Front cover: Sacramento River near Colusa, California, with the Sutter Buttes in the background. *(Photograph by Cathy Munday, U.S. Geological Survey)*

Occurrence and Transport of Diazinon in the Sacramento River and Selected Tributaries, California, during Two Winter Storms, January–February 2001

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GALE A. NORTON, *Secretary*

U.S. GEOLOGICAL SURVEY
Charles G. Groat, *Director*

For additional information write to:

U.S. Geological Survey
Water Resources
Placer Hall, Suite 2012
6000 J Street
Sacramento, California 95819-6129
http://ca.water.usgs.gov

Copies of this report can be purchased from:

U.S. Geological Survey
Information Services
Building 810
Box 25286, Federal Center
Denver, CO 80225-0286

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CONVERSION FACTORS

Multiply	By	To obtain
foot (ft)	3.048	meter (m)
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
inch (in.)	2.54	centimeter (cm)
mile (mi)	1.6093	kilometer (km)
square mile mi^2	12.590	square kilometer (km^2)
pound (lb)	0.4546	kilogram (kg)

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

$$°F=1.8\ °C+32.$$

WATER QUALITY INFORMATION

Pesticide concentrations in water samples are given in nanograms per liter (ng/L). One thousand nanograms per liter is equivalent to 1 microgram per liter (µg/L) or 0.001 milligram per liter (mg/L). Nanograms per liter is equivalent to "parts per trillion" (ppt). Loads, distances, and area are given in English units.

ABBREVIATIONS AND ACRONYMS

µm	micrometer
lb a.i.	pounds active ingredient
ADCP	acoustic Doppler current profiler
CDFG	California Department of Fish and Game
CSUC	California State University at Chico
lb/d	pound per day
DPR	California Department of Pesticide Regulations
DWR	California Department of Water Resources
GC/MS	gas chromatography with mass spectrometry
GC/ECD/TSD	gas chromatography coupled with an electron capture detector and thermionic specific detector
GIS	Geographic Information System
kHz	kiloherz
L,	liter
mL	milliliter
ng/L	nanogram per liter
NWQL	National Water Quality Laboratory
PUR	Pesticide Use Report
Regional Board	Central Valley Regional Water Quality Control Board
SIM	Selective ion monitoring
SOP	Standard Operating Procedure
SRWP	Sacramento River Watershed Program
TMDL	Total Maximum Daily Load
UDSDA	United States Department of Agriculture
USGS	United States Geological Survey

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By Peter D. Dileanis[1], David L. Brown[2], Donna L. Knifong[1], *and* Dina Saleh[1]

Abstract

Diazinon, an organophosphate insecticide, is applied as an orchard dormant spray in the Sacramento Valley during the winter months when the area receives most of its annual rainfall. During winter rainstorms that frequently follow dormant spray applications, some of the applied pesticide is transported in storm runoff to the Sacramento River and its tributaries. Diazinon is also used to control insect pests on residential and commercial properties in urban areas and is frequently detected in urban storm runoff draining into the Sacramento River system.

Between January 24 and February 14, 2001, diazinon concentrations and loads were measured in the Sacramento River and selected tributaries during two winter storms that occurred after dormant spray applications were made to orchards in the Sacramento Valley. Water samples were collected at 21 sites that represented agricultural and urban inputs on a variety of scales, from small tributaries and drains representing local land use to main-stem river sites representing regional effects.

Concentrations of diazinon ranged from below laboratory reporting levels to 1,380 nanograms per liter (ng/L), with a median of 55 ng/L during the first monitored storm and 26 ng/L during the second. The highest concentrations were observed in small channels draining predominantly agricultural land.

About 26,000 pounds of diazinon were reported applied to agricultural land in the study area just before and during the monitoring period. About 0.2 percent of the applied insecticide appeared to be transported to the lower Sacramento River during that period. The source of about one third of the total load measured in the lower Sacramento River appears to be in the portion of the drainage basin upstream of the city of Colusa. About 12 percent of the diazinon load in the lower Sacramento River was transported from the Feather River Basin, which drains much of the mountainous eastern portions of the Sacramento River Basin.

Diazinon use in the study area during the 2000–2001 dormant spray season continued a declining trend observed since 1993. The maximum concentrations of diazinon observed during the last 2 years of monitoring were lower than concentrations observed in previous years when larger amounts of diazinon had been applied as dormant sprays.

[1]U.S. Geological Survey, Placer Hall, 6000 J Street, Sacramento, California 95819

[2]Bidwell Environmental Institute, California State University, Chico, 400 West First Street, Chico, California 95929

Introduction

Diazinon is an organophosphate insecticide that is applied to nut and stone-fruit trees in the Sacramento Valley during their winter dormant period to control peach twig borer, San Jose scale, and mite pests. The dormant season occurs from December through March of most years, and is considered the best time to control these pests because the efficacy of pesticide applications is greatest before the trees develop a leaf canopy (Zalom and others, 1995). Diazinon is also used in home, garden, and commercial applications in urban and industrial areas of the watershed.

The Sacramento Valley usually receives most of its annual rainfall during the period when dormant sprays are applied. Pesticide monitoring studies have shown that rain and associated surface runoff from winter storms facilitate the transport of diazinon from its point of application to the Sacramento River and its tributaries. Evidence for this mode of transport is supported by observations that diazinon has been detected more frequently in valley streams during the rainy season than at dry times of the year and the highest diazinon concentrations measured have been in winter storm runoff during the dormant-spray season (Foe and Sheipline, 1993; MacCoy and others, 1995; Domagalski, 1996; Ganapathy and others, 1997; Nordmark, 1998, 1999; Nordmark and others, 1998; Holmes and others, 2000; Dileanis and others, 2002). Diazinon has also been detected in air samples and in rain collected during the dormant-spray season, indicating that atmospheric transport may play a role in the offsite movement of diazinon (Giddings and others, 2000; Majewski and Baston, 2002).

In the winter of 2000, the U.S. Geological Survey (USGS) began participating in a storm-runoff monitoring program in cooperation with the California Department of Pesticide Regulation (DPR) and with guidance from the Sacramento River Watershed Program (SRWP) and the Central Valley Regional Water Quality Control Board (Regional Board). The goal of the monitoring program was to characterize the occurrence and magnitude of diazinon contamination in Sacramento Valley streams and to determine the sources of the diazinon detected in the Sacramento and Feather Rivers. The monitoring program, designed to expand the knowledge base developed by previous monitoring studies, was initiated to support the development of a pesticide management plan and a Total Maximum Daily Load (TMDL) program for diazinon. Background information on the diazinon monitoring program and results from the winter 2000 storm monitoring are reported by Dileanis and others (2002).

This report presents the results of storm runoff monitoring during the winter of 2001. Between January 24 and February 14, 2001, diazinon and other pesticide concentrations were monitored during two storms that occurred in the Sacramento Valley after dormant-spray applications had begun. Samples were collected at 21 sites throughout a period of 5 or more days that began when each storm began. Diazinon loads from selected subbasins were estimated for the monitoring periods in order to identify the largest sources of diazinon to the Sacramento and Feather Rivers. Data on pesticide use in these subbasins was incorporated into a Geographic Information System (GIS) coverage to estimate diazinon yields, the portion of applied diazinon that was transported to the rivers.

Environmental Setting of the Sacramento River Watershed

The Sacramento River watershed (fig. 1) drains more than 27,000 mi^2 of land from its upper reaches near the California–Oregon border to its mouth 50 mi northeast of the city of San Francisco (Kahrl, 1979). The major land uses in the watershed are forestry, agriculture, urban, and mining. The Sacramento River and its numerous tributaries provide water for a multitude of beneficial uses including irrigation of agricultural lands, domestic water supply, aquatic habitat, and recreation. The Sacramento River's largest natural tributary is the Feather River, which originates in the Sierra Nevada and drains much of the eastern area of the Sacramento River watershed. Many smaller tributaries originate in the coastal mountains and the Sierra Nevada. Wintertime streamflow in the watershed is affected by reservoir releases, storm runoff, and diversions to bypass channels used for flood control. Portions of Sacramento River streamflow are exported for agricultural and domestic use in the southern part of the state.

The middle and lower reaches of the Sacramento River flow through the Sacramento Valley, which forms the northern part of California's prominent Central Valley. It is geographically continuous with the San Joaquin Valley to the south, but is defined by its distinct drainage basin. Beginning near the town of Red Bluff, the valley stretches about 150 mi to the southeast where it merges into the broad expanse of the Sacramento-San Joaquin River Delta, south of the Sacramento metropolitan area. The generally flat valley floor occupies about 5,000 mi^2, its elevation decreasing almost imperceptibly from about 300 ft at its northern end to near sea level in the delta.

Agriculture is the dominant land use on the valley floor, followed by urban development. Figure 2 shows the extent and distribution of agricultural and urban land use in the valley. The hot summer and temperate winter climate, combined with the availability of water for irrigation during the normally dry summer months, allows a wide variety of crops to be grown. Land once occupied by natural flood basins on either side of the Sacramento River is characterized by shallow ground water and silty, poorly draining soils. Much of this area is planted with rice. Row crops and orchards requiring well-drained land are grown on soil derived from alluvial fans or the coarser soils associated with stream channels. About 2,300 mi^2 in the watershed are devoted to agricultural use. Stone-fruit and almond orchards occupy about 290 mi^2, mostly in the northern and central parts of the valley (California Department. of Water Resources, 1990, 1994a, 1994b, 1995a, 1995b, 1995c, 1995d, 2000).

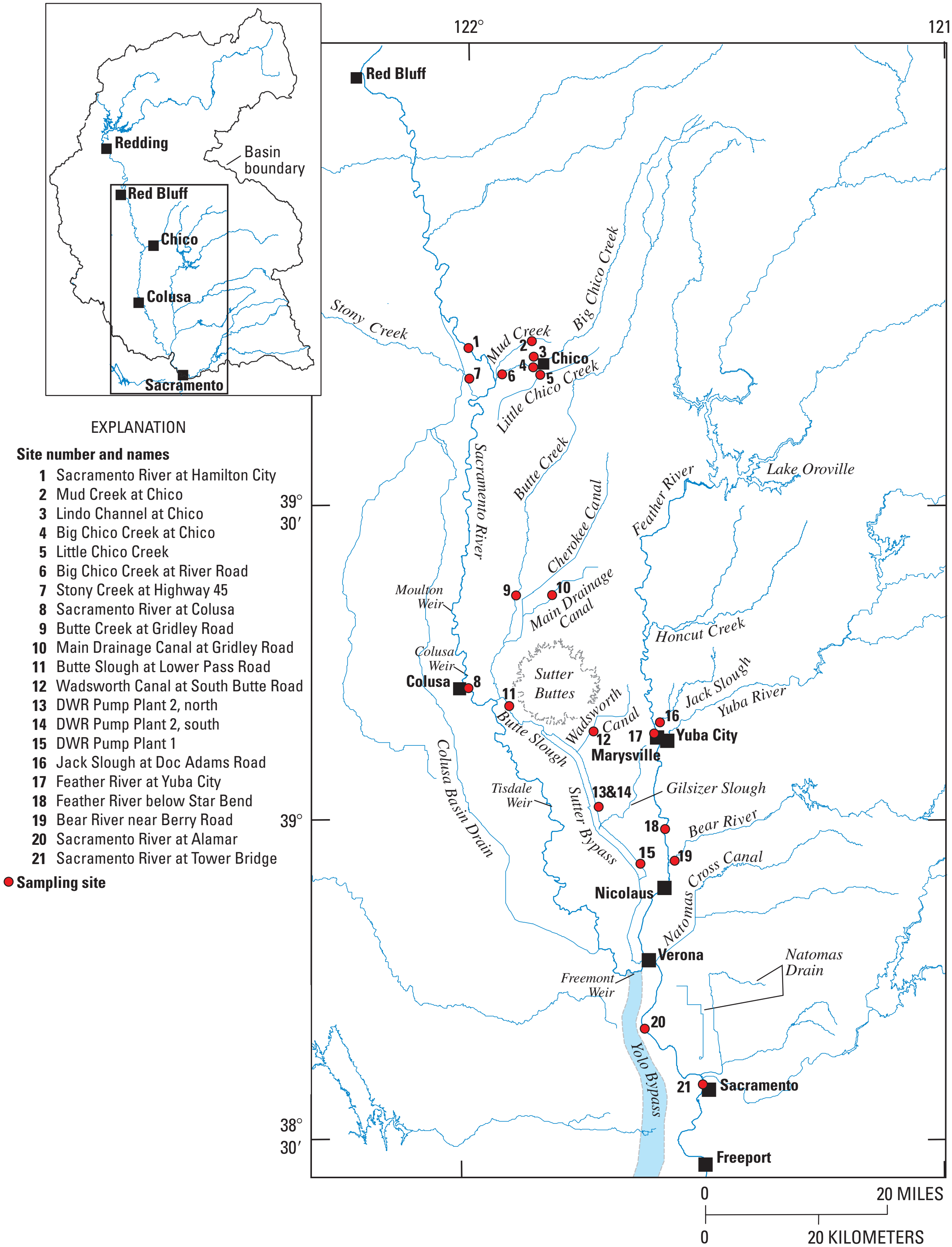

Figure 1. Sampling sites in the Sacramento River watershed, California.

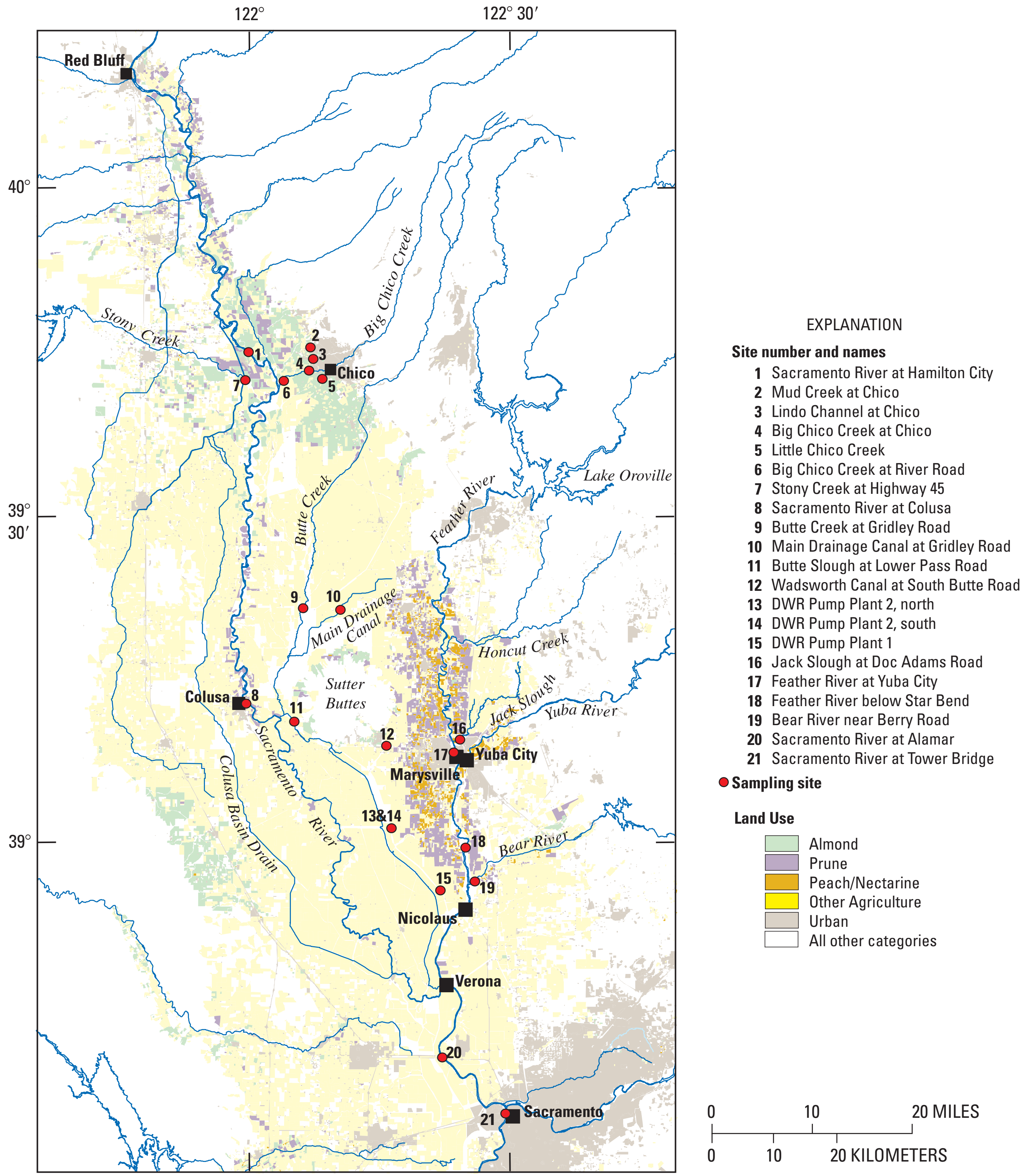

Figure 2. Land use in the Sacramento Valley, California.
[Land use derived from California Department of Water Resources digital land-use data (California Department of Water Resources, 1990, 1994, 1995, 2000).]

Most precipitation in the watershed occurs from November through March, with the largest amount, on average, during the month of January. With rare exceptions, precipitation on the valley floor falls as rain. Mean annual rainfall on the valley floor tends to increase with latitude and elevation, ranging from 22 in. at Sacramento to 30 in. at Red Bluff. In the higher elevations of the Sierra Nevada on the eastern boundary of the watershed, precipitation averages 80 to 90 in. each year, primarily from heavy snowfall during the winter months (National Oceanic and Atmospheric Administration, 2001).

Acknowledgments

Kevin P. Bennett of the California Department of Pesticide Regulation led the study design team and was in charge of logistics for the 2001 monitoring year fieldwork. Field personnel included Kevin Kelley, Sainey Ceesay, Jesse Ybarra, Carissa Ganapathy, Amy Washburn, and Linda Rivard from the California Department of Pesticide Regulation; Mary Menconi, Sam Harder, Michele McGraw, Zhimin “Jamie” Lu, and Debbie Daniels from the Central Valley Regional Water Quality Control Board; Frank Moseanko, Jerry Harmon, and Jason May from the U.S. Geological Survey; and our colleagues from the California State University at Chico: Matt Bacior, Chris Bujalski, Vicky Snowden, Lisa Stultz, and Sara Taddo.

Study Design and Methodology

Selection of Sampling Sites

Water samples were collected at 21 sites and analyzed for diazinon and other pesticides in order to monitor the occurrence and transport of the insecticide in storm runoff during the 2000–2001 dormant spray season. The locations of individual sampling sites are described in table 1 and shown on the map of the study area (fig. 1). Sites were chosen to represent the effects of upstream land use on a variety of scales, from small tributaries and drains representing local land use to main-stem river sites representing regional effects. Site selection criteria included historic or suspected diazinon use upstream, availability of streamflow data, accessibility during stormy weather, and the safety of field personnel.

Four sites (1, 8, 20, and 21) were located on the Sacramento River and two sites (17 and 18) on the Feather River to evaluate pesticide contamination in these large rivers that receive diazinon inputs from multiple upstream sources. Site 1, Sacramento River at Hamilton City (located near river mile 199), was farthest upstream and chosen to monitor the effect of pesticide sources in the northern portion of the watershed, which covers approximately 10,800 mi^2 upstream of the site (U.S. Geological Survey, accessed February 3, 2003). Winter streamflow at the site is largely a function of controlled water releases from Lake Shasta located 45 mi upstream and storm runoff from tributaries between the dam and Hamilton City. Land use near the Sacramento River upstream of site 1 is a mosaic of orchard, row crops, pockets of urban land use, and natural riparian forests in various stages of restoration. Air photos and previous field reconnaissance of the river indicate that many of the orchards directly adjoin the river with no apparent buffer strips or runoff control structures.

Potential diazinon sources between site 1 and the next downstream monitoring location (site 8, Sacramento River at Colusa) at river mile 144 include Stony Creek, the Chico urban area, and orchards near the river. Nearly continuous leveed banks downstream of Stony Creek (river mile 172) restrict runoff inflow into the river, but there are numerous small pockets of orchard lands located within the leveed floodplain.

Near flood stage, Sacramento River water is often diverted into leveed bypass channels that augment the limited capacity of the main river channel. At river mile 158, about 13 mi upstream of Colusa, Moulton Weir can divert water to the east of the river channel, and at river mile 146, just 2 mi above site 8, water can be diverted east from the Colusa Weir. Water from both these weirs flows overland to Butte Slough and the Sutter Bypass channel, both of which flow southward. Water can also be diverted into the Sutter Bypass through Tisdale Weir at river mile 119. The Sutter Bypass merges back into the Sacramento River near the mouth of the Feather River. At this point (river mile 81) the Freemont Weir can divert a large portion of the Sacramento River flow southwest to the delta through the Yolo Bypass to prevent flooding in the Sacramento Metropolitan area.

Site 20, Sacramento River at Alamar (river mile 70), included additional sources from the Feather River, Butte Creek-Sutter Bypass, and Natomas Cross Canal subbasins. The site farthest downstream in the study area was site 21 (Sacramento River at Tower Bridge), which combined diazinon from upstream sources with runoff from the northern part of the Sacramento metropolitan area.

Table 1. Sites used to monitor the occurrence and transport of diazinon during the 2000–2001 dormant spray season, Sacramento River watershed, California.

[DWR, California Department of Water Resources]

Site No.	Site name	Latitude	Longitude	Description
1	Sacramento River at Hamilton City	39°45′07″	121° 59′38″	Bridge on Highway 32 at Hamilton City
2	Mud Creek at Chico	39°47′00″	121°53′13″	Bridge at Esplanade Road northwest of Chico
3	Lindo Channel at Chico	39°44′30″	121°52′48″	Bridge on Highway 32 in Chico
4	Big Chico Creek at Chico	39°43′38″	121°51′44″	Bridge at Rose Avenue in Chico
5	Little Chico Creek	39°43′12″	121°50′26″	Bridge at Dayton Road in Chico
6	Big Chico Creek at River Road	39°42′17″	121°56′17″	Bridge on River Road (Sutter Avenue) southeast of Chico, just upstream of river mouth
7	Stony Creek at Highway 45	39°42′38″	122°00′08″	Bridge on Highway 45, 2 miles south of Hamilton City
8	Sacramento River at Colusa	39°12′52″	121°59′57″	Bridge on River Road in Colusa
9	Butte Creek at Gridley Road	39°21′43″	121°53′30″	Bridge on Gridley Road 10 miles west of Gridley
10	Main Drainage Canal at Gridley Road	39°21′44″	121°49′23″	Bridge on Gridley Road 6.5 miles west of Gridley
11	Butte Slough at Lower Pass Road	39°11′16″	121°54′28″	Bridge on Lower Pass Road, southeast of the Sutter Buttes
12	Wadsworth Canal at South Butte Road	39°09′11″	121°44′00″	Bridge on South Butte Road 15 miles west of Yuba City
13	DWR Pumping Plant 2, North (Obanion Outfall)	39°01′33″	121°43′30″	Pedestrian bridge just upstream of weir at pumping plant on west end of Obanion Ave
14	DWR Pumping Plant 2, South (Obanion Outfall)	39°01′33″	121°43′30″	Single-lane bridge just upstream of the pumping plant
15	DWR Pumping Plant 1 (Sacramento Outfall)	38°55′60″	121°38′01″	Samples collected from the bank of north drain at pumping plant near west end of Sacramento Ave
16	Jack Slough near Doc Adams Road	39°09′43″	121°35′43″	North bank of slough north of Marysville near Doc Adams Road
17	Feather River at Yuba City	39°08′37″	121°36′26″	West bank of river beneath Highway 20 bridge in Yuba City
18	Feather River below Star Bend	39°00′20″	121°34′42″	Samples collected from boat 8 miles upstream of Highway 99 bridge (near river mile 17)
19	Bear River near Berry Road	38°57′18″	121°33′02″	1 mile downstream of Highway 70 bridge. Waded at low flow; south bank at high flows
20	Sacramento River at Alamar	38°40′30″	121°37′36″	Pier on east bank at river mile 71, just upstream of Highway 5 (Veteran's) bridge
21	Sacramento River at Tower Bridge	38°34′30″	121°30′20″	Tower Bridge on Capitol Avenue, downtown Sacramento

Streamflow at sites 17 and 18 on the Feather River is largely controlled by releases from Oroville Dam in the Sierra foothills. Prune, peach, and nectarine orchards occur throughout the lower watershed and dominate the landscape along the east and west sides of the Feather River (fig. 2). The channel is leveed throughout much of its lower reach below Lake Oroville, and most of the runoff from the orchards and urban areas west of the river levies flows southwest to the Butte Slough and Sutter Bypass before entering the Sacramento River just upstream of the mouth of the Feather River. Orchard runoff drains directly into the Feather River from orchards growing within the leveed channel and from east side tributaries. Site 17 (Feather River at Yuba City) is downstream of Honcut Creek and Jack Slough. Jack Slough was monitored just upstream of its confluence with the Feather River at site 16 because most of the orchards in its watershed are located close to the river. Site 18 (Feather River below Star Bend) was 11 mi downstream of site 17 and sampled by boat. The original sampling plan called for site 18 to be located farther downstream below the mouth of the Bear River, but unusually low flow in the Feather River made access to the site difficult, so an alternate site was chosen where the channel is narrower and water depths were sufficient for the sampling boat. Access to site 17 was limited to the riverbank, and no streamflow data was available at this location. Site 18 was located on the Bear River, the largest tributary to the Feather River below Lake Oroville. Combined flows and loads of diazinon estimated at sites 18 and 19 represent the total flow and load from the Feather River.

