/2004	104%
2/25/2004	118%

Appendix C. Recovery of lab spikes and surrogates

Date Extracted	Diazinon	Chlorpyrifos	Surrogate
2/4/2004	100%	106%	113%
2/5/2004	90%	84%	103%
2/6/2004	90%	82%	98%
2/10/2004	110%	92%	118%
2/18/2004	87%	86%	92%
2/19/2004	91%	89%	106%
2/20/2004	93%	106%	114%
2/24/2004	106%	101%	112%
2/25/2004	98%	99%	114%