Diazinon transported in storm runoff from the city of Chico and the surrounding urban area was monitored at five sites on four creeks that flow through and drain the mostly commercial and residential urban lands. Data from the U.S. Census indicates that the rapidly growing population of Chico was 60,000 in 2000 and covered an area of 28 mi^2 (U.S. Census Bureau, accessed April 18, 2003). The total population of the city and surrounding urban area was approximately 100,000. Flows in Mud Creek at Chico (site 2), Big Chico Creek at Chico (site 4) and Big Chico Creek at River Road (site 6), and Little Chico Creek (site 5) combine discharge from urban runoff and from their watersheds in the Sierra foothills. The Lindo Channel at Chico (site 3) was created by enlarging a small distributary channel (Sandy Gulch) of Big Chico Creek to accommodate flows of 6,000 ft^3/s (U.S. Army Corps of Engineers, 1961). The urban area upstream of each sampling site was estimated using GIS data from the City of Chico Department of Public Works. Site 3 on the Lindo Channel has the largest contributing area of approximately 5,200 acres. Site 2 on Mud Creek is next largest at 4,500 acres. The third largest at 4,200 acres is site 5 on Little Chico Creek. The creation of parkland (Bidwell Park) and the California State University at Chico (CSUC) campus in the city's early history constrained construction of storm sewer outfalls along Big Chico Creek. Because of these constraints the urban drainage area of Big Chico Creek at site 4 just downstream of the city is only 890 acres. Big Chico Creek also was sampled 5.5 mi downstream of the Chico urban area and just upstream of its confluence with the Sacramento River (site 6). At this point, flows from Mud Creek and the Lindo Channel have entered the Big Chico Creek channel, creating a potential composite of runoff from approximately 72 percent of the Chico urban area. Little Chico Creek, draining the southeastern portions of the Chico urban area, flows south to eventually enter Butte Slough above site 11.

Lower Stony Creek was monitored at site 7 about 3 mi upstream of its confluence with the Sacramento River. The Stony Creek watershed covers approximately 720 mi^2 (Kondolf and Swanson, 1993) with elevations ranging from approximately 6,500 ft in the headwaters of the Coast Range to approximately 120 ft at its confluence with the Sacramento River. Black Butte Dam, located 21.5 mi upstream of site 7, exerts a major control on streamflow in the lower reach of Stony Creek. The dam is operated for flood control and irrigation water storage. Land use in the Stony Creek watershed is largely agricultural with grazing in the lower foothills trending to orchards and row crops close to the Sacramento River. The nearest stream gage to site 7 is located just below Black Butte Dam and is operated by the U.S. Army Corp of Engineers.

Butte Creek at Gridley Road (site 9) receives runoff from the Sierra foothills and mixed agricultural land that includes almond orchards southeast of Chico. The Main Drainage Canal at Gridley Road (site 10) conveys runoff from prune, peach, and nectarine orchards in the portion of the valley floor just west of the Feather River and north of the Sutter Buttes. Water from both these sites merges upstream of site 11 (Butte Slough at Lower Pass Road) before flowing into the Sutter Bypass. Runoff from orchards and urban areas east and southeast of the Sutter Buttes drains to the Sutter Bypass through the Wadsworth Canal at South Butte Road (site 12), or through channels leading to California Department of Water Resources (DWR) pumping plants 1 and 2 (sites 13, 14, and 15). Two channels leading to DWR Pumping Plant 2 were monitored close to the pumps. Site 13 drains the largely agricultural area to the north of the site, and site 14 drains both agricultural land and the Yuba City urban area. Site 15, at DWR Pumping Plant 1, appears to drain mostly agricultural land including orchards and rice fields.

Monitoring Periods and Sampling Frequency

Sample collection was scheduled to begin during the first large rainstorm to occur after a significant number of dormant spray applications had been made, and during a later storm that might occur after the number of applications had appeared to peak. Diazinon applications were monitored through field observations and conversations with the personnel at the California Department of Pesticide Regulation and agents in county agricultural commissioner offices. Storms with significant potential to produce runoff were those with at least 1/2 in. of rain if the preceding weeks had been dry, or about 1/3 in. of rain if the soil was saturated with water from recent rainfall.

Sample collection began on January 24, 2001, for the first monitored storm and on February 9 or 10 at sites monitored during the second storm. Sites 8, 11, and 13 through 20 (see table 1) were sampled once each day for a period of five consecutive days after the beginning of each storm. Because site 21 (Sacramento River at Tower Bridge) is located many miles downstream of agricultural sources of diazinon, elevated concentrations at the site were expected to lag behind upstream sites and to remain elevated above pre-storm levels for a longer period of time. Sampling at that site began on January 25 (a day later than the upstream sites) and a single sample collected each day until January 29, with an additional sample collected on January 31, 2 days after sampling ended at upstream sites.

Samples were collected more frequently at sites 9, 10, and 12. These sites are located on smaller subbasins with extensive agricultural land use. Conditions were expected to change rapidly at these sites because of their proximity to diazinon sources and because the hydrologic characteristics of small subbasins are such that streamflow responds rapidly to storm runoff. Water samples at these sites were collected up to six times throughout each 24-hour period.

Samples were collected at site 1 (Sacramento River at Hamilton City), around the city of Chico (sites 2–6), and at site 7 (Stony Creek at Highway 45) during the second storm. Site 1 was sampled daily from February 9 to 14. Sites 2, 3, and 5 (Mud Creek at Chico, Lindo Channel at Chico, and Little Chico Creek) were sampled once each day on February 9 and 10. The two sites on Big Chico Creek (sites 4 and 6) were sampled twice each day between February 9 and 12. At site 7, samples were collected once each day on February 9 and 10.

Sample-Collection Methods

Samples at sites 1 through 7 were collected by personnel from CSUC, and samples from sites 18, 19, and 21 were collected by personnel from USGS. Samples at all other sites were collected by personnel from DPR and the Regional Board.

At most sites water samples were collected from bridges using a US series D–77 sampler. Depth- integrated samples at a single point in the center of each channel were collected in a 3-L Teflon bottle mounted in the sampler. Teflon collection bottles were used to minimize contamination or loss of pesticide from sorption to container walls. Samples were usually collected at Bear River near Berry Road (site 19) by wading across the channel and collecting depth-integrated samples in a handheld sampler (DH–81 with 3-L Teflon bottle) at 5 to 10 equal-width increments. On February 12, 13, and 14, during the second storm monitoring period, streamflow was too high to wade the Bear River, so grab samples were collected in a 3-L Teflon bottle from the stream bank. Grab samples were collected at Lindo Channel at Chico (site 3) with a 3-L Teflon bottle because the water depths at the site were too shallow for a depth-integrating sampler. After vigorous mixing of the collected sample, subsamples were poured directly into baked amber 1-L glass bottles fitted with Teflon-lined caps.

At Feather River below Star Bend (site 18), depth-integrated water samples were collected from a boat using a D–77 sampler at 7 to 10 points (equal-width increments) across the channel. The total volume of water collected along the channel cross section exceeded the capacity of a single 3-L bottle, so water collected at each point in the cross section was poured into a Teflon-lined stainless steel churn splitter (a device for mixing and subsampling composite samples; Capel and Larson, 1996) and the individual glass sample bottles filled from the splitter.

At sites 13–17 and 20, grab samples were collected directly into glass sample bottles held at the end of a telescoping rod and submerged to a depth of approximately 1 m while filling. The grab samples at sites 13, 14, and 15 were collected at the center of each channel from low bridges. Samples at site 16 were collected from the stream bank, and samples at sites 17 and 20 were collected from piers. At site 21, subsurface grab samples were collected in glass bottles from Sacramento's Tower Bridge using a weighted cage sampler suspended from a hand line and lowered from the water surface to the streambed while filling.

Immediately after collection, samples were placed on wet ice in insulated coolers. Samples sent to the USGS's National Water Quality Laboratory in Denver, Colorado, were shipped on ice by overnight freight on the day of collection. Samples collected for analysis by the California Department of Fish and Game Water Pollution Control Laboratory (CDFG laboratory) in Sacramento, California, were held in a refrigerated storage unit (4 degrees Celsius) until delivered to the lab at the end of each sampling event (1–7 days holding time). Personnel handling sample collection bottles wore disposable latex or nitrile gloves. Teflon collection bottles and nozzles were rinsed three times in deionized water between samples. The collection bottles and the churn splitter used at sites 18 and 19 were field-washed with a nonphosphate detergent before rinsing with deionized water that had received additional treatment to remove organic compounds. Cleaned bottles, nozzles, and splitters were stored in clean polyethylene bags when not in use.

Laboratory Analytical Methods

The CDFG laboratory in Sacramento, California, analyzed samples from all sites with the exception of site 21. Gas chromatography coupled with an electron capture detector and thermionic specific detector (GC/ECD/TSD) was used to determine the concentration of diazinon, as well as chlorpyrifos, dimethoate, fonophos, malathion, methidathion, methyl parathion, and phosmet in 253 environmental samples. Unfiltered samples were extracted with methylene chloride in a separatory funnel. The extract was dried with sodium sulfate, evaporated using a Kuderna-Danish apparatus, and solvent exchanged into petroleum ether. The extract was then concentrated using a micro-snyder apparatus to about 1 ml and adjusted to 2 ml with iso-octane before injection into the gas chromatograph. Tributyl phosphate and triphenyl phosphate were used as surrogates to evaluate the performance of the method. An optional florisil column cleanup procedure to eliminate or reduce interferences is part of the method's Standard Operating Procedure (SOP), (Dave Crane, California Department of Fish and Game Water Pollution Control Laboratory, Sacramento, CA, written commun., 2001). For this method, the laboratory reporting limit for diazinon, chlorpyrifos, malathion, and methyl parathion concentration was 20 ng/L. The reporting limit for dimethoate, fonophos, methidathion, and phosmet was 50 ng/L.

At selected sites on the Sacramento and Feather Rivers where diazinon concentrations were expected to be below the CDFG laboratory detection limits, samples were analyzed by the USGS's National Water Quality Laboratory (NWQL) in Denver, Colorado, using an analytical method with lower reporting limits. Duplicate (split-replicate) samples from sites 8, 18, and 20 were analyzed by both the CDFG and USGS laboratories. Samples collected at site 21 were analyzed only by the USGS laboratory. The USGS laboratory used gas chromatography with mass spectrometry (GC/MS) operated in the Selective Ion Monitoring (SIM) mode for identification and quantification of diazinon and 46 other pesticides and pesticide by-products. Water samples were filtered through baked glass fiber filters with a 0.7-µm effective pore diameter and organic compounds isolated by C–18 solid-phase extraction prior to analysis by GC/MS (Zaugg and others, 1995). The USGS lab reporting limit for diazinon concentration using this method was 5 ng/L.

Stage and Streamflow Measurement

Streamflow at seven sites (1, 4, 5, 8, 11, 20, and 21) was available from existing gaging stations. Sites 1, 4, and 11 were located in proximity to active DWR gaging stations located at the Sacramento River at Hamilton City, Rose Avenue in Chico, and Butte Slough near Meridian, respectively. Site 8 was adjacent to a USGS gage at Colusa.

The DWR gage on Little Chico Creek at Taffee Avenue was used to estimate flow at site 5. The stream gage is located 3.5 mi downstream of the sampling site, and although there are no large tributaries between the gage and sample site, flow estimates for this site should be considered approximate. There were not enough data available to use flow routing methods to increase the reliability of estimates for this site.

Streamflow at site 20 was estimated using records from a USGS gage at Verona located 8 mi upstream from the sampling site. Streamflow at site 21 was estimated using records at a USGS gage at Freeport 13 mi downstream of the sampling site. Because there is no significant inflow or outflow from the leveed channel between the stream gage and the sampling location at sites 20 and 21, and because the channel geometry is uniform throughout the intervening reach in both cases, flow estimates were based on time offsets between gage and sampling site calculated using Manning's equation and mean stream velocity (Linsley and others, 1958). Mean stream velocity used in the calculations was based on a stage-velocity relationship developed from previous discharge measurements made at the gage sites.

Some flow data were available for site 3 from the DWR gage at Lindo Channel at Chico, but flow data at the time of sampling were missing during the monitoring period at that site. Data provided by DWR for Mud Creek at Chico (site 2) was limited to stage measurement. DWR was unable to make discharge measurements at the gage at the time of the study and did not calculate streamflow records for the site. A previously developed stage-discharge rating obtained from DWR was used to approximate streamflow at the site, but because channel conditions may have changed since the older rating was developed, the estimates must be considered only an approximation of streamflow at the time of sampling. Comparisons with streamflow measured downstream at Big Chico Creek near River Road indicate these approximations may be biased high.

Temporary stream gages were installed by the USGS at site 10 (Main Drainage Canal at Gridley Road) and site 16 (Jack Slough near Doc Adams Road) to provide continuous streamflow data for the duration of the study. Streamflow records were developed by the USGS using continuous stage measurements recorded at the sites and instantaneous discharge measurements made by DPR staff (Rantz and others, 1982). Discharge measurements were made from bridges following USGS protocol using a type AA current meter suspended from a cable (Rantz and others, 1982). The gage at Jack Slough was located on Jack Slough Road 1 mi above the sampling site to avoid interference from fluctuating backwater conditions near the Feather River. Streamflow records at this site do not account for any local surface runoff between the gage and sampling site.

At selected sites where streamflow data were not available from gaging stations, discharge measurements were made at the time of sample collection. CSUC field crews measured discharge from a bridge at site 6 (Big Chico Creek at River Road) using a type AA current meter suspended from a cable.

USGS field crews made wading measurements at site 19 (Bear River near Berry Road) using a rod-suspended AA current meter (Rantz and others, 1982). On February 11 and 12, the Bear River rose too high to safely wade. Streamflow at the time of sample collection on those two days was estimated from an extended stage-discharge rating curve developed using measurements made at wading stages (Rantz and others, 1982). A stage reference mark was installed at the site, and daily discharge measurements were made for several days after sample collection ended to provide additional data needed to develop a rating for the site.

Measurements at site 18 (Feather River below Star Bend) were made by USGS field crews using an acoustic Doppler current profiler (ADCP) mounted on the sampling boat (Simpson, 2001). The ADCP measured the Doppler frequency shift of reflected sound waves (propagated by the instrument at a frequency of 1,200 kHz) to determine the speed and direction of moving water. Horizontal position and cross-section widths were determined using the bottom-tracking function of the ADCP. Streamflow was calculated from ADCP data using the software program WinRiver from RD Instruments, Inc., the maker of the ADCP.

Only stage data were available from DWR gages at site 9 (Butte Creek at Gridley Road), site 12 (Wadsworth Canal at South Butte Road), and site 17 (Feather River at Yuba City). Neither streamflow nor stage data were available for sites 7, 13, 14, or 15. The closest stream gage to site 7 was approximately 21.5 mi upstream from the sampling site. Because inflow to the stream between the gage and the sampling site was unknown, the upstream gage could not be used to reliably estimate flow at the sampling site.

Sites 13, 14, and 15 were located just upstream of DWR pumping plants 1 and 2, which pump water into the Sutter Bypass when the water level in the leveed bypass is above the elevation of the surrounding land. Water levels in the bypass were low during the monitoring period, so flows in the channels leading to the pumping plants were attributed to gravity flow through gated culverts at the bypass with occasional pumping. Measurement of gravity flow was impractical because of the physical characteristics of the sites.

Load Calculation Methods

Instantaneous loads of diazinon were calculated by multiplying diazinon concentration by the streamflow at the time of sample collection with a unit conversion term. For example:

$$\text{Concentration (ng/L)} \times \text{Streamflow (ft}^3\text{/s)} \times 5.3 \times 10^{-6} = \text{Load (lb/d)}$$

Storm period loads were calculated for sites with a sufficient number of instantaneous load measurements to estimate the pattern of diazinon loading response (chemograph) over each of the two storm hydrographs monitored in the study.

Loading throughout each storm period was estimated for each 60-minute interval by linear interpolation between measured instantaneous loads in a simple spreadsheet model. Total loads for each storm period were calculated by summing the intervening hourly loads. This numerical estimation is functionally equivalent to estimating loads graphically from the measured area under a plot of load versus time. The same storm period was used for all sites upstream of Sacramento River at Tower Bridge. The two periods ran from January 24 at 9:00 a.m. to January 28 at 12 p.m. and from February 9 at 9:00 a.m. to February 14 at 12 p.m. Load estimates were often extrapolated a few hours past the first or last instantaneous measurement during the mornings of the first and last day so that the time period for load calculations were the same for all sites. Extrapolations were made using the observed trend in a graph of load against time for each site.

Additional samples were collected by the USGS at Sacramento River at Tower Bridge (site 21) to extend the monitoring period at that site to January 31 for the first monitored storm period and to February 16 for the second period. Load values for the monitoring periods are presented in English units.

Quality Assurance and Quality Control

The reliability of field and laboratory methods used in this study was assessed by the analysis of blank, spiked, and replicate samples collected or prepared during environmental sampling trips. The comparability of data released from the two laboratories that provided analytical services for this study was evaluated from the results of split replicate samples sent to each laboratory. The results of the laboratory analysis of quality control samples are presented in appendix 1 (see back of report).

Possible contamination of environmental samples from all sources, from collection and processing through laboratory analysis, was evaluated by analyzing field blanks. After cleaning the sampling equipment in the field, deionized water was passed through the sample collection bottles before being poured into sample bottles and stored alongside environmental samples. Seventeen such blanks were made at random times throughout the monitoring period. Eleven of these blanks were analyzed by the CDFG laboratory and six by the USGS laboratory.

Ambient blanks were prepared by pouring deionized water directly into sample bottles at the same time that environmental samples were being processed in the field. These blanks were used to evaluate possible contamination from all sources except sampling equipment and collection bottles. Eleven ambient blanks were prepared at random times throughout the monitoring period and analyzed by the CDFG laboratory. No diazinon was detected in any field or ambient blank sample (Appendix 1, tables 1 and 4). Data from analysis of blank samples did not indicate any problem with site-to-site carryover of residual pesticides in sampling equipment or other possible sources of sample contamination. An estimated value of 1 ng/L of propanil, a post-emergent herbicide, was reported for one blank sample, a value that is far below the level of quantitation defined by the laboratory's reporting level of 11 ng/L for this constituent. Values below the reporting level are also subject to an increased risk of false positive detection. Out of 43 environmental samples analyzed by the USGS laboratory, only 4 estimated detections of propanil were noted. All four of these values were below the reporting limit and did not appear to be present in significant amounts in the environment or blank samples.

The accuracy, or bias, of laboratory analyses was evaluated using spiked samples. Blind spikes were made by adding a known quantity of diazinon to split replicates of environmental samples before submitting them for analysis along with regular samples. In eight blind spikes analyzed by the CDFG laboratory, diazinon spike concentrations were set at 200 or 500 ng/L. Recovery ranged from 74 to 84 percent with a mean of 83 percent (Appendix 1, table 2). Two samples spiked with 100 ng/L of diazinon were submitted to the USGS laboratory. Recovery in these samples was 97 and 111 percent (Appendix 1, table 5). Deviations from 100 percent recovery represent bias and variability of laboratory methods as well as matrix effects caused by the interference of other organic materials that may be present in the samples.

The variability in each laboratory's analytical results was evaluated by comparing diazinon concentrations in split replicate samples taken from the same water sample. Split replicates of 31 environmental samples were analyzed by the CDFG laboratory with concentrations ranging from reporting levels to 456 ng/L (Appendix 1, table 3). The mean relative percent difference between replicates above reporting levels (n = 18) was 7 percent (4 ng/L) with a standard deviation of 21 percent (24 ng/L). Seven split replicates were analyzed by the USGS laboratory with concentrations ranging from 10 to 100 ng/L (Appendix 1, table 4). The mean relative percent difference was 2 percent (0.4 ng/L) with a standard deviation of 8 percent (1.7 ng/L).

Although the two laboratories that provided analytical services to the study used different methods, there was no measurable bias observed in the results reported by each laboratory. Because the CDFG laboratory used a method that extracted pesticides from whole water samples and the USGS laboratory used a method that extracted pesticides from filtered water samples, there was some concern that sediment-bound diazinon might be excluded from the USGS analysis resulting in lower concentration values. Bias in analytical results reported by the CDFG and USGS laboratories was evaluated using data from 30 split replicate environmental samples sent to both labs for concurrent analysis. Diazinon concentrations in 11 of these samples were above the reporting limits for both laboratories and ranged from 12 to 84 ng/L. The average difference in concentration reported by the two labs was 3 ng/L with a standard deviation of 9 ng/L. These differences are within the range of analytical variability observed during the study.

Concentrations in samples analyzed by the USGS laboratory were lower than the CDFG laboratory in only 4 of the 11 samples. In order to better compare results from the two laboratories, nine split replicates that were collected in the 2000 monitoring study and analyzed by both the CDFG and USGS laboratories using the same methods used in the current study (Dileanis and others, 2002) were included in this evaluation. The larger data set allows for a better statistical test for bias between the two labs. In the combined data set, diazinon concentrations in 6 of 20 samples analyzed by the USGS laboratory were lower than concentrations reported by the CDFG laboratory. A Wilcoxon signed rank test of the paired data did not show a statistically significant difference between the diazinon concentrations reported by the two labs ($p = 0.13$). On the basis of this interlaboratory comparison, there is no apparent bias between the methods employed by the two laboratories used in this study despite the use of filtered or whole water samples and other differences in methodology. Environmental concentrations of diazinon reported by the two laboratories and the load estimates derived from those concentrations are, therefore, directly comparable.

Hydrologic Conditions During the Study Period

Data from four National Weather Service gages in the Sacramento Valley were used to characterize rainfall in the study area during the 2000–2001 dormant spray season. These gages are located at Red Bluff in the north end of the valley, at Chico and Marysville in the mid-sections of the valley, and at Sacramento in the southern end of the valley. The average of the total rainfall from December 1, 2000, to March 31, 2001, at these gages was 12.3 in.

Total rainfall was slightly less than normal because of the lower-than-normal rainfall amounts in November and December. However, monthly rainfall for January was 13 percent above normal, and for February was 47 percent above normal (fig. 3). Daily average rainfall at the four rain gages, and diazinon use, are shown in figure 4.

Streamflow in the smaller tributaries in the valley generally reflects local storm runoff during the winter months after irrigation ends in autumn. Flows in the Sacramento, Feather, Yuba, and Bear Rivers are largely controlled by reservoirs above the valley floor. Releases from the upstream reservoirs are determined by downstream flood and reservoir management concerns and may not always correspond well to actual storm runoff patterns and rainfall amounts. Because there is relatively little agricultural land above the valley floor, releases from these reservoirs tend to dilute pesticides washed into the larger streams from sources in the valley. A relatively dry November and December left considerable storage capacity in the reservoirs, and flows in the Sacramento River and its regulated tributaries were relatively low compared with monthly mean flows and with conditions during the previous year's diazinon monitoring study. The mean streamflow measured at Sacramento River at Verona (gage number 11425500 near site 20, Sacramento River at Alamar) for January and February 2001 was 52 and 54 percent, respectively, of the mean monthly flows at that site since 1946 (after Shasta Dam became operational). The mean streamflow at Feather River at Oroville (gage number 11407000, measuring releases from Lake Oroville to the Feather River) for January and February 2001 was 21 and 28 percent, respectively, of mean monthly flows since 1969 (after Oroville Dam became operational). The mean streamflow at Bear River near Wheatland (gage number 11424000), just downstream of Camp Far West Reservoir, during January and February 2001 was less than 2 percent of the mean monthly flow since 1966 (Rockwell and others, 2002).

Instantaneous streamflow at the time that samples were collected at Sacramento River at Alamar (site 20) in 2001 ranged from 11,000 to 26,000 ft^3/s. During the diazinon monitoring program's 2000 sampling, instantaneous flows ranged from 32,600 to 62,300 ft^3/s. At Feather River near Nicolaus, estimated flows (estimated by summing the flow at Feather River near Star Bend and the input from Bear River) ranged from 3,200 to 6,400 ft^3/s in 2001. In 2000, flows ranged from 5,900 to 41,100 ft^3/s. Flows measured or estimated in the Bear River at the time of sample collection were between 77 and 855 ft^3/s in 2001 and between 1,030 and 17,400 ft^3/s in 2000.

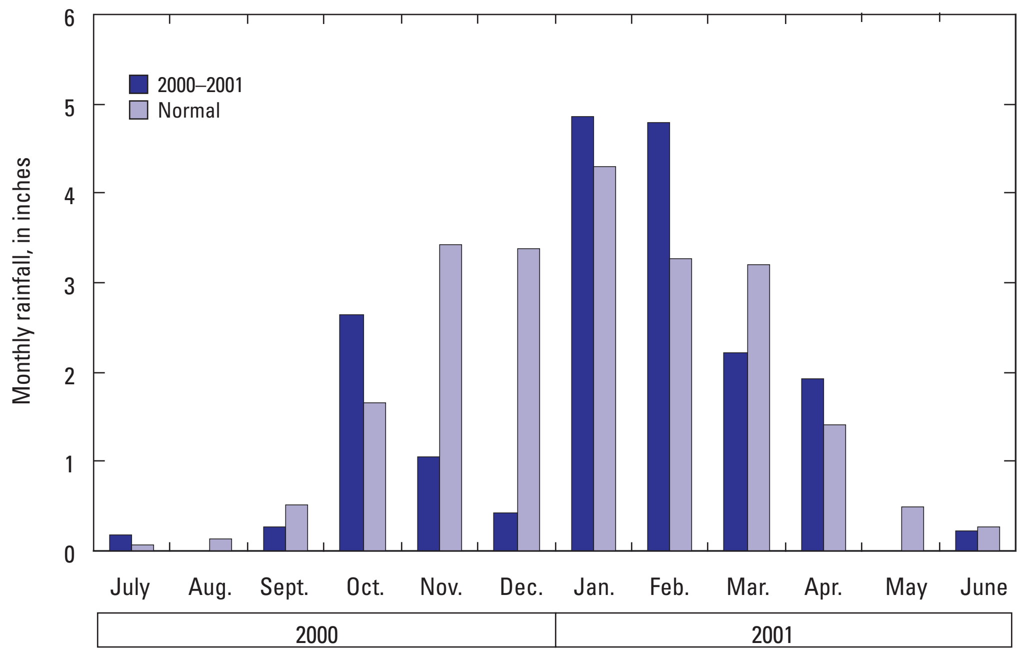

Figure 3. Monthly rainfall in the Sacramento Valley, California.

Values are the average of rainfall recorded at Red Bluff, Chico, Marysville, and Sacramento. Normal values represent average monthly rainfall from 1961 to 1990 for the four sites. Source: National Oceanic and Atmospheric Administration, 2001.

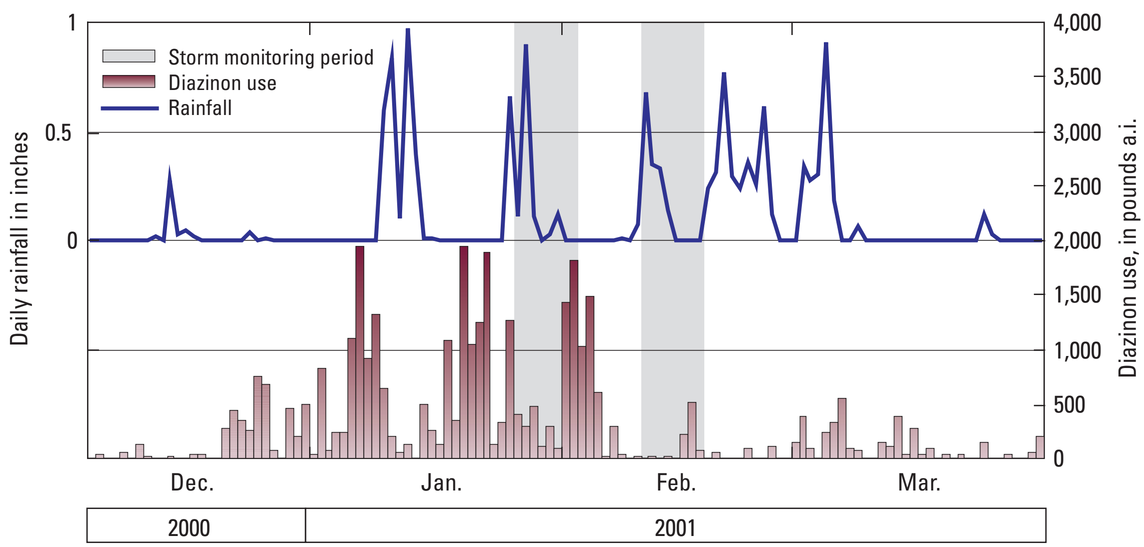

Figure 4. Daily rainfall and reported diazinon use in the Sacramento Valley, California, during the 2000–2001 dormant spray season.

Rainfall values are the average of values recorded at weather stations in Red Bluff, Chico, Marysville, and Sacramento. Diazinon use data were derived from the California Department of Pesticide Regulation's Pesticide Use Database for areas in the valley draining to the Sacramento River upstream of Sacramento. Shaded areas identify sample collection periods. (a.i., active ingredient).

Occurrence and Transport of Diazinon

Diazinon Use in the Sacramento Valley

In California, state regulations require that the location and quantity of agricultural and commercial pesticide applications must be reported to DPR. That information is compiled in the agency's Pesticide Use Database and released as a Pesticide Use Report (PUR) each year.

The quantity of diazinon applied to agricultural lands in the Sacramento Valley during dormant spray seasons from 1993 to 2001 is presented in figure 5. Diazinon use decreased during that period. In the 1999–2000 and 2000–2001 seasons, 42,400 and 40,700 lb a.i. (pounds active ingredient) were applied to agricultural lands compared with over 80,000 lb a.i. four years earlier. The decrease may be due in part to lower market prices for orchard crops and changes in management practices, including the substitution of other insecticides, such as pyrethrins, for diazinon (Epstein and others, 2001).

The greatest diazinon use occurs in January and February. During the last eight dormant spray seasons, 59 percent of the total use on the valley floor was in January and 27 percent in February (statistics derived from the Pesticide Use Database, California Department of Pesticide Regulation, 2002).

Bar charts and maps in figures 6 through 13 show daily diazinon use and the location of applications during the 2000–2001 dormant spray season in subbasins upstream of selected sampling sites. Maps and subbasin use data were developed from a GIS coverage of the study area that incorporated data from the Pesticide Use Database. Locations are given at the section level of the Public Lands Survey System. Only those subbasins with known boundaries could be included in the GIS analysis.

The general timing of applications throughout the 2001 dormant spray season (December 1 to March 31) can be seen in figure 6*A*. This figure shows all applications in the watershed that drains to the Sacramento River upstream of Sacramento River at Tower Bridge (site 21). Diazinon applications in the part of the valley draining to the Colusa Basin Drain are not included in the figure because the drain is diverted to the Yolo Bypass and the delta during winter months and does not flow into the Sacramento River. Large scale diazinon applications began in mid- December, and by February 5, 86 percent of the seasonal applications had been applied.

Pesticide applications upstream of monitoring sites with defined drainage boundaries during four time periods related to the monitored storm events are summarized in table 2. Period 1 includes all early season applications from December 1 through 23. Period 2 includes all applications made in the 30 days prior to the first sample collection on January 24. Period 3 includes applications made after the first monitored storm until the second monitored storm. Period 4 covers the time between the last monitored storm and the end of the dormant spray season. Rainfall did occur during period 4. However, only 14 percent of the total diazinon application of the dormant spray period occurred during period 4.

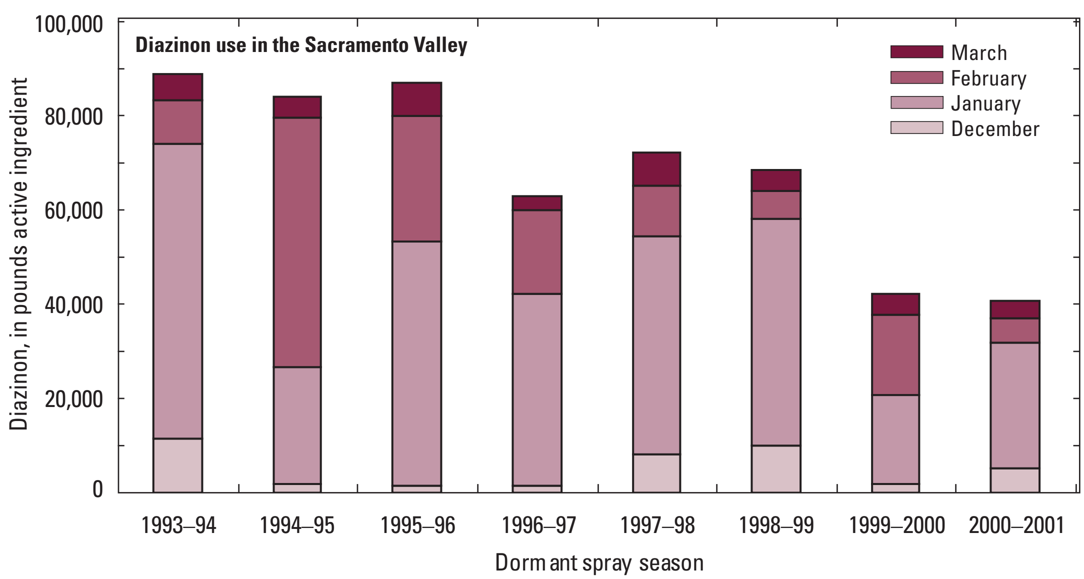

Figure 5. Diazinon use in the Sacramento Valley, California, during dormant spray seasons from 1993 to 2001.

[Data derived from California Department of Pesticide Regulation, Pesticide Use Database].

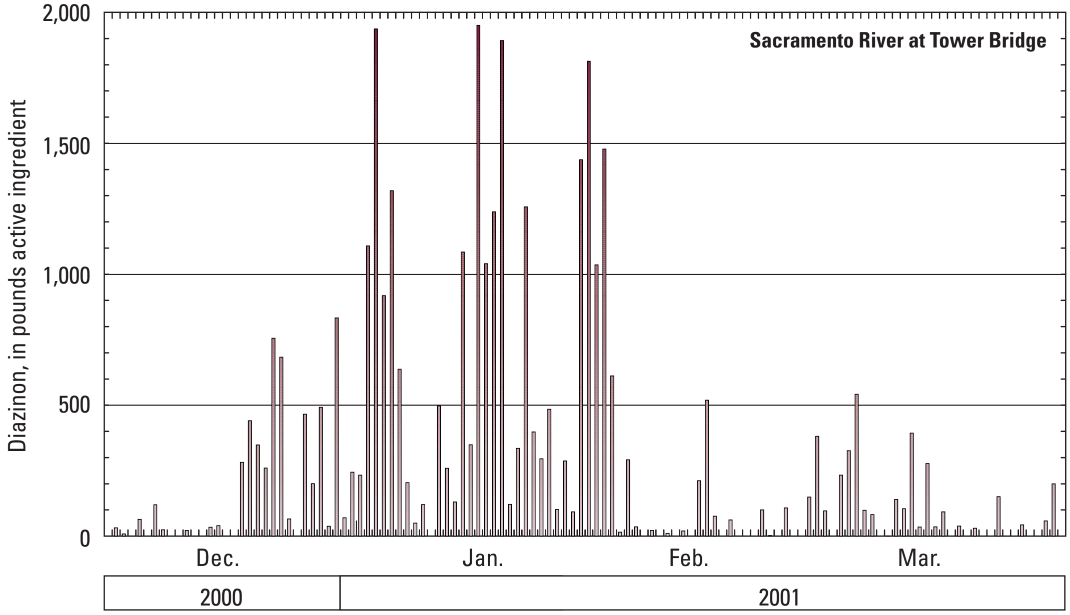

Figure 6. Diazinon use upstream of Sacramento River at Tower Bridge (site 21).

(*A*) Daily diazinon use from December 1, 2000, to March 31, 2001.
See figure 1 and table 1 for site location.

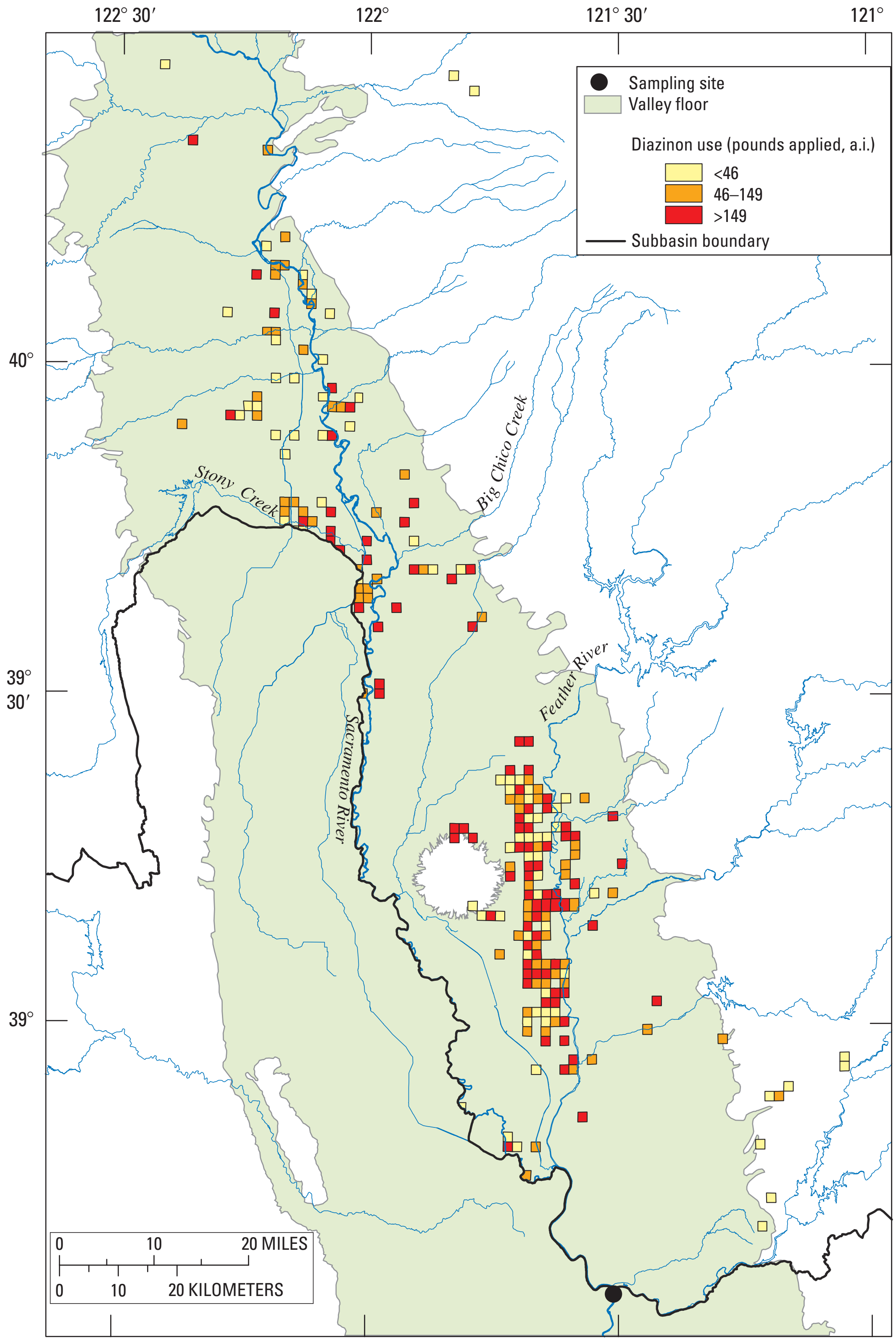

Figure 6. Diazinon use upstream of Sacramento River at Tower Bridge (site 21).

(B) Areal distribution of applications.
See figure 1 and table 1 for site location. [<, less than; >, greater than; a.i., active ingredient].

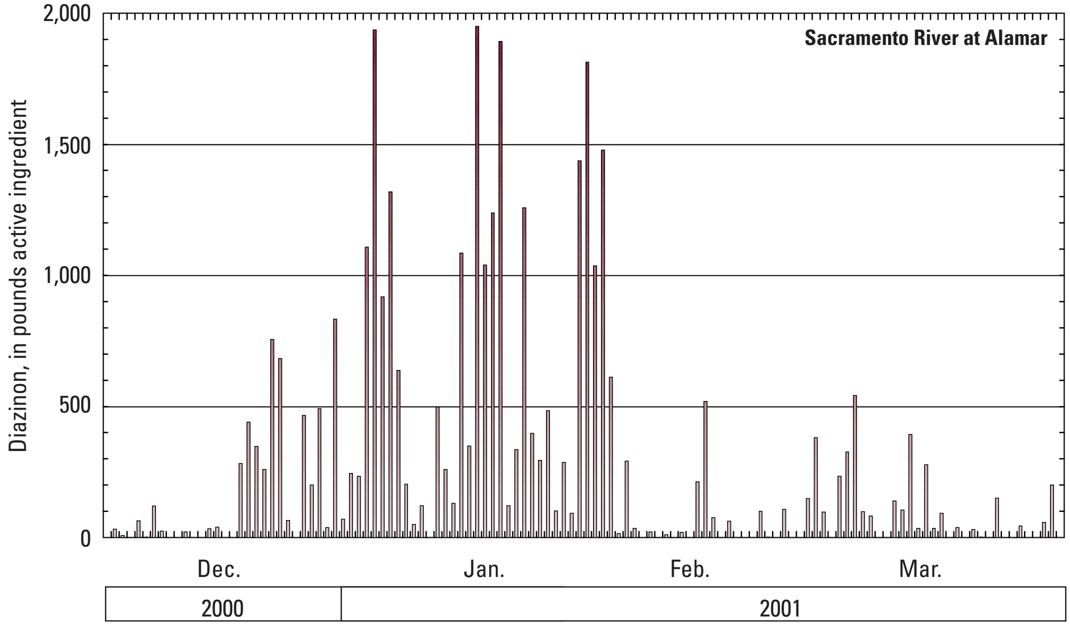

Figure 7. Diazinon use upstream of Sacramento River at Alamar (site 20).

(*A*) Daily diazinon use from December 1, 2000, to March 31, 2001.
See figure 1 and table 1 for site location.

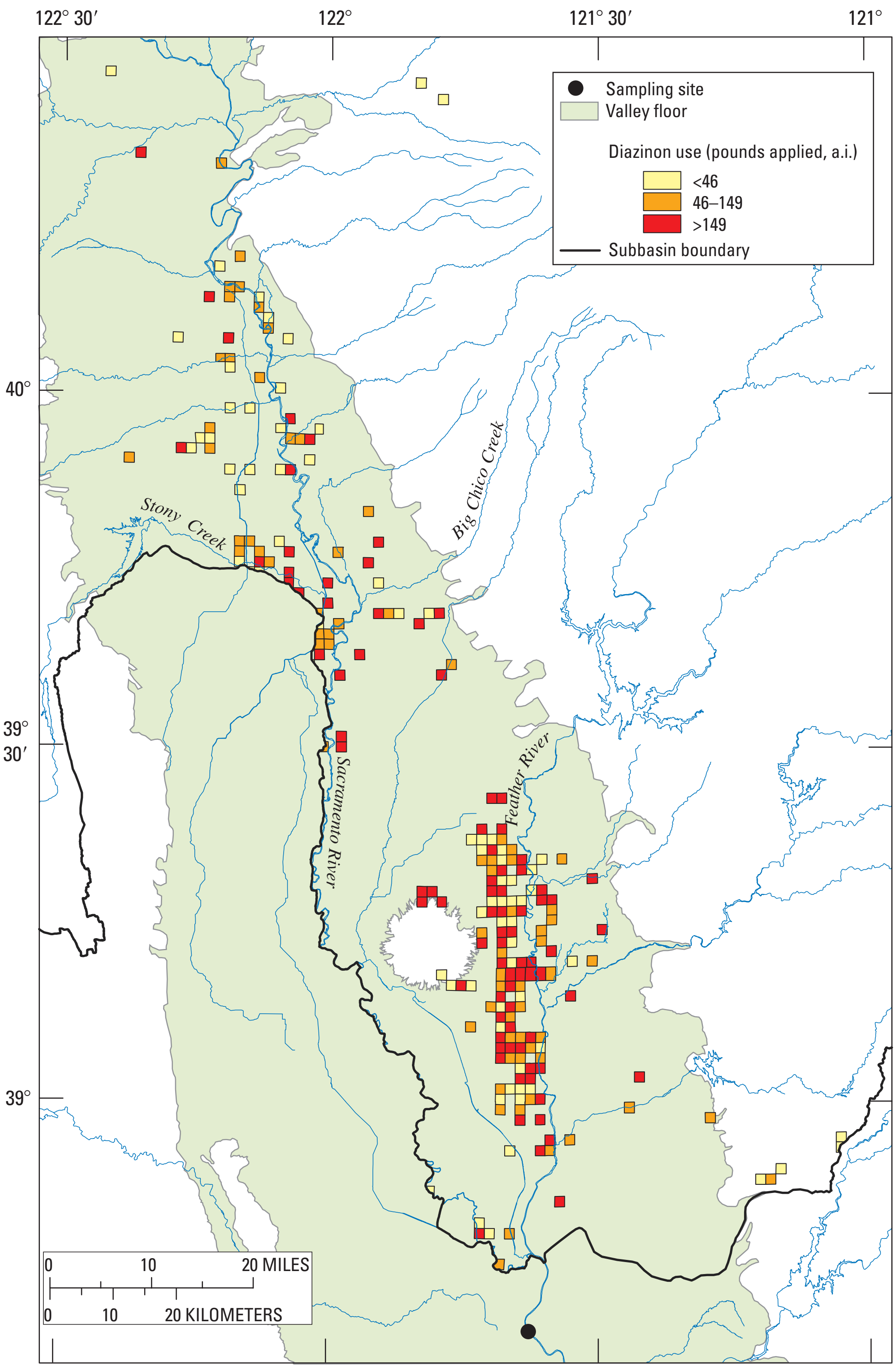

Figure 7. Diazinon use upstream of Sacramento River at Alamar (site 20).

(*B*) Areal distribution of applications.
See figure 1 and table 1 for site location. [<, less than; >, greater than; a.i., active ingredient]

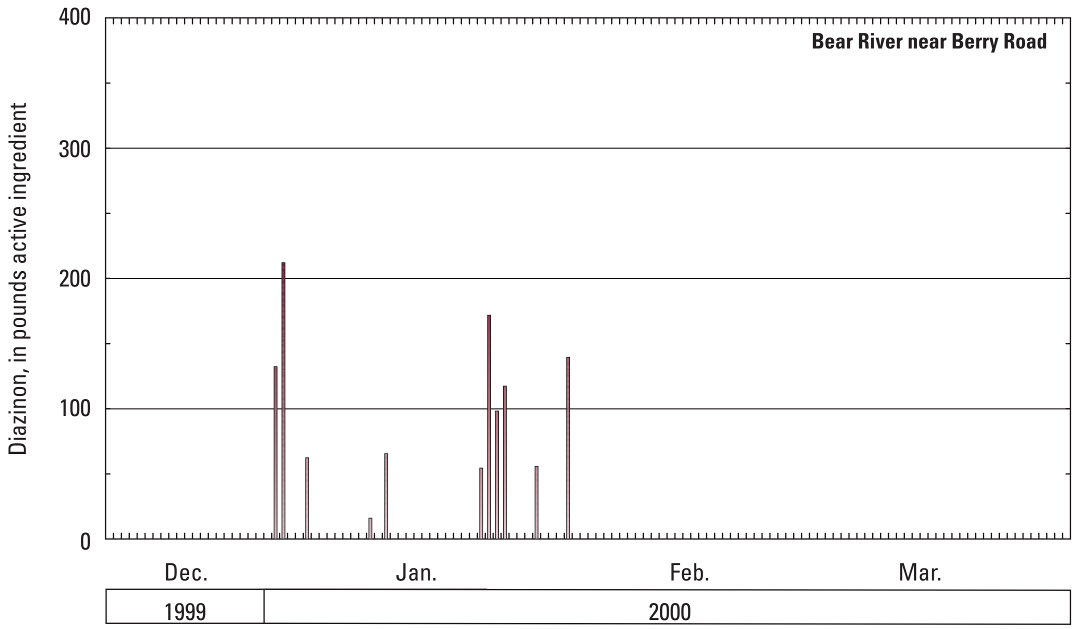

Figure 8. Diazinon use upstream of Bear River near Berry Road (site 19).

(*A*) Daily diazinon use from December 1, 1999, to March 30, 2000.
See figure 1 and table 1 for site location.

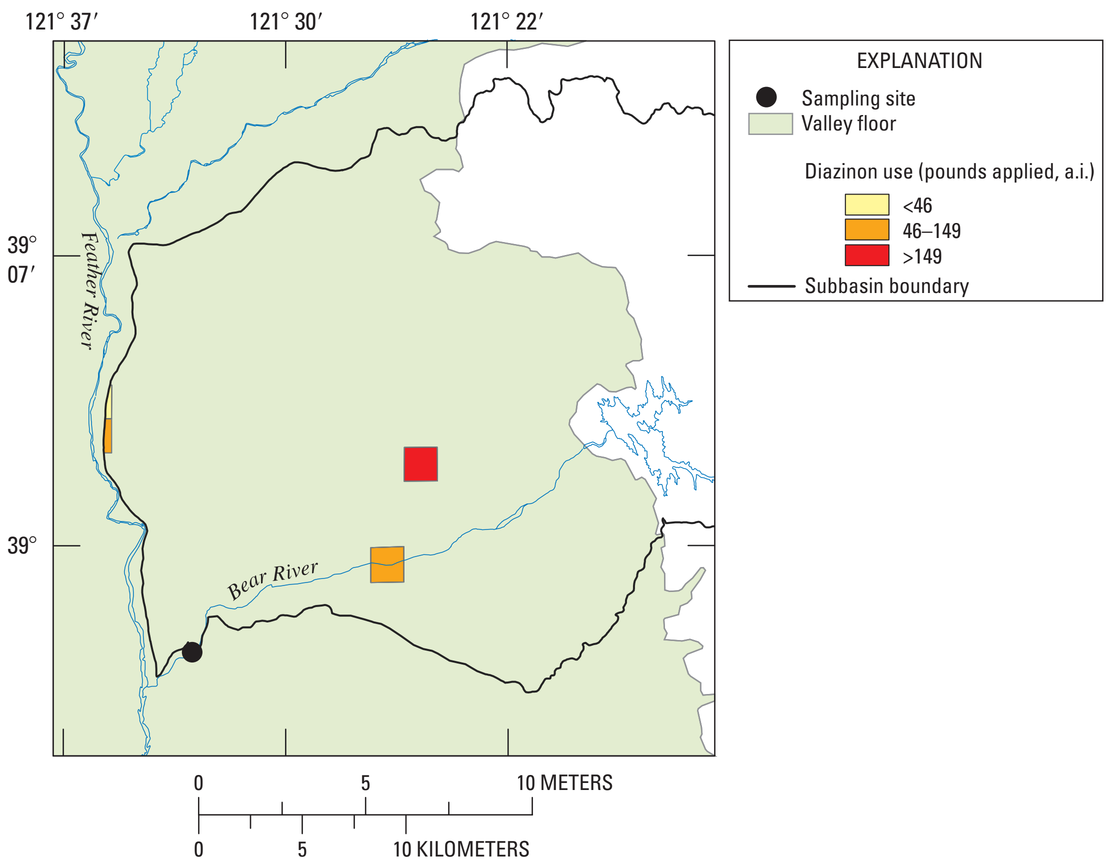

Figure 8. Diazinon use upstream of Bear River near Berry Road (site 19).

(*B*) Areal distribution of applications.
See figure 1 and table 1 for site location. [<, less than; >, greater than; a.i., active ingredient].

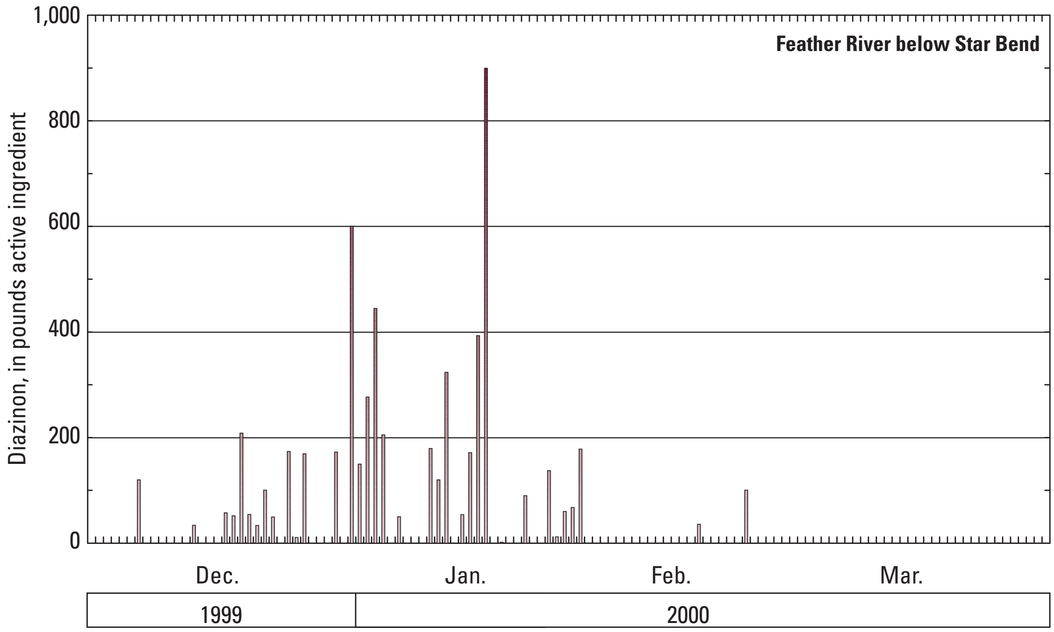

Figure 9. Diazinon use upstream of Feather River below Star Bend (site 18).

(*A*) Daily diazinon use from December 1, 1999, to March 30, 2000.
See figure 1 and table 1 for site location.

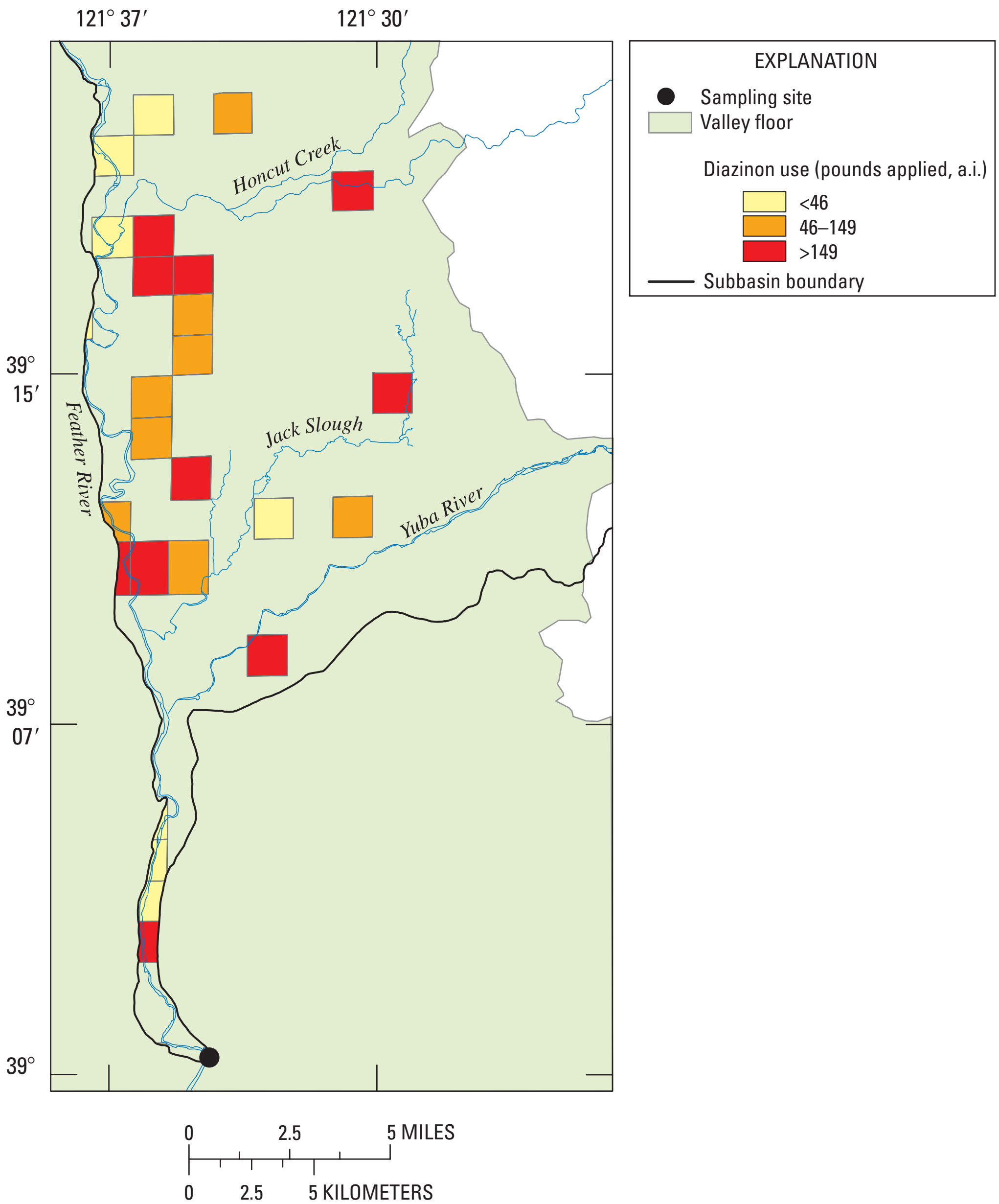

Figure 9. Diazinon use upstream of Feather River below Star Bend (site 18).

(*B*) Areal distribution of applications.
See figure 1 and table 1 for site location. [<, less than; >, greater than; a.i., active ingredient]

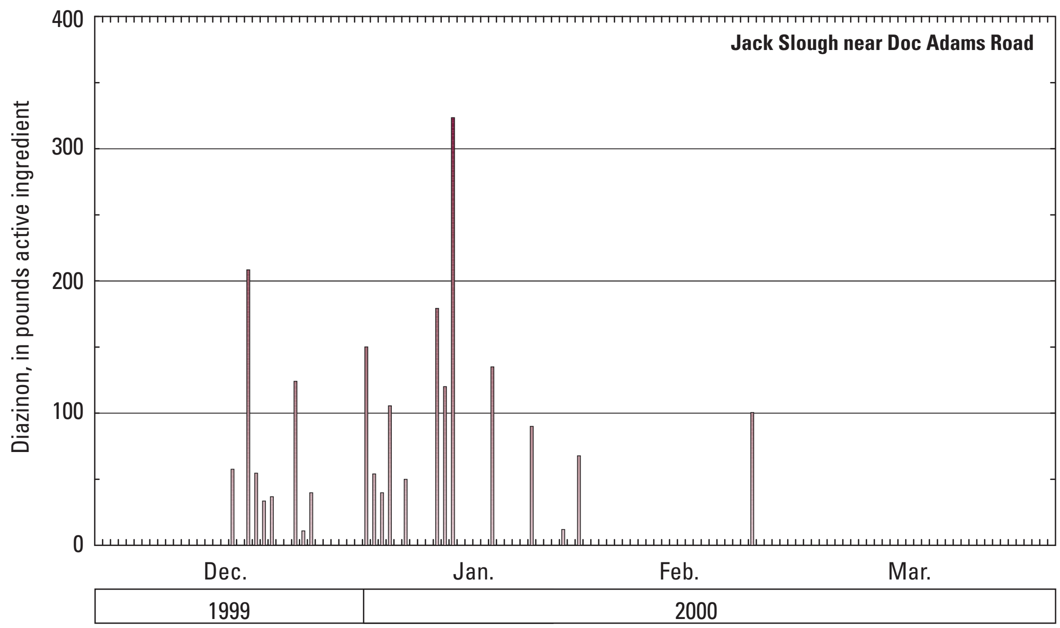

Figure 10. Diazinon use upstream of Jack Slough near Doc Adams Road (site 16).

(*A*) Daily diazinon use from December 1, 1999, to March 30, 2000.
See figure 1 and table 1 for site location.

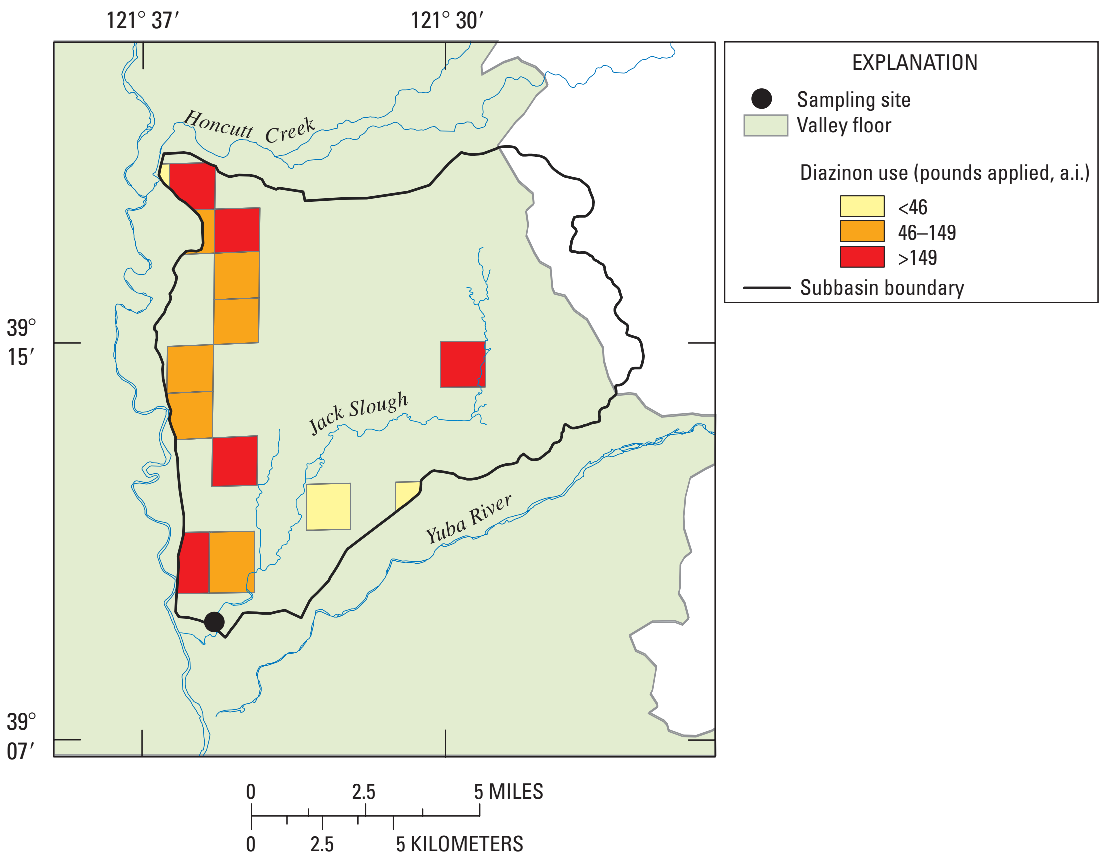

Figure 10. Diazinon use upstream of Jack Slough near Doc Adams Road (site 16).

(*B*) Areal distribution of applications.
See figure 1 and table 1 for site location. [<, less than; >, greater than; a.i., active ingredient]

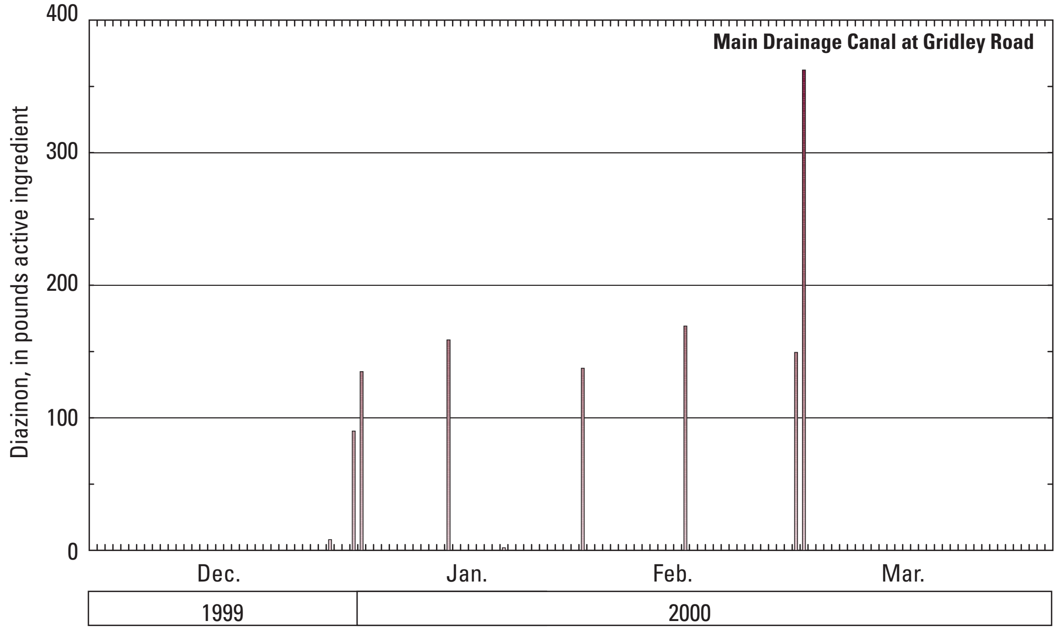

Figure 11. Diazinon use upstream of Main Drainage Canal at Gridley Road (site 10).

(*A*) Daily diazinon use from December 1, 1999, to March 30, 2000.
See figure 1 and table 1 for site location.

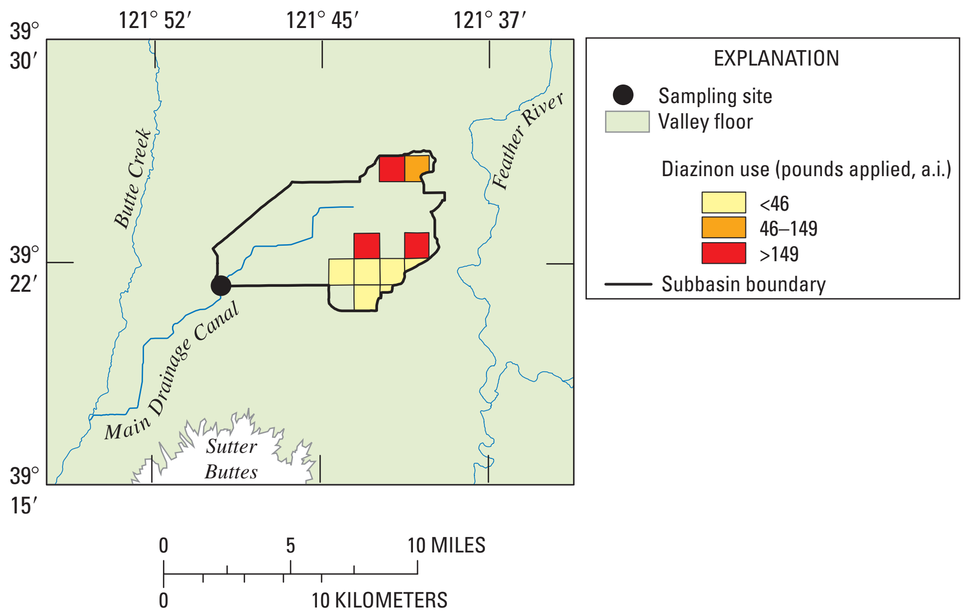

Figure 11. Diazinon use upstream of Main Drainage Canal at Gridley Road (site 10).

((B) Areal distribution of applications.
See figure 1 and table 1 for site location. [<, less than; >, greater than; a.i., active ingredient]

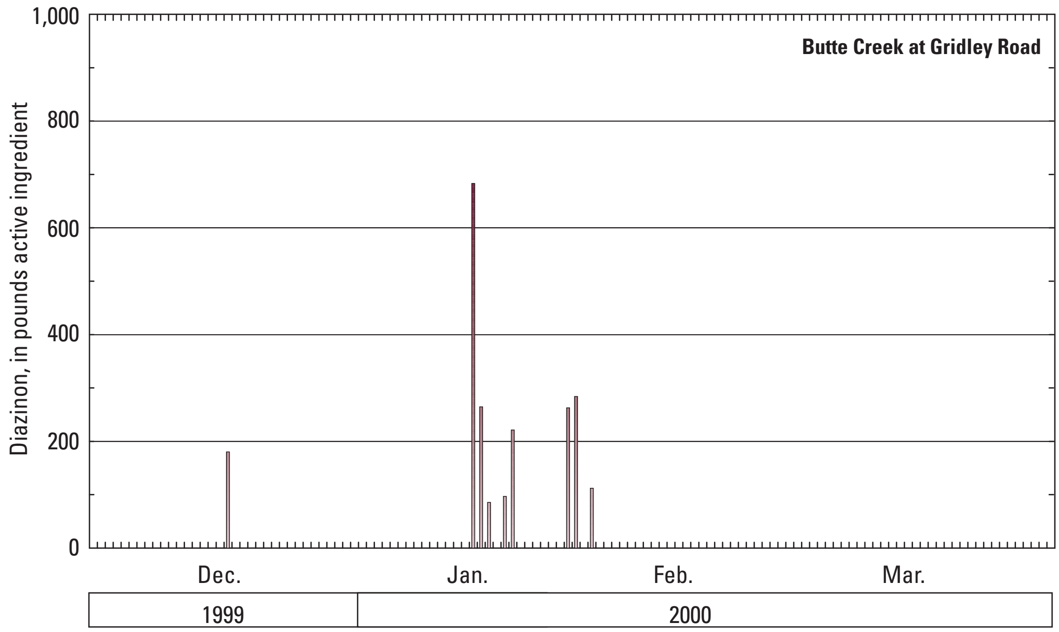

Figure 12. Diazinon use upstream of Butte Creek at Gridley Road (site 9).

(*A*) Daily diazinon use from December 1, 1999, to March 30, 2000.
See figure 1 and table 1 for site location.

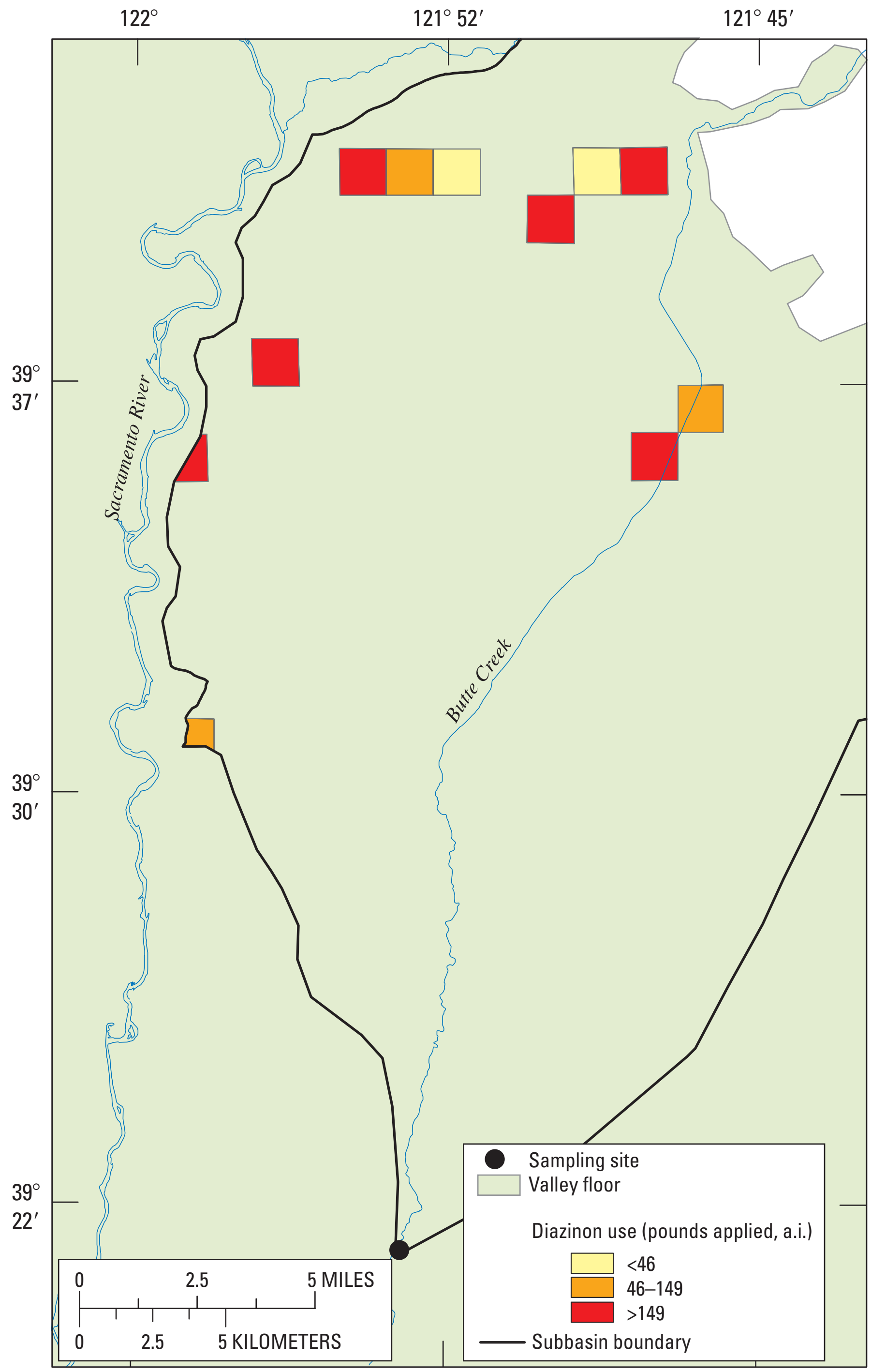

Figure 12. Diazinon use upstream of Butte Creek at Gridley Road (site 9).

(*B*) Areal distribution of applications.
See figure 1 and table 1 for site location. [<, less than; >, greater than; a.i., active ingredient]

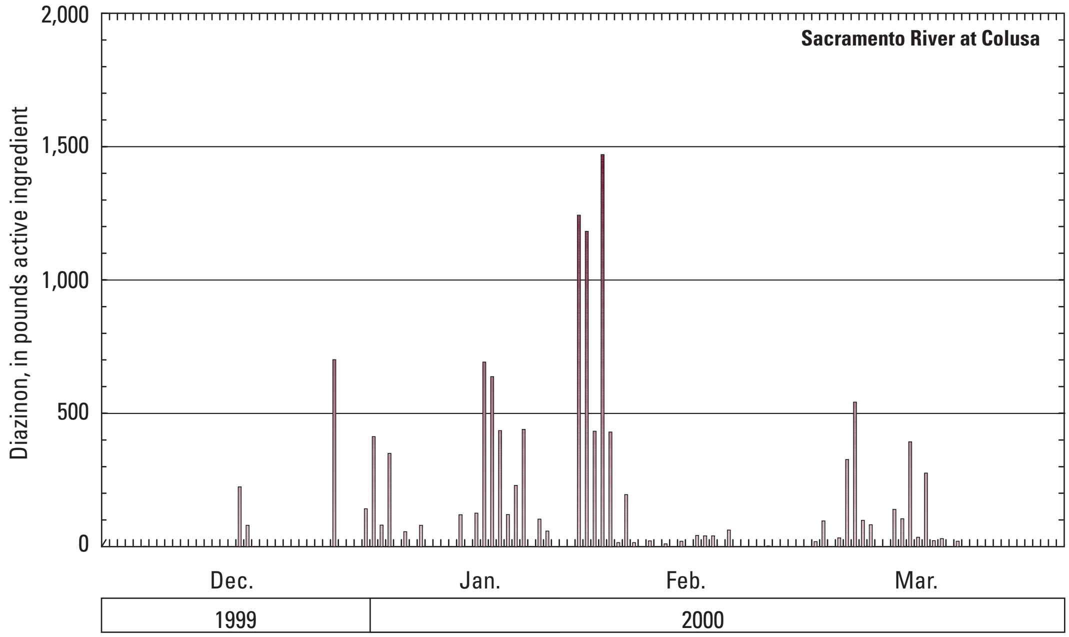

Figure 13. Diazinon use upstream of Sacramento River at Colusa (site 8).

(*A*) Daily diazinon use from December 1, 1999, to March 30, 2000.
See figure 1 and table 1 for site location.

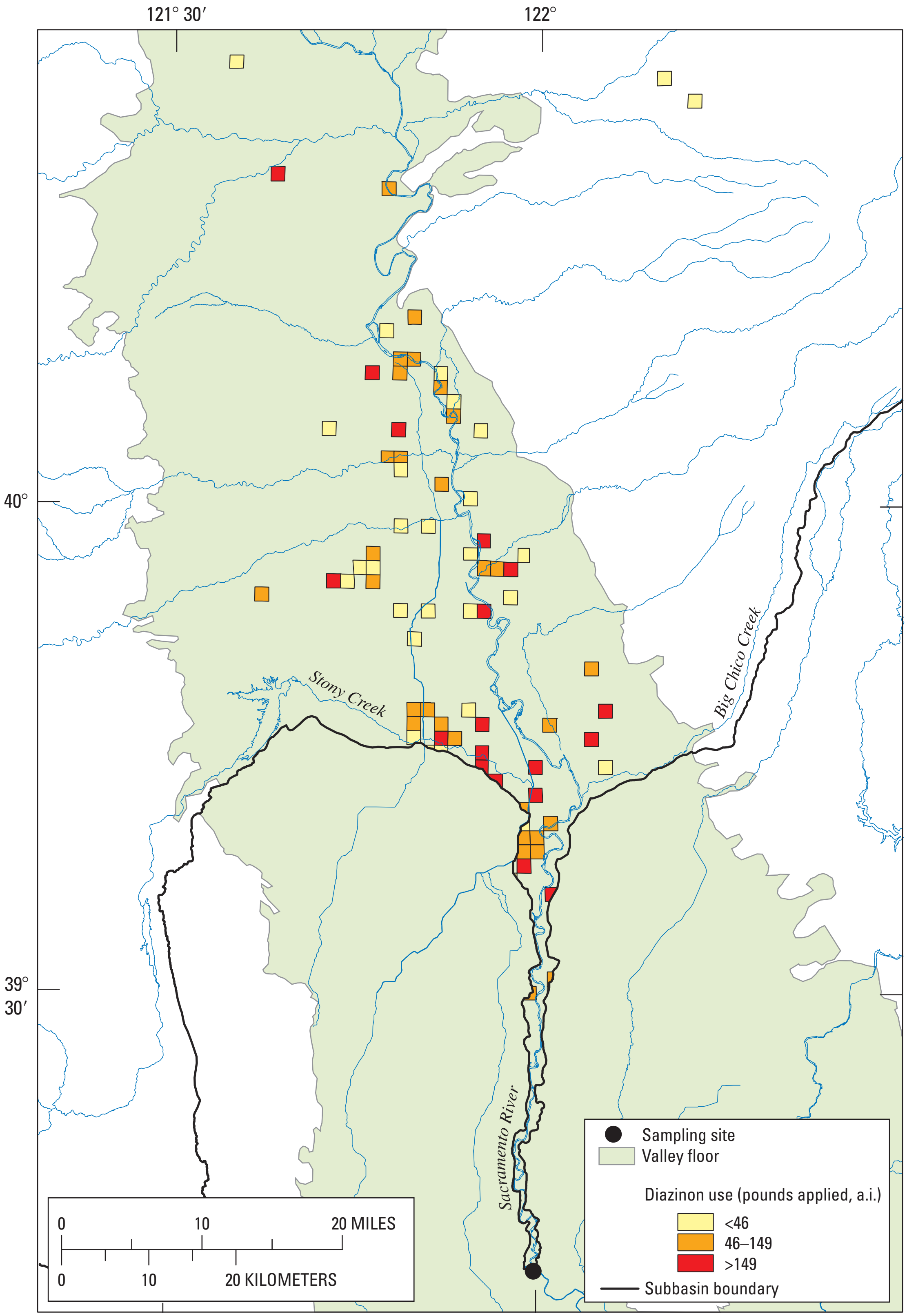

Figure 13. Diazinon use upstream of Sacramento River at Colusa (site 8).

(*B*) Areal distribution of applications.
See figure 1 and table 1 for site location. [<, less than; >, greater than; a.i., active ingredient]

Table 2. Diazinon use in selected subbasins during four time periods in the 2000–2001 dormant spray season, Sacramento Valley, California.

[Pounds applied are active ingredient. Subbasin area and area applied are in square miles. Colusa Basin Drain was not a study site but is included for comparison]

Site name	Basin area	Period 1 (12/1/00-12/23/00)		Period 2 (12/24/00-1/24/01)	
		Pounds applied	Area applied (in basin)	Pounds applied	Area applied (in basin)
Bear River near Berry Road	574	344	1.0	169	1.5
Butte Creek at Gridley Road	589	180	1.0	1,010	7.4
Main Drainage Canal at Gridley Road	35	0	0	386	4.1
Jack Slough near Doc Adams Road	73	321	3.8	1,122	6.9
Feather River below Star Bend	5,300	442	5.9	2,987	14
Feather River at Yuba City	3,940	430	5.7	2,323	11
Sacramento River at Colusa	12,260	125	2.9	3,234	22
Sacramento River at Alamar	19,810	3,114	33	19,105	124
Sacramento River at Tower Bridge	22,020	3,114	33	19,111	127
Colusa Basin Drain (for comparison)	1,630	0	0	4,126	32

Site name	Basin area	Period 3 (1/25/01-2/09/01)		Period 4 (2/10/001-3/31/01)		Total pounds applied
		Pounds applied	Area applied (in basin)	Pounds applied	Area applied (in basin)	
Bear River near Berry Road	574	139	1.0	0	0.0	653
Butte Creek at Gridley Road	589	511	3.3	0	0.0	1,701
Main Drainage Canal at Gridley Road	35	137	1.3	680	2.9	1,203
Jack Slough near Doc Adams Road	73	119	2.0	70	0.6	1,631
Feather River below Star Bend	5,300	257	5.0	104	2.4	3,790
Feather River at Yuba City	3,940	206	4.2	104	2.4	3,062
Sacramento River at Colusa	12,260	3,806	21	2,412	36	9,577
Sacramento River at Alamar	19,810	7,029	61	4,553	58	33,801
Sacramento River at Tower Bridge	22,020	7,041	63	4,567	62	33,832
Colusa Basin Drain (for comparison)	1,630	1,549	13	416	8.2	6,091

Concentrations of Diazinon Observed during Storms

Diazinon concentrations measured at many of the sampling sites are plotted together with stream discharge in figure 14 or with stage (if no discharge was available) in figure 15. Sites with few or no detections were not included. The results of all laboratory analyses and field measurements are presented in appendix 2 (see back of report). With a few exceptions, the highest diazinon concentrations were observed during the first of the two monitored storms. The median concentration was 55 ng/L in samples collected during the first storm and 26 ng/L during the second storm. A similar pattern was observed in the 1999–2000 monitoring study where concentrations declined in each of the three successive storms monitored in that study (Dileanis and others, 2002). The two notable exceptions to this trend in the 2000–2001 study were at the Main Drainage Canal at Gridley Road (site 10) and Wadsworth Canal at South Butte Road (site 12). Higher concentrations during the second storm at these sites may have been related to the timing of applications and to the length of time for transport from points of application to sampling sites in the slow moving drains. Diazinon use in the Main Drainage Canal watershed was more evenly distributed throughout the season than in the other subbasins. However, a greater amount of diazinon was applied before the first monitored storm than in the interval between the first and second storms. Diazinon transport from points of application to the sampling site may be slower than in many of the other subbasins in the study area, resulting in a greater time lag between the onset of rainfall and the appearance at the sampling site. The Main Drainage Canal at Gridley Road site showed the same trend of higher concentrations in later storms during the previous dormant spray season. Because the watershed boundaries of the Wadsworth Canal were not known, the timing of diazinon applications upstream of the sampling site could not be determined.

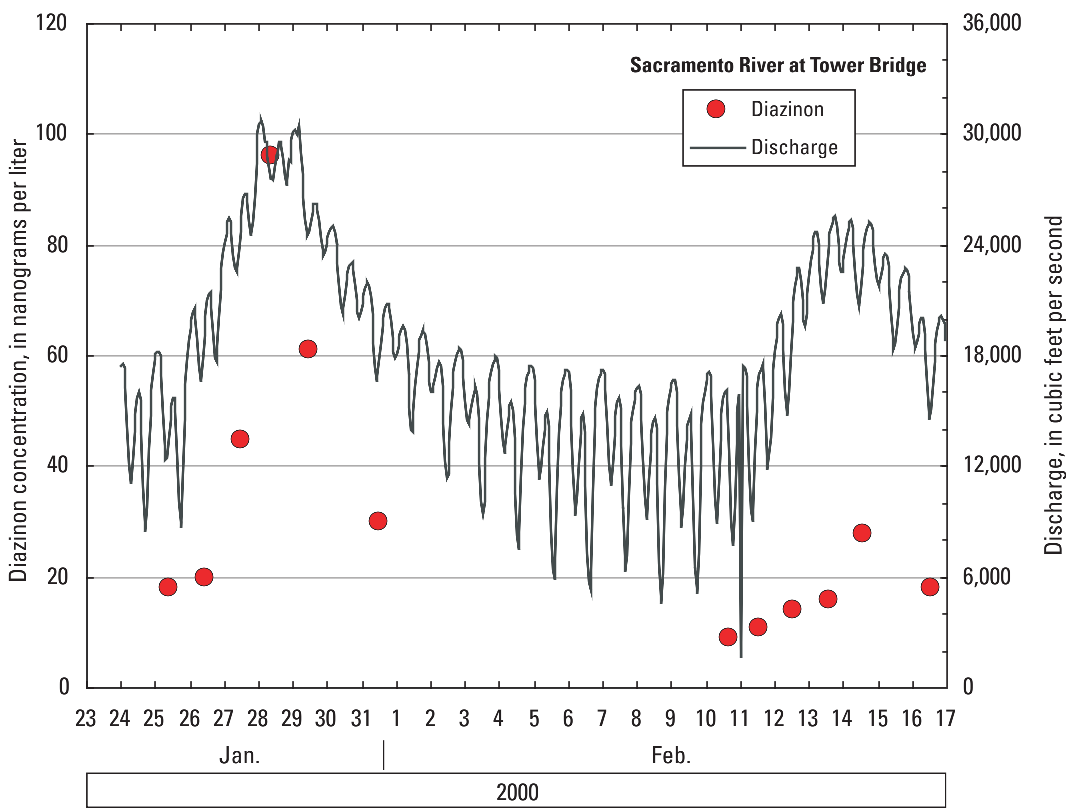

Figure 14. Diazinon concentrations and streamflow at sampling sites in the Sacramento Valley, California, from January 23, 2000, to February 17, 2001.

(*A*) Sacramento River at Tower Bridge (site 21).
See figure 1 and table 1 for location.

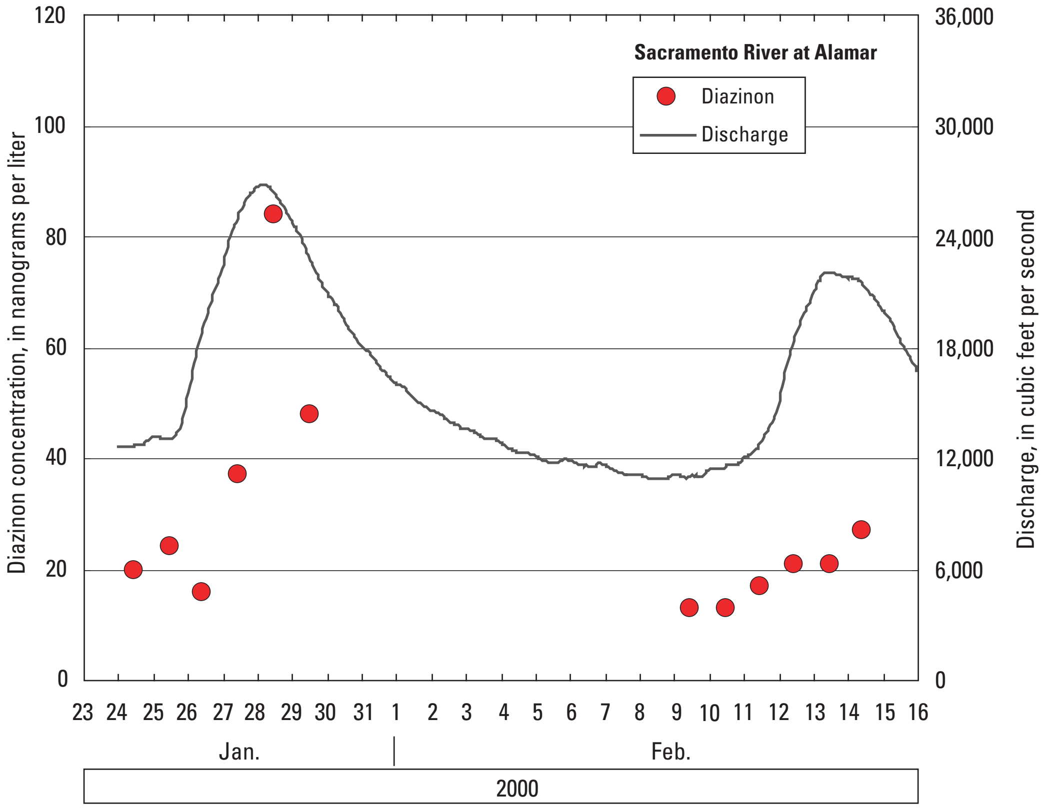

Figure 14. Diazinon concentrations and streamflow at sampling sites in the Sacramento Valley, California, from January 23, 2000, to February 17, 2001.

(*B*) Sacramento River at Alamar (site 20).
See figure 1 and table 1 for location.

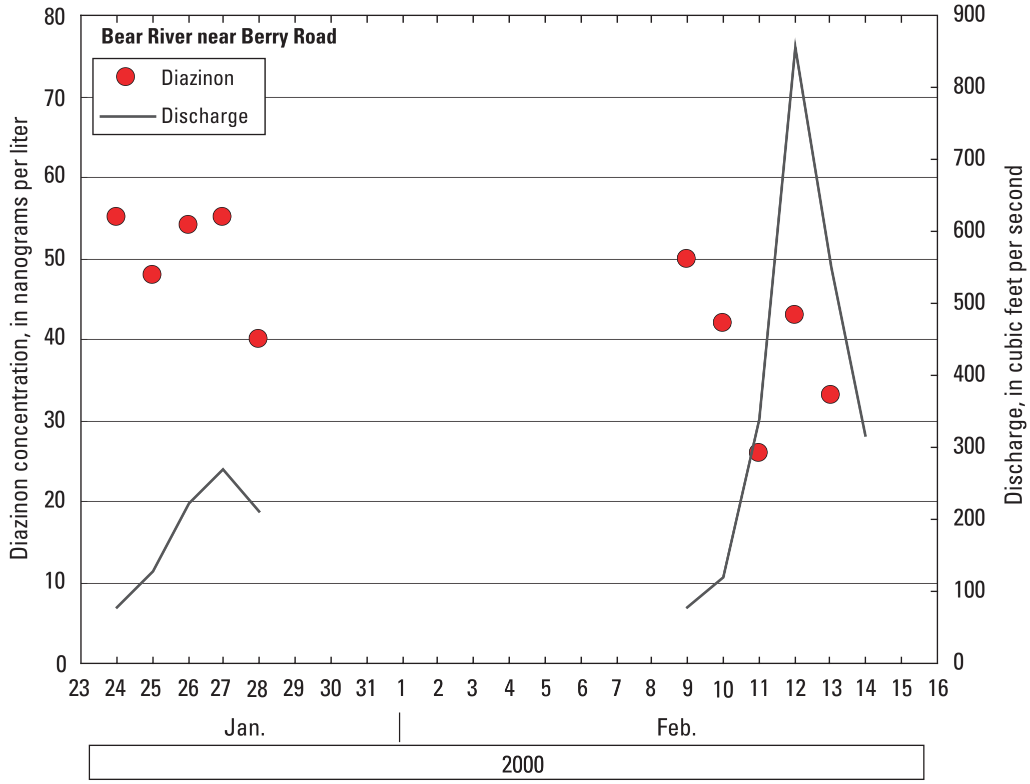

Figure 14. Diazinon concentrations and streamflow at sampling sites in the Sacramento Valley, California, from January 23, 2000, to February 17, 2001.

(*C*) Bear River near Berry Road (site 19).
See figure 1 and table 1 for location.

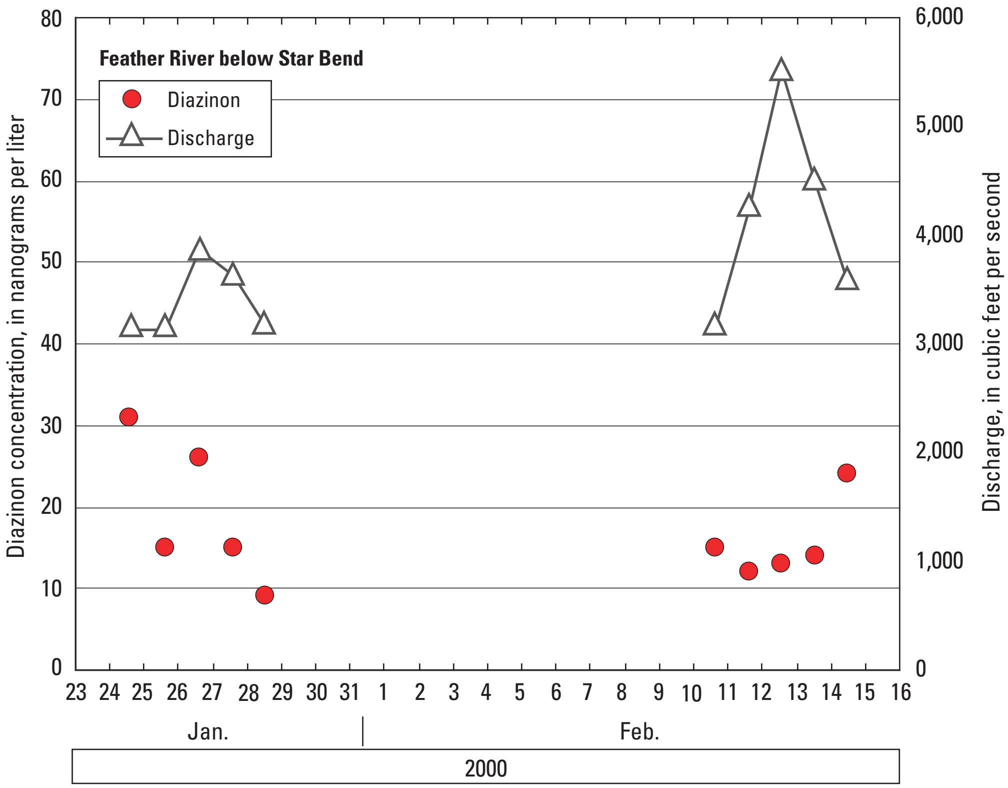

Figure 14. Diazinon concentrations and streamflow at sampling sites in the Sacramento Valley, California, from January 23, 2000, to February 17, 2001.

(*D*) Feather River below Star Bend (site 18).
See figure 1 and table 1 for location.

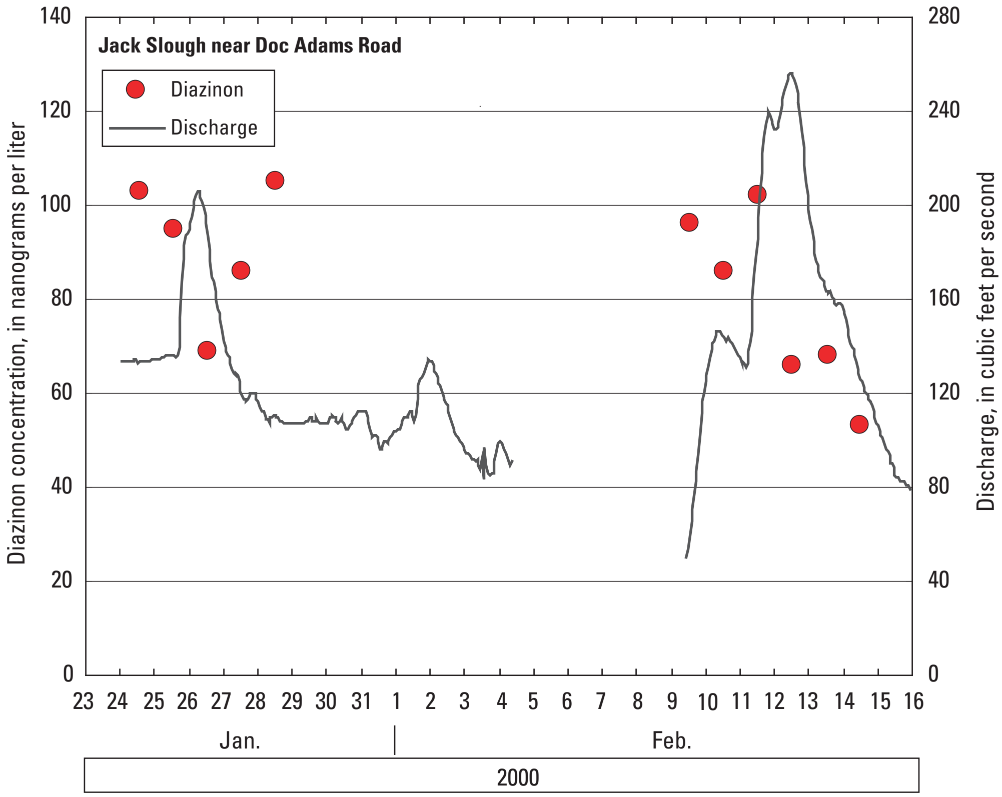

Figure 14. Diazinon concentrations and streamflow at sampling sites in the Sacramento Valley, California, from January 23, 2000, to February 17, 2001.

(*E*) Jack Slough near Doc Adams Road (site 16).
See figure 1 and table 1 for location.

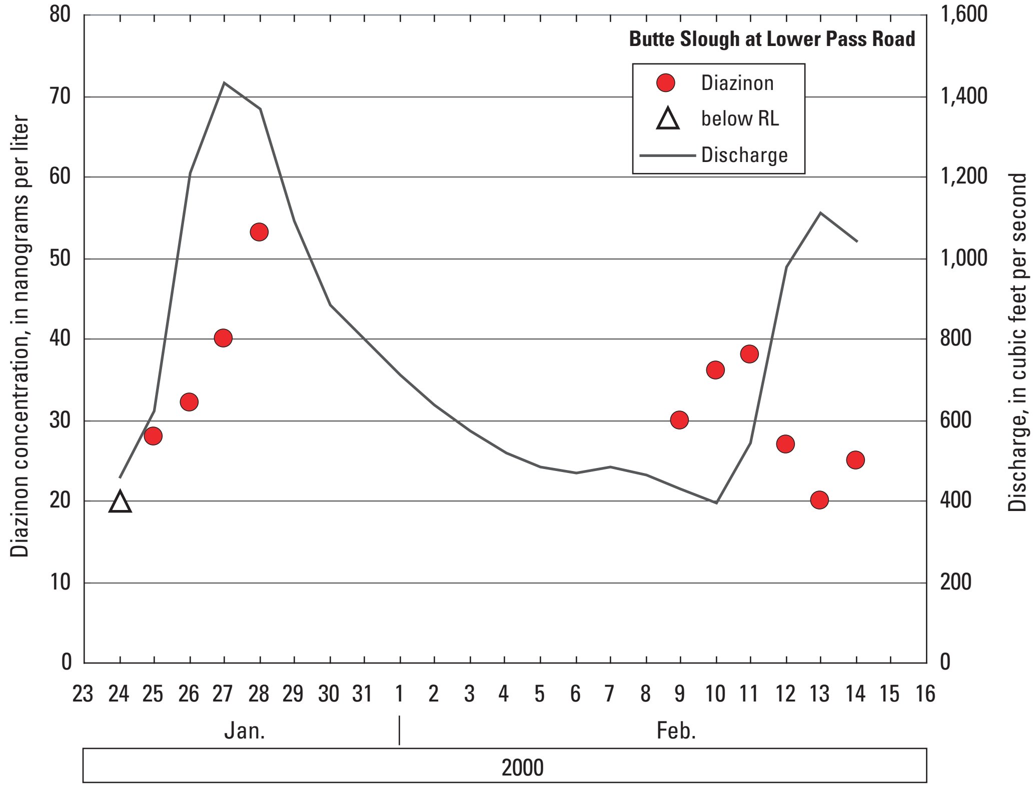

Figure 14. Diazinon concentrations and streamflow at sampling sites in the Sacramento Valley, California, from January 23, 2000, to February 17, 2001.

(F) Butte Slough at Lower Pass Road (site 11).
See figure 1 and table 1 for location. RL, reporting limit.

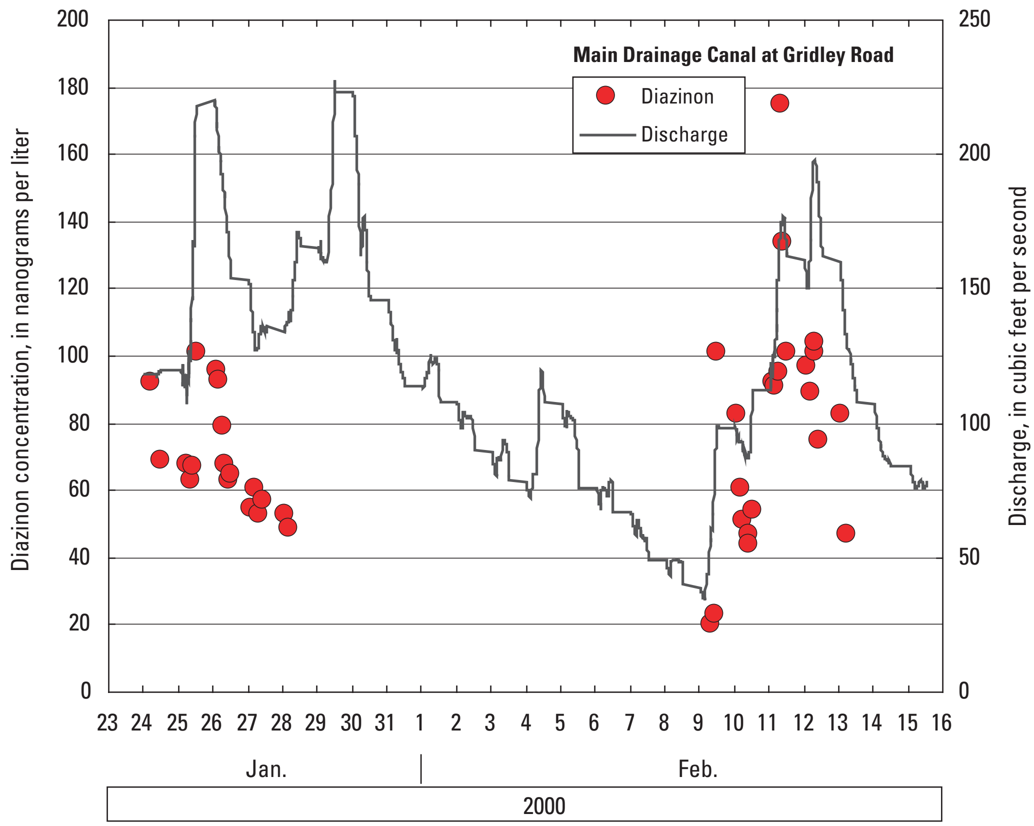

Figure 14. Diazinon concentrations and streamflow at sampling sites in the Sacramento Valley, California, from January 23, 2000, to February 17, 2001.

(*G*) Main Drainage Canal at Gridley Road (site 10).
See figure 1 and table 1 for location.

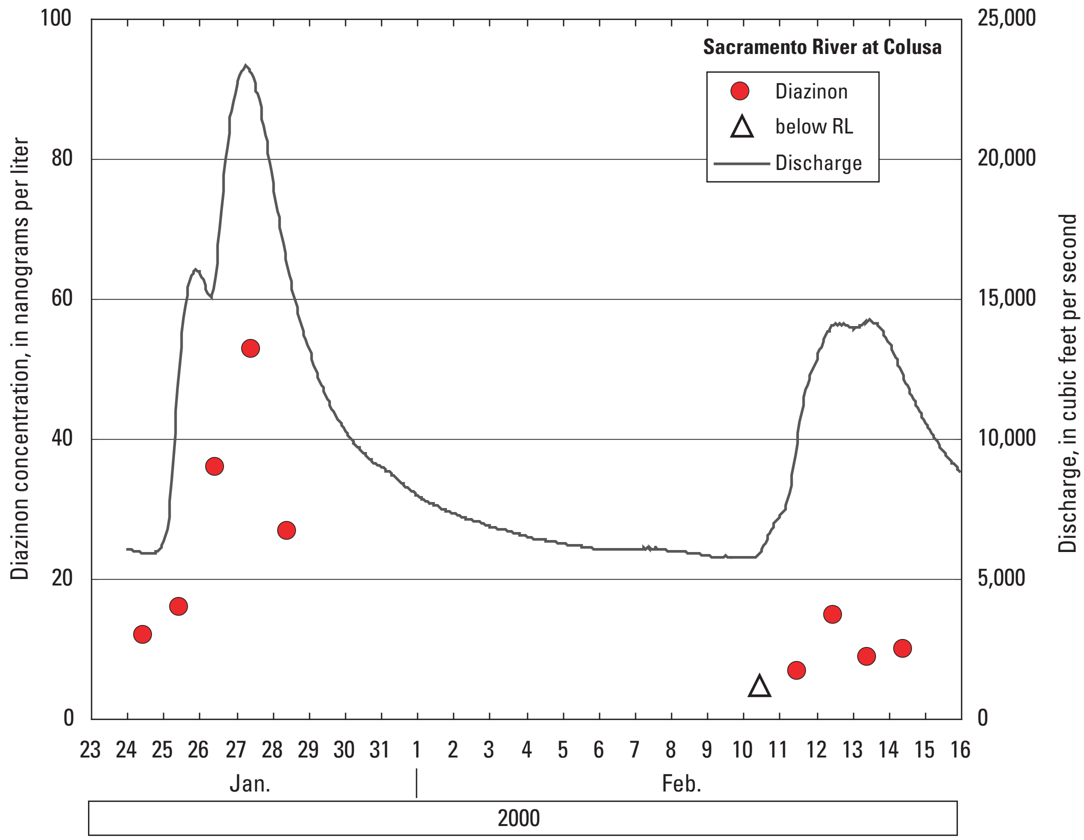

Figure 14. Diazinon concentrations and streamflow at sampling sites in the Sacramento Valley, California, from January 23, 2000, to February 17, 2001.

(*H*) Sacramento River at Colusa (site 8).
See figure 1 and table 1 for location. RL, reporting limit.

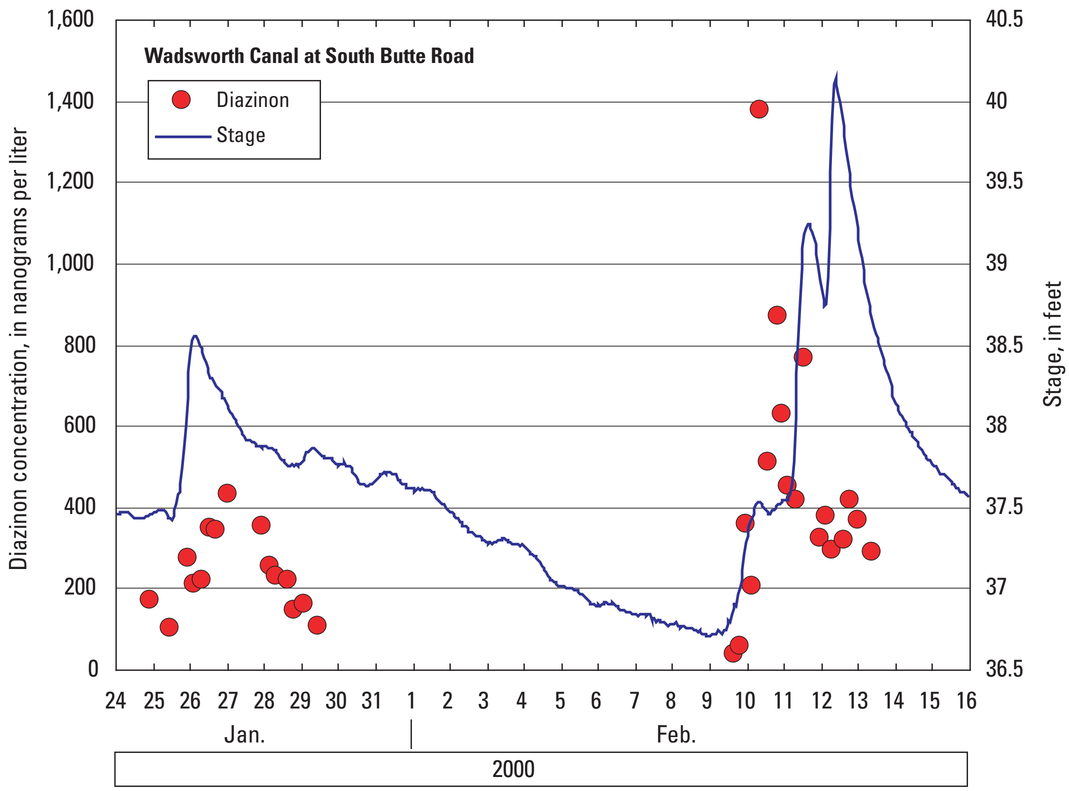

Figure 15. Diazinon concentrations and stream stage at sampling sites in the Sacramento Valley, California, from January 23, 2000, to February 16, 2001.

(*A*) Wadsworth Canal at South Butte Road (site 12).
See figure 1 and table 1 for location.

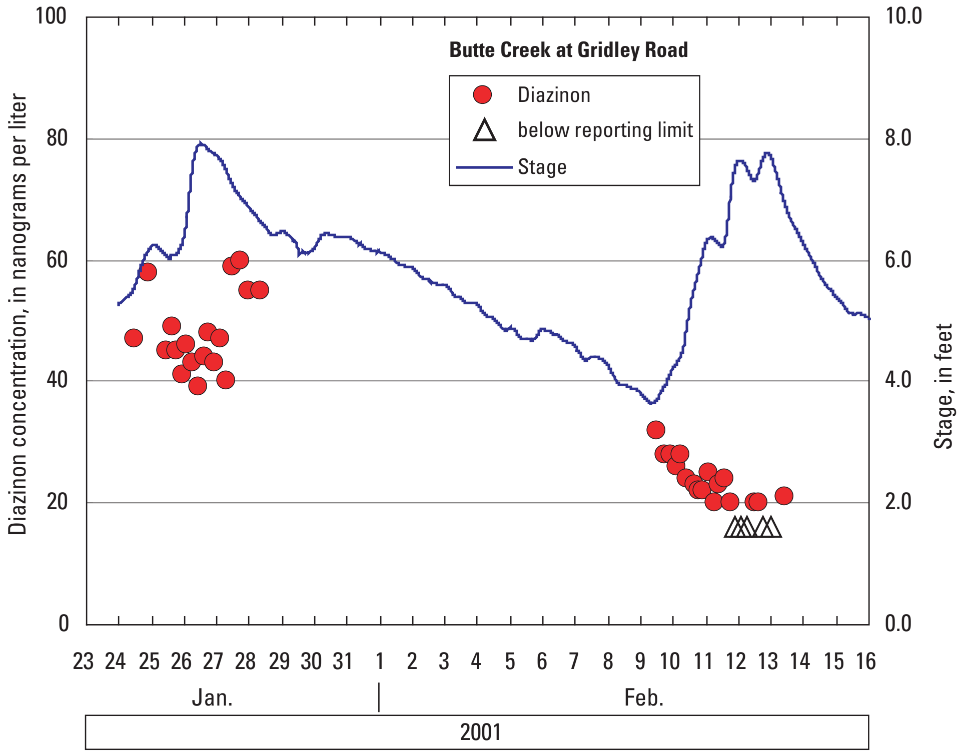

Figure 15. Diazinon concentrations and stream stage at sampling sites in the Sacramento Valley, California, from January 23, 2000, to February 16, 2001.

(*B*) Butte Creek at Gridley Road (site 9) from January 23, 2000, to February 16, 2001.
See figure 1 and table 1 for location.

Peak concentrations often coincided with peak storm flows. Exceptions to this pattern can be observed at Butte Creek at Gridley Road (site 9), Feather River below Star Bend (site 18), and Jack Slough near Doc Adams Road (site 16). Peak concentrations at these sites occurred prior to or after peak flows. These patterns may be due to dilution of local agricultural runoff with flows originating upstream of agricultural areas. Despite the proximity of agricultural land to the monitoring sites, the flat topography of the valley floor (and the resulting low velocities in many of the channels draining that area) may result in significant lag times in transport of diazinon from points of application to the monitoring sites.

Boxplots of diazinon concentration during the monitoring period at many of the sites are shown in figure 16. Sites with few samples or few concentrations above reporting levels are not included. Sites receiving mostly agricultural or urban drain water had the highest concentrations of diazinon. Samples collected at Wadsworth Canal at South Butte Road (site 12), which drains agricultural lands east of the Sutter Buttes, had a median concentration of 308 ng/L and a maximum value of 1,380 ng/L. These were the highest values observed during the monitoring period. Other drains with relatively high concentrations were DWR Pump Plant 1 (site 15), Jack Slough near Doc Adams Road (site 16), Main Drainage Canal at Gridley Road (site 10), DWR Pump Plant 2–north channel (site 13), and DWR Pump Plant 2–south channel (site 14), with median concentrations of 141, 78, 68, 61, and 50 ng/L, respectively.

Diazinon concentrations were lower in samples collected at sites draining medium-sized basins where agricultural land occupies a smaller percentage of the watershed. Median concentrations at Bear River near Berry Road (site 19), Butte Slough at Lower Pass Road (site 11), and Butte Creek at Gridley Road (site 9) were 43, 29, and 28 ng/L, respectively. The lowest concentrations observed were at the large river sites where most of the flow originated in nonagricultural and nonurban land. Median concentrations at Sacramento River at Colusa (site 8) and Feather River above Star Bend were both 15 ng/L. The median concentration at Sacramento River at Alamar (site 20), which is downstream of most agricultural inputs, was 21 ng/L. The median concentration at Sacramento River at Tower Bridge (site 21), which receives drainage from the northern portion of the Sacramento metropolitan area in addition to upstream agricultural inputs, was very similar at 20 ng/L.

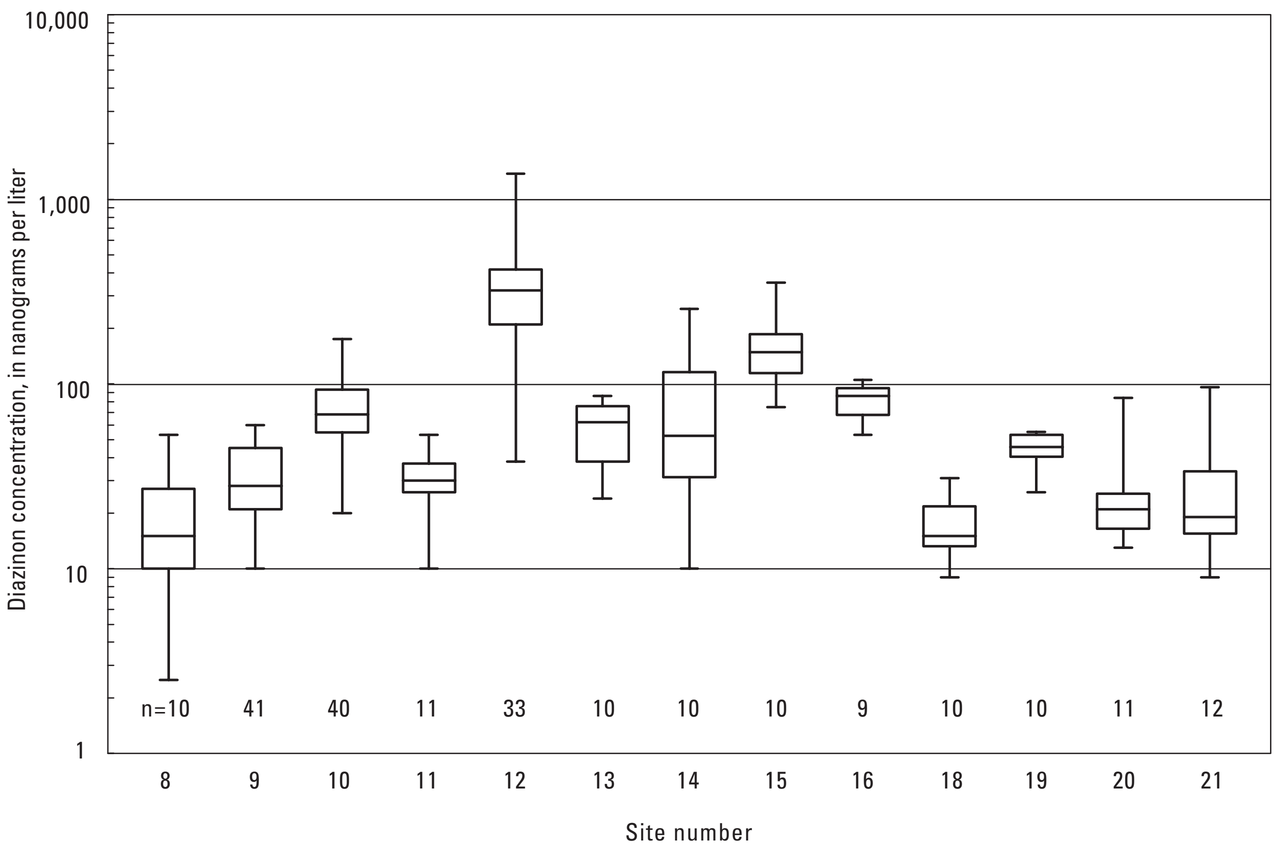

Figure 16. Boxplots of diazinon concentrations at many of the sampling sites in the Sacramento Valley, California.

[µg/L, microgram per liter. Values less than the reporting limit set at 1/2 reporting limit for the following sites: 8 (1/2 reporting limit = 2.5 µg/L), 9, 11, and 14 (1/2 reporting limit =10 µg/L).]

During the second monitored storm, samples were collected at Sacramento River at Hamilton City (site 1), Stony Creek at Highway 45 (site 7), and in streams receiving urban storm runoff from the city of Chico. All diazinon concentrations at Sacramento River at Hamilton City (site 1) were below the reporting limit (20 ng/L) for the method used at that site. Samples collected at Stony Creek at Highway 45 (site 7) were near or below the reporting limit of 20 ng/L. Samples collected from Mud Creek at Chico (site 2), Lindo Channel at Chico (site 3), and Little Chico Creek (site 5) had values ranging from 20 to 185 ng/L. Samples were collected from two sites on Big Chico Creek (sites 4 and 6), which originates in the Sierra foothills and runs through the city of Chico before discharging into the Sacramento River. Diazinon concentrations at Big Chico Creek at Chico (site 4) ranged from below the reporting limit to 24 ng/L. Diazinon concentrations in seven of the nine samples collected at Big Chico Creek at River Road (site 6), located farther downstream, were below the laboratory reporting limit of 20 ng/L. Concentrations in the two samples above the reporting limit were 22 and 62 ng/L.

Rain from the first monitored storm occurred from January 23 to 26 and produced an average total rainfall of 1.9 in. at the four rain gages mentioned earlier. An earlier large storm, which began on January 7, produced an average total rainfall of 2.9 in. The January 7 storm was not monitored, because it was believed at the time that few dormant spray applications had been made before that date. However, data from the PUR released the following year show that 34 percent (11,900 lb a.i.) of the total seasonal diazinon applications were made in the 30 days prior to the storm. One of the difficulties in carrying out storm runoff studies of pesticide transport is choosing the most relevant storms to monitor, given a limited number of samples that can be collected and the limited information available about the amount and timing of recent pesticide applications in an area as large as the Sacramento Valley.

Diazinon applications between the January 7 storm and the first monitored storm were 32 percent (11,300 lb a.i.) of the season total. Although the "first flush' of the January 7 storm was missed, the pre-storm applications for both storms were similar in quantity and timing. The amounts of diazinon transported to the aquatic environment during both storms may have been similar.

The average rainfall during the second monitored storm (1.6 in.) was slightly less than the rainfall during the first monitored storm, and less diazinon was applied in the valley during the dry period before the second storm (7,300 lb a.i. or 21 percent of the season total) than was applied during the dry period before the first monitored storm. These two factors may explain the lower concentrations observed overall during the second monitored storm.

Two major storms occurred after the monitoring ended at most sites on February 14 (fig. 4). Less than 6 percent (4,600 lb a.i.) of the seasonal total was applied in the dry period just before those storms, and resulting diazinon concentrations were probably considerably less than the earlier monitored storms.

Because reservoir releases were relatively low during the 2001 monitoring period, diazinon transported to the Sacramento and Feather Rivers from storm runoff on the valley floor was less likely to be diluted by upstream flows originating in nonagricultural areas. Concentrations in these large rivers during years with higher rainfall and larger storm releases from upstream reservoirs may be lower given similar diazinon use.

Measured and Estimated Diazinon Loads at Monitoring Sites

Storm period loads were estimated for sites 8, 10, 11, 16, 18, 19, 20, and 21 during the two monitoring periods (table 3). The estimated load at Sacramento River at Tower Bridge (site 21) for both periods was 52 lb. Because there were no diversions from the Sacramento River to the Yolo Bypass during the monitoring period, this load represents the sum of all sources in the Sacramento Valley with the exception of the Colusa Basin Drain watershed, which is diverted to the Bypass through the Knights Landing Ridge Cut each winter. Loads at the Sacramento River at Colusa (site 8) during the two 5-day monitoring periods represent about 30 percent of the loads at Tower Bridge. Because the 5-day length of the monitoring periods at these two sites did not include all the high flows from runoff, the time periods for load estimation at the Sacramento River at Colusa were extended two additional days beyond the time of the last sample collection to include most of the storm runoff that passed through the site. Diazinon concentrations during the additional two days were estimated graphically by extending the decreasing trends in concentration observed during the last days of the monitoring period and using the site hydrograph as a guide to runoff conditions. The percent of the storm load at Tower Bridge originating upstream of Colusa did not change significantly (34 percent) using the estimated full storm runoff period.

Table 3. Diazinon loads estimated for sites in the Sacramento Valley, California, during two storm-monitoring periods in 2001.

[All values are in pounds]

Site number	Site name	Storm monitoring period 1	Storm monitoring period 2	Total
8	Sacramento River at Colusa	12.5	2.68	15.1
10	Main Drainage Canal at Gridley Road	0.22	0.26	0.48
11	Butte Slough at Lower Pass Road	0.86	0.57	1.43
16	Jack Slough near Doc Adams Road	0.28	0.36	0.64
18	Feather River below Star Bend	1.54	0.34	1.87
19	Bear River near Berry Road	0.22	0.40	0.62
20	Sacramento River at Alamar	16.4	8.72	25.1
21	Sacramento River at Tower Bridge (5 days)	18.9	5.85	24.7
21	Sacramento River at Tower Bridge (7 days)	41.10	10.90	52

Loads from the Feather River were estimated by summing loads at Feather River below Star Bend (site 18) and Bear River near Berry Road (site 19). Approximately 6.2 lb of diazinon was estimated to have entered the Sacramento River from the Feather River during the monitoring periods, representing about 12 percent of the load at Sacramento River at Tower Bridge (site 21). This is about half the percentage estimated for the Feather River during the previous dormant spray season (Dileanis and others, 2002).

Several problems were encountered in developing load estimates for creeks draining the Chico urban area, and load estimates are only available for the second storm-monitoring period in February. In Little Chico Creek, discharge was not reported by DWR for the Taffee Avenue Gage during the period just before samples were collected. The reliability of data from the gage during the times of sample collection was uncertain, thus reducing the confidence of the estimated loading of 0.04 lb, which is based on the two samples collected at the site.

The discharge record at the Lindo Channel at Chico gage (site 3) was limited in that there were data gaps during the monitoring period. Instantaneous streamflow measurements were made at the time of sample collection at the Lindo Channel at Chico (site 3), and instantaneous loads of 0.004 lb/d and 0.028 lb/d were estimated. These loads, coupled with visual observations of low flows in the channel throughout the storm period, suggest that the total load would have been small and comparable to loads estimated for Little Chico Creek.

Loads from Mud Creek during the monitoring period were estimated to be 0.11 lb on the basis of the two samples and a continuous discharge record. Because the discharge record for this site may be overestimated, the load estimate may be conservatively high. Only two of the nine samples collected at Big Chico Creek at Chico (site 4) were above the laboratory reporting limit of 20 ng/L. On the basis of this limited data, the load estimate for the second monitoring period is 0.04 lb. Diazinon concentrations at Big Chico Creek at River Road (site 6) were also below the reporting limit for seven of the nine samples collected. Only instantaneous streamflow measurements made at the time of sampling were available for this site. Instantaneous load estimates of 0.02 and 0.1 lb/d were made for the two occasions when samples with concentrations above reporting limits were collected.

Loads from Wadsworth Canal at South Butte Road (site12), the DWR pumping plants (sites 13–15), Butte Creek at Gridley Road (site 9), Feather River at Yuba City (site 17), and Stony Creek at Highway 45 (site 7) could not be estimated because no streamflow data were available for these sites. Loads at Sacramento River at Hamilton City (site 1) could not be estimated because diazinon concentrations at this site were below the laboratory reporting limits (20 ng/L) in all five samples collected at the site.

Estimated loads from the Sacramento River upstream of Colusa, the Feather River, and Butte Slough (which includes Butte Creek) upstream of the Sutter Bypass made up about 40 percent of the load estimated at Sacramento River at Tower Bridge (site 21). A significant portion of the diazinon load measured at Sacramento River at Tower Bridge may have originated from sources draining into the Sutter Bypass, for which no load estimates are available. About half (approximately 16,800 lb) of the diazinon that was applied in the 2001 dormant spray season was used in this area, which is east and southeast of the Sutter Buttes and drains to the Sutter Bypass through the Wadsworth Canal and at the DWR pumping plants.

Because the periods when samples were collected were sometimes shorter than the duration of the runoff flows defined by the storm hydrographs at the monitoring sites, load estimates may be underestimated at some sites. A monitoring period of 5 days after rainfall begins, appears to be a sufficient time to capture peak diazinon concentrations at the smaller streams such as the Wadsworth Canal, but not in some of the larger channels. The monitoring period ended at the Sacramento River at Alamar, Feather River, and Butte Slough before concentrations and loads were observed to peak during both storms, despite monitoring at Alamar for six consecutive days, a day longer than other upstream sites. Sacramento River at Tower Bridge provides a good example of the need to continue monitoring until concentrations show a well-documented declining trend. The total load at that site during the first 5 days of monitoring was about 24.7 lb. An additional sample collected 2 days later allowed a more complete estimate of the storm load at that site. The 7-day storm total of 52 lb (table 3) represents an increase of 100 percent over the 5-day total. Because the Sacramento River at Tower Bridge site is the site farthest downstream and is integrating runoff and diazinon sources throughout the basin, the length of the storm hydrograph, the delay of peak concentrations, and the period of elevated diazinon concentrations are all expected to be greater there than at sites farther upstream on the Sacramento and Feather Rivers. Five days of monitoring at Sacramento River at Colusa was the minimum length of time required to estimate loads at that site in 2001. An additional day of sampling at that site would reduce the uncertainty of load estimates by including more of the storm hydrograph and reducing the time of any extrapolations beyond the last sample. In future sampling, consideration should be given to collecting samples at Sacramento River at Alamar and Tower Bridge for a minimum of 7 days. These time estimates are based on conditions encountered in 2001. The suggested time periods should be extended if future monitoring occurred during much higher flows or longer storm durations.

Relation of Diazinon Loads to Use

In general, diazinon loads were greater in subbasins with greater diazinon use. Figure 17 shows the relation between use and storm loads during the monitoring periods in the six subbasins in which both pesticide use and storm period loads were reported.

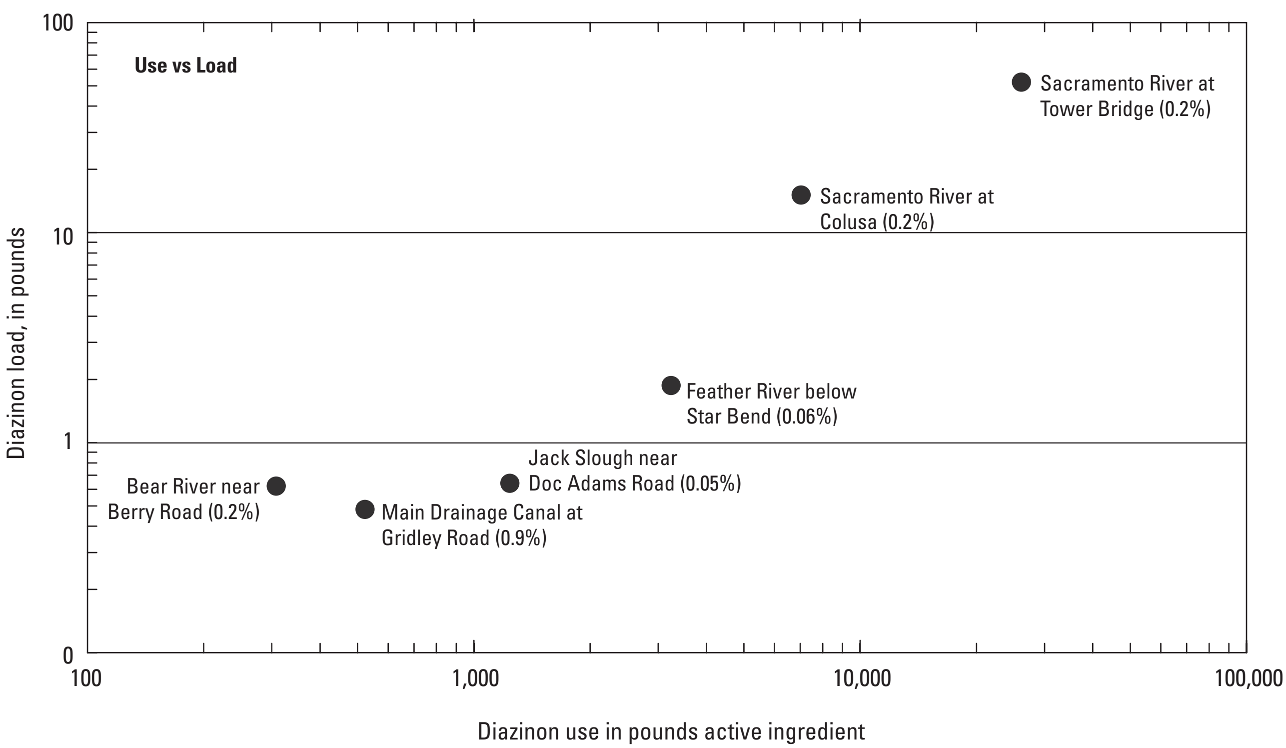

Figure 17. Diazinon load in relation to use in six subbasins in the Sacramento Valley. [Numbers in parentheses are percentages of load to upstream use.]

Estimates of the fraction of applied diazinon transported to the Feather and Sacramento Rivers (yield) were made by dividing storm loads by the mass of diazinon applied upstream in the period before and during the monitored storm events. Diazinon applied from December 23 to January 24 was used in the calculations for the first monitoring period (period 2 in table 2), and diazinon applied from January 25 to February 9 was used for the second monitoring period (period 3 in table 2).

Although there was some agricultural use of diazinon in December (period 1 in table 2), diazinon use during this period was not included in the analysis. The field half-life of diazinon is reported to be between 3 and 54 days (U.S. Department of Agriculture, 2003). The amount of diazinon applied in December was relatively small, and sufficient time had elapsed between the early applications and the first monitored storm at the end of January for significant degradation and loss of applied diazinon from the study area.

Diazinon yield at the Sacramento River (sites 8 and 21) during the monitoring periods was approximately 0.02 percent of the amount applied to upstream agricultural lands. Sacramento River at Alamar (site 20) was not included in the analysis because the monitoring periods at this site did not cover the entire storm hydrographs, so the storm loads would have been underestimated.

Storm period loads at Feather River below Star Bend (site 18), Jack Slough near Doc Adams Road (site 16), and the Main Drainage Canal at Gridley Road (site 10) ranged between 0.05 and 0.09 percent of the applied pesticide. The amount of applied diazinon transported to Bear River near Berry Road (site 19) was 0.02 percent. The estimated amount of diazinon transported from agricultural land to the Sacramento River and its tributaries was lower in 2001 than the previous year. In the 2000 storm runoff study, basin yields for the Sacramento River at Tower Bridge (site 21) ranged from 0.20 to 0.85 percent, and yields from the Feather River ranged from 0.25 to 0.49 percent (Dileanis and others, 2002). The quantity of pesticides applied in the Sacramento Valley during the 2000 and 2001 dormant spray seasons was just over 40,000 lb a.i. in each of the two years. However, there were differences in use by subbasin. Diazinon applications used to calculate loads upstream of Sacramento River at Tower Bridge (site 21) were 27 percent higher in 2000. In the Feather River (sites 18 and 19), diazinon applications were 164 percent higher in 2000 than in 2001.

Another factor in the decrease in yield observed in 2001 may have been the amount of rainfall that occurred during the monitoring periods. Marysville, located close to the Feather River, received 13.7 in. of rain during January and February 2000. In 2001, 8.7 in. was recorded. The average rainfall (1960–90) for January and February at Marysville is 7.2 in. (National Oceanic and Atmospheric Administration, 2001). The unusually high rainfall in 2000 and the lower diazinon use in 2001 is reflected in the lower yields observed in 2001.

Summary

A portion of the diazinon applications made to orchards and urban areas during the winter months in the Sacramento Valley of California is transported to streams and agricultural drains in storm runoff. In the winter of 2001, diazinon concentrations in the Sacramento River and selected tributaries ranged from less than 5 ng/L (analytical detection level) to 1,380 ng/L, with a median of 55 ng/L during the first storm and 26 ng/L during the second storm. The highest concentrations were present in small streams draining agricultural areas. Concentrations in streams draining the Chico urban area were also elevated relative to streams draining nonagricultural land.

Load estimates for two storm runoff periods indicate that about 30 percent of the diazinon in the lower Sacramento River is introduced from the portion of the basin upstream of Colusa. Diazinon transported from the Chico urban area does not appear to be a large portion of the load observed in the Sacramento River at Colusa.

About 26,000 lb of diazinon were reported applied to agricultural land in the Sacramento Valley just before and during the monitoring period. About 0.2 percent of the applied diazinon appeared to be transported to the lower Sacramento River during the period of monitoring. About 0.06 percent of the applied diazinon was estimated to have entered the Feather River from orchard applications in this watershed. These yields were lower than those estimated for these basins during the previous winter. Lower yields may be related in part to lower pesticide use, especially in the Feather River watershed.

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APPENDIXES

Appendix 1. Table 1. Diazinon and methidathion concentrations in blank samples analyzed by the California Department of Fish and Game's Water Pollution Control Laboratory.

[ng/L, nanogram per liter; <, less than; DWR, California Department of Water Resources]

Site number	Site name	Date and time	Diazinon concentration (ng/L)	Methidathion concentration (ng/L)
AMBIENT BLANKS				
1	Sacramento River at Hamilton City	02/09/01 1525	<20	<50
7	Stony Creek at Highway 45	02/10/01 1120	<20	<50
9	Butte Creek at Gridley Road	01/24/01 1155	<20	<50
10	Main Drainage Canal at Gridley Road	01/25/01 1830	<20	<50
10	Main Drainage Canal at Gridley Road	02/10/01 0635	<20	<50
11	Butte Slough at Lower Pass Road	01/24/01 1144	<20	<50
11	Butte Slough at Lower Pass Road	02/10/01 1120	<20	<50
13	DWR Pumping Plant 2, North	02/09/01 1310	<20	<50
13	DWR Pumping Plant 2, North	12/14/00 1035	<20	<50
19	Bear River near Berry Road	01/26/01 1120	<20	<50
19	Bear River near Berry Road	02/11/01 1030	<20	<50
FIELD BLANKS				
1	Sacramento River at Hamilton City	02/10/01 1210	<20	<50
9	Butte Creek at Gridley Road	02/09/01 1225	<20	<50
9	Butte Creek at Gridley Road	02/11/01 1800	<20	<50
11	Butte Slough at Lower Pass Road	01/25/01 1125	<20	<50
11	Butte Slough at Lower Pass Road	02/11/01 1125	<20	<50
12	Wadsworth Canal at South Butte Road	01/25/01 1140	<20	<50
12	Wadsworth Canal at South Butte Road	02/09/01 1605	<20	<50
14	DWR Pumping Plant 2, South	01/25/01 1255	<20	<50
14	DWR Pumping Plant 2, South	02/10/01 1222	<20	<50
18	Feather River below Star Bend	01/25/01 1150	<20	<50
18	Feather River below Star Bend	02/10/01 1300	<20	<50

Appendix 1. Table 2. Pesticide recovery from spiked samples analyzed by the California Department of Fish and Game Water Pollution Control Laboratory.

[µg/L, microgram per liter]

Extraction date	Sample number	Pesticide	Spike level (µg/L)	Percent recovery
01/25/01	109	Chlorpyrifos	0.1	97
01/25/01	109	Diazinon	0.2	89
01/25/01	109	Malathion	0.2	96
01/25/01	109	Methidathion	0.1	101
01/25/01	110	Chlorpyrifos	0.1	94
01/25/01	110	Diazinon	0.2	85
01/25/01	110	Malathion	0.2	87
01/25/01	110	Methidathion	0.1	112
02/01/01	112	Chlorpyrifos	0.05	98
02/01/01	112	Diazinon	0.5	87
02/01/01	112	Dimethoate	0.2	110
02/01/01	112	Methidathion	0.2	110
02/04/01	111	Chlorpyrifos	0.05	96
02/04/01	111	Diazinon	0.5	84
02/04/01	111	Dimethoate	0.2	112
02/04/01	111	Methidathion	0.2	105
02/13/01	113	Chlorpyrifos	0.1	91
02/13/01	113	Diazinon	0.5	74
02/13/01	113	Dimethoate	0.2	106
02/13/01	113	Methidathion	0.2	97
02/14/01	117	Chlorpyrifos	0.1	94
02/14/01	117	Diazinon	0.2	84
02/14/01	117	Malathion	0.2	93
02/14/01	117	Methidathion	0.1	108
02/14/01	119	Chlorpyrifos	0.1	97
02/14/01	119	Diazinon	0.5	79
02/14/01	119	Dimethoate	0.2	111
02/14/01	119	Methidathion	0.2	98
02/20/01	115	Chlorpyrifos	0.1	97
02/20/01	115	Diazinon	0.2	86
02/20/01	115	Malathion	0.2	92
02/20/01	115	Methidathion	0.1	102

Appendix 1. Table 3. Diazinon and methidathion concentrations in replicate samples from sites in the Sacramento River Basin, California, analyzed by the California Department of Fish and Game's Water Pollution Control Laboratory.

[ng/L, nanogram per liter; <, less than; DWR, California Department of Water Resources]

Site No.	Site name	Date and time	Diazinon (ng/L)	Replicate diazinon (ng/L)	Methidathion (ng/L)	Replicate methidathion (ng/L)
1	Sacramento River at Hamilton City	02/09/01 1525	<20	<20	<50	<50
1	Sacramento River at Hamilton City	02/11/01 1115	<20	<20	<50	<50
1	Sacramento River at Hamilton City	02/12/01 1050	<20	<20	<50	<50
1	Sacramento River at Hamilton City	02/13/01 1010	<20	<20	<50	<50
5	Little Chico Creek	02/10/01 1450	20	<20	<50	<50
7	Stony Creek at Highway 45	02/09/01 1055	21	<20	<50	<50
9	Butte Creek at Gridley Road	01/24/01 2100	58	52	<50	<50
9	Butte Creek at Gridley Road	01/25/01 1025	45	61	<50	<50
9	Butte Creek at Gridley Road	01/25/01 1800	45	49	<50	<50
9	Butte Creek at Gridley Road	01/27/01 0625	40	49	<50	<50
9	Butte Creek at Gridley Road	01/27/01 1800	60	47	<50	<50
9	Butte Creek at Gridley Road	02/10/01 0615	28	<20	<50	<50
9	Butte Creek at Gridley Road	02/12/01 0620	<20	<20	<50	<50
10	Main Drainage Canal at Gridley Road	01/25/01 1045	68	76	<50	<50
10	Main Drainage Canal at Gridley Road	01/26/01 0635	93	98	<50	<50
10	Main Drainage Canal at Gridley Road	01/26/01 1830	63	78	<50	<50
10	Main Drainage Canal at Gridley Road	02/10/01 0635	61	67	<50	<50
10	Main Drainage Canal at Gridley Road	02/11/01 0700	91	87	4,720	4,160
11	Butte Slough at Lower Pass Road	02/14/01 1115	25	<20	<50	<50
12	Wadsworth Canal at South Butte Road	01/26/01 0730	200	223	<50	<50
12	Wadsworth Canal at South Butte Road	01/27/01 0300	256	286	<50	<50
12	Wadsworth Canal at South Butte Road	02/11/01 0825	418	456	<50	<50
13	DWR Pumping Plant 2, North	01/24/01 1230	86	93	<50	<50
14	DWR Pumping Plant 2, South	02/13/01 1254	31	45	3,700	4,500
15	DWR Pumping Plant 1	01/24/01 1140	171	93	<50	<50
15	DWR Pumping Plant 1	02/09/01 1210	111	97	<50	<50
17	Feather River at Yuba City	01/26/01 1240	<20	<20	<50	<50
17	Feather River at Yuba City	02/12/01 1230	<20	<20	<50	<50
19	Bear River near Berry Road	01/25/01 0930	48	52	<50	<50
19	Bear River near Berry Road	02/10/01 1030	42	<20	<50	<50
20	Sacramento River at Alamar	2/11/01 1100	<20	44	<50	<50

Appendix 1. Table 4. Pesticide concentrations in blank and replicate samples from sites in the Sacramento River Basin, California, analyzed by the U.S. Geological Survey National Water Quality Laboratory.

[<, less than; E, estimated value; ng/L, nanograms per liter]

Site no.	Site name	Date	Time	2,6-Diethyl aniline	Aceto- chlor	Alachlor (ng/L)	Alpha- BHC	Atrazine (ng/L)	Benflur- alin (ng/L)	Butylate (ng/L)
	Blank samples									
8	Sacramento River at Colusa	01/28/01	0948	<2	<4	<2	<5	<7	<10	<2
8	Sacramento River at Colusa	02/12/01	1048	<2	<4	<2	<5	<7	<10	<2
18	Feather River below Star Bend	01/25/01	1308	<2	<4	<2	<5	<7	<10	<2
18	Feather River below Star Bend	02/13/01	1138	<2	<4	<2	<5	<7	<10	<2
20	Sacramento River at Alamar	01/28/01	1058	<2	<4	<2	<5	<7	<10	<2
21	Sacramento River at Tower Bridge	02/11/01	1308	<2	<4	<2	<5	<7	<10	<2
	Replicate samples									
18	Feather River below Star Bend	02/13/01	1131	<2	<4	<2	<5	<7	<10	<2
21	Sacramento River at Tower Bridge	01/29/01	1101	<2	<4	<2	<5	<7	<10	<2
21	Sacramento River at Tower Bridge	02/11/01	1301	<2	<4	<2	<5	<7	<10	<2
8	Sacramento River at Colusa	01/26/01	0941	<2	<4	<2	<5	<7	<10	<2
8	Sacramento River at Colusa	02/14/01	1001	<2	<4	<2	<5	<7	<10	<2
20	Sacramento River at Alamar	01/25/01	1111	<2	<4	<2	<5	<7	<10	<2
20	Sacramento River at Alamar	02/10/01	1051	<2	<4	<2	<5	<7	<10	<2

Site no.	Site name	Date	Time	Carbaryl (ng/L)	Carbo- furan	Chlor- pyrifos	Cyanazine (ng/L)	DCPA (ng/L)	Desethyl atrazine	Diazinon surrogate
	Blank samples									
8	Sacramento River at Colusa	01/28/01	0948	<41	<20	<5	<18	<3	<6	108
8	Sacramento River at Colusa	02/12/01	1048	<41	<20	<5	<18	<3	<6	89
18	Feather River below Star Bend	01/25/01	1308	<41	<20	<5	<18	<3	<6	97
18	Feather River below Star Bend	02/13/01	1138	<41	<20	<5	<18	<3	<6	91
20	Sacramento River at Alamar	01/28/01	1058	<41	<20	<5	<18	<3	<6	97
21	Sacramento River at Tower Bridge	02/11/01	1308	<41	<20	<5	<18	<3	<6	87
	Replicate samples									
18	Feather River below Star Bend	02/13/01	1131	<41	<20	<5	<18	<3	<6	108
21	Sacramento River at Tower Bridge	01/29/01	1101	<41	<20	<5	<18	<3	<6	92
21	Sacramento River at Tower Bridge	02/11/01	1301	<41	<20	<5	<18	<3	<6	95
8	Sacramento River at Colusa	01/26/01	0941	<41	<20	E3	<18	<3	<6	126
8	Sacramento River at Colusa	02/14/01	1001	<41	<20	<5	<18	<3	<6	100
20	Sacramento River at Alamar	01/25/01	1111	<41	E6	<5	<18	<3	<6	105
20	Sacramento River at Alamar	02/10/01	1051	<41	<20	<5	<18	<3	<6	84

Appendix 1. Table 4. Pesticide concentrations in blank and replicate samples from sites in the Sacramento River Basin, California, analyzed by the U.S. Geological Survey National Water Quality Laboratory—*Continued.*

Site no.	Site name	Date	Time	Diazinon (ng/L)	Dieldrin (ng/L)	Disulfoton (ng/L)	EPTC (ng/L)	Ethal-fluralin	Ethoprop (ng/L)	Fonofos (ng/L)
	Blank samples									
8	Sacramento River at Colusa	01/28/01	0948	<5	<5	<21	<2	<9	<5	<3
8	Sacramento River at Colusa	02/12/01	1048	<5	<5	<21	<2	<9	<5	<3
18	Feather River below Star Bend	01/25/01	1308	<5	<5	<21	<2	<9	<5	<3
18	Feather River below Star Bend	02/13/01	1138	<5	<5	<21	<2	<9	<5	<3
20	Sacramento River at Alamar	01/28/01	1058	<5	<5	<21	<2	<9	<5	<3
21	Sacramento River at Tower Bridge	02/11/01	1308	<5	<5	<21	<2	<9	<5	<3
	Replicate samples									
18	Feather River below Star Bend	02/13/01	1131	16	<5	<21	<2	<9	<5	<3
21	Sacramento River at Tower Bridge	01/29/01	1101	60	<5	<21	<2	<9	<5	<3
21	Sacramento River at Tower Bridge	02/11/01	1301	12	<5	<21	<2	<9	<5	<3
8	Sacramento River at Colusa	01/26/01	0941	39	<5	<21	<2	<9	<5	<3
8	Sacramento River at Colusa	02/14/01	1001	10	<5	<21	<2	<9	<5	<3
20	Sacramento River at Alamar	01/25/01	1111	24	<5	<21	<2	<9	<5	<3
20	Sacramento River at Alamar	02/10/01	1051	11	<5	<21	<2	<9	<5	<3

Site no.	Site name	Date	Time	Alpha-D6 HCH	Lindane (ng/L)	Linuron (ng/L)	Malathion (ng/L)	Methyl azinphos	Methyl parathion	Meto-lachlor
	Blank samples									
8	Sacramento River at Colusa	01/28/01	0948	107	<4	<35	<27	<50	<6	<13
8	Sacramento River at Colusa	02/12/01	1048	73	<4	<35	<27	<50	<6	<13
18	Feather River below Star Bend	01/25/01	1308	101	<4	<35	<27	<50	<6	<13
18	Feather River below Star Bend	02/13/01	1138	97	<4	<35	<27	<50	<6	<13
20	Sacramento River at Alamar	01/28/01	1058	102	<4	<35	<27	<50	<6	<13
21	Sacramento River at Tower Bridge	02/11/01	1308	77	<4	<35	<27	<50	<6	<13
	Replicate samples									
18	Feather River below Star Bend	02/13/01	1131	117	<4	<35	<27	<50	<6	<13
21	Sacramento River at Tower Bridge	01/29/01	1101	84	<4	<35	<27	<50	<6	<13
21	Sacramento River at Tower Bridge	02/11/01	1301	79	<4	<35	<27	<50	<6	<13
8	Sacramento River at Colusa	01/26/01	0941	120	<4	<35	<27	<50	<6	E8
8	Sacramento River at Colusa	02/14/01	1001	117	<4	<35	<27	<50	<6	<13
20	Sacramento River at Alamar	01/25/01	1111	107	<4	<35	<27	<50	<6	E1
20	Sacramento River at Alamar	02/10/01	1051	69	<4	<35	<27	<50	<6	<13

Appendix 1. Table 4. Pesticide concentrations in blank and replicate samples from sites in the Sacramento River Basin, California, analyzed by the U.S. Geological Survey National Water Quality Laboratory—*Continued.*

Site no.	Site name	Date	Time	Metribuzin (ng/L)	Molinate (ng/L)	Naprop-amide	*p,p'*-DDE (ng/L)	Parathion (ng/L)	Pebulate (ng/L)	Pendi-methalin
	Blank samples									
8	Sacramento River at Colusa	01/28/01	0948	<6	<2	<7	<3	<7	<2	<10
8	Sacramento River at Colusa	02/12/01	1048	<6	<2	<7	<3	<7	<2	<10
18	Feather River below Star Bend	01/25/01	1308	<6	<2	<7	<3	<7	<2	<10
18	Feather River below Star Bend	02/13/01	1138	<6	<2	<7	<3	<7	<2	<10
20	Sacramento River at Alamar	01/28/01	1058	<6	<2	<7	<3	<7	<2	<10
21	Sacramento River at Tower Bridge	02/11/01	1308	<6	<2	<7	<3	<7	<2	<10
	Replicate samples									
18	Feather River below Star Bend	02/13/01	1131	<6	10	<7	<3	<7	<2	<10
21	Sacramento River at Tower Bridge	01/29/01	1101	<6	9	<7	<3	<7	<2	<10
21	Sacramento River at Tower Bridge	02/11/01	1301	<6	25	<7	<3	<7	<2	<10
8	Sacramento River at Colusa	01/26/01	0941	<6	<2	<7	<3	<7	<2	<10
8	Sacramento River at Colusa	02/14/01	1001	<6	<2	<7	<3	<7	<2	<10
20	Sacramento River at Alamar	01/25/01	1111	<6	22	<7	<3	<7	<2	<10
20	Sacramento River at Alamar	02/10/01	1051	<6	19	<7	<3	<7	<2	<10

Site no.	Site name	Date	Time	Permethrin (ng/L)	Phorate (ng/L)	Prometon (ng/L)	Pronamide (ng/L)	Propachlor (ng/L)	Propanil (ng/L)	Propargite (ng/L)
	Blank samples									
8	Sacramento River at Colusa	01/28/01	0948	<6	<11	<15	<4	<10	<11	<23
8	Sacramento River at Colusa	02/12/01	1048	<6	<11	<15	<4	<10	<11	<23
18	Feather River below Star Bend	01/25/01	1308	<6	<11	<15	<4	<10	<11	<23
18	Feather River below Star Bend	02/13/01	1138	<6	<11	<15	<4	<10	<11	<23
20	Sacramento River at Alamar	01/28/01	1058	<6	<11	<15	<4	<10	E1	<23
21	Sacramento River at Tower Bridge	02/11/01	1308	<6	<11	<15	<4	<10	<11	<23
	Replicate samples									
18	Feather River below Star Bend	02/13/01	1131	<6	<11	<15	<4	<10	<11	<23
21	Sacramento River at Tower Bridge	01/29/01	1101	<6	<11	<15	17	<10	<11	<23
21	Sacramento River at Tower Bridge	02/11/01	1301	<6	<11	<15	<4	<10	<11	<23
8	Sacramento River at Colusa	01/26/01	0941	<6	<11	<15	<4	<10	<11	<23
8	Sacramento River at Colusa	02/14/01	1001	<6	<11	<15	<4	<10	<11	<23
20	Sacramento River at Alamar	01/25/01	1111	<6	<11	<15	E3	<10	<11	<23
20	Sacramento River at Alamar	02/10/01	1051	<6	<11	<15	6	<10	<11	<23

Appendix 1. Table 4. Pesticide concentrations in blank and replicate samples from sites in the Sacramento River Basin, California, analyzed by the U.S. Geological Survey National Water Quality Laboratory—*Continued.*

Site no.	Site name	Date	Time	Simazine (ng/L)	Tebuthiuron (ng/L)	Terbacil (ng/L)	Terbufos (ng/L)	Thiobencarb (ng/L)	Triallate (ng/L)	Trifluralin (ng/L)
Blank samples										
8	Sacramento River at Colusa	01/28/01	0948	<11	<16	<34	<17	<5	<2	<9
8	Sacramento River at Colusa	02/12/01	1048	<11	<16	<34	<17	<5	<2	<9
18	Feather River below Star Bend	01/25/01	1308	<11	<16	<34	<17	<5	<2	<9
18	Feather River below Star Bend	02/13/01	1138	<11	<16	<34	<17	<5	<2	<9
20	Sacramento River at Alamar	01/28/01	1058	<11	<16	<34	<17	<5	<2	<9
21	Sacramento River at Tower Bridge	02/11/01	1308	<11	<16	<34	<17	<5	<2	<9
Replicate samples										
18	Feather River below Star Bend	02/13/01	1131	18	<16	<34	<17	E4	<2	<9
21	Sacramento River at Tower Bridge	01/29/01	1101	69	<16	<34	<17	<5	<2	<9
21	Sacramento River at Tower Bridge	02/11/01	1301	<11	<16	<34	<17	<10	<2	<9
8	Sacramento River at Colusa	01/26/01	0941	24	<16	<34	<17	<5	<2	<9
8	Sacramento River at Colusa	02/14/01	1001	21	<16	<34	<17	<5	<2	<9
20	Sacramento River at Alamar	01/25/01	1111	E11	<16	<34	<17	10	<2	<9
20	Sacramento River at Alamar	02/10/01	1051	<11	<16	<34	<17	6	<2	<9

Appendix 1. Table 5. Pesticide recovery from spiked samples analyzed by the U.S. Geological Survey National Water Quality Laboratory.

[Spike for all analytes was 0.1 µg (microgram)]

Pesticides	Sacramento River at Colusa (site 8) recovery, in percent (2/10/01 9:30)	Sacramento River at Alamar (site 20) recovery, in percent (1/26/01 8:40)	Pesticides	Sacramento River at Colusa (site 8) recovery, in percent (2/10/01 9:30)	Sacramento River at Alamar (site 20) recovery, in percent (1/26/01 8:40)
2,6-Diethyl aniline	184	87	Methyl Parathion	67	115
Acetochlor	111	131	Metolachlor	120	131
Alachlor	109	123	Metribuzin	79	113
Alpha-BHC	75	104	Molinate	94	103
Atrazine	86	116	Napropamide	80	132
Benfluralin	55	89	*p,p*'-DDE	39	48
Butylate	97	98	Parathion	65	136
Carbaryl	276	595	Pebulate	99	100
Carbofuran	281	454	Pendimethalin	52	118
Chlorpyrifos	63	93	Permethrin	32	36
Cyanazine	87	216	Phorate	64	73
DCPA	69	114	Prometon	35	48
Desethyl Atrazine	53	81	Pronamide	81	115
Diazinon	97	111	Propachlor	94	117
Dieldrin	95	103	Propanil	73	126
Disulfoton	46	50	Propargite	86	112
EPTC	158	95	Simazine	85	121
Ethalfluralin	66	110	Tebuthiuron	87	139
Ethoprop	70	104	Terbacil	147	161
Fonofos	97	102	Terbufos	63	92
Lindane	81	109	Thiobencarb	93	117
Linuron	105	158	Triallate	97	104
Malathion	102	156	Trifluralin	52	102
Methyl Azinphos	43	264			

Appendix 2. Table 1. Diazinon and methidathion concentrations in environmental samples from the Sacramento River Basin, California, analyzed by the California Dept. of Fish and Game Water Pollution Control Laboratory.

[(1) Sample collected as part of California Dept. of Pesticide Regulation's Dormant Spray Program, no sample time given; <, less than; ng/L, nanogram per liter. All data in table available from the California Department of Pesticide Regulation]

Site no.	Site name	Date Time	Diazinon (ng/L)	Methidathion (ng/L)
1	Sacramento River at Hamilton City	02/09/01 1525	<20	<50
1	Sacramento River at Hamilton City	02/10/01 1210	<20	<50
1	Sacramento River at Hamilton City	02/11/01 1115	<20	<50
1	Sacramento River at Hamilton City	02/12/01 1050	<20	<50
1	Sacramento River at Hamilton City	02/13/01 1010	<20	<50
1	Sacramento River at Hamilton City	02/14/01 1110	<20	<50
2	Mud Creek at Chico	02/09/01 1600	48	<50
2	Mud Creek at Chico	02/10/01 1310	20	<50
3	Lindo Channel at Chico	02/09/01 1655	129	<50
3	Lindo Channel at Chico	02/10/01 1340	185	<50
4	Big Chico Creek at Chico	02/09/01 1210	24	<50
4	Big Chico Creek at Chico	02/09/01 1910	<20	<50
4	Big Chico Creek at Chico	02/10/01 0850	<20	<50
4	Big Chico Creek at Chico	02/10/01 1525	<20	<50
4	Big Chico Creek at Chico	02/11/01 0855	20	<50
4	Big Chico Creek at Chico	02/11/01 1510	<20	<50
4	Big Chico Creek at Chico	02/12/01 1445	<20	<50
4	Big Chico Creek at Chico	02/13/01 0825	<20	<50
4	Big Chico Creek at Chico	02/12/01 0835	<20	<50
5	Little Chico Creek	02/09/01 1335	133	<50
5	Little Chico Creek	02/10/01 1450	20	<50
6	Big Chico Creek at River Rd.	02/09/01 0920	<20	<50
6	Big Chico Creek at River Rd.	02/09/01 1755	62	<50
6	Big Chico Creek at River Rd.	02/10/01 1020	<20	<50
6	Big Chico Creek at River Rd.	02/10/01 1600	22	<50
6	Big Chico Creek at River Rd.	02/11/01 0945	<20	<50
6	Big Chico Creek at River Rd.	02/11/01 1725	<20	<50
6	Big Chico Creek at River Rd.	02/12/01 0920	<20	<50
6	Big Chico Creek at River Rd.	02/12/01 1515	<20	<50
6	Big Chico Creek at River Rd.	02/13/01 0900	<20	<50
7	Stony Creek at Highway 45	02/09/01 1055	21	<50
7	Stony Creek at Highway 45	02/10/01 1120	<20	<50
8	Sacramento River at Colusa	01/24/01 1020	19	<50
8	Sacramento River at Colusa	01/25/01 0944	<20	<50

Appendix 2. Table 1. Diazinon and methidathion concentrations in environmental samples from the Sacramento River Basin, California, analyzed by the California Dept. of Fish and Game Water Pollution Control Laboratory—*Continued.*

Site no.	Site name	Date Time	Diazinon (ng/L)	Methidathion (ng/L)
8	Sacramento River at Colusa	01/26/01 0940	34	<50
8	Sacramento River at Colusa	01/27/01 1040	32	<50
8	Sacramento River at Colusa	01/28/01 1020	25	<50
8	Sacramento River at Colusa	02/10/01 1020	<20	<50
8	Sacramento River at Colusa	02/11/01 1045	<20	<50
8	Sacramento River at Colusa	02/12/01 1045	20	<50
8	Sacramento River at Colusa	02/13/01 1030	<20	<50
8	Sacramento River at Colusa	02/14/01 1000	<20	<50
9	Butte Creek at Gridley Road	01/24/01 1155	47	<50
9	Butte Creek at Gridley Road	01/24/01 2100	58	<50
9	Butte Creek at Gridley Road	01/25/01 1025	45	<50
9	Butte Creek at Gridley Road	01/25/01 1445	49	<50
9	Butte Creek at Gridley Road	01/25/01 1800	45	<50
9	Butte Creek at Gridley Road	01/25/01 2200	41	<50
9	Butte Creek at Gridley Road	01/26/01 0200	46	<50
9	Butte Creek at Gridley Road	01/26/01 0620	43	<50
9	Butte Creek at Gridley Road	01/26/01 1010	39	<50
9	Butte Creek at Gridley Road	01/26/01 1410	44	<50
9	Butte Creek at Gridley Road	01/26/01 1800	48	<50
9	Butte Creek at Gridley Road	01/26/01 2200	43	<50
9	Butte Creek at Gridley Road	01/27/01 0000	55	<50
9	Butte Creek at Gridley Road	01/27/01 0200	47	<50
9	Butte Creek at Gridley Road	01/27/01 0625	40	<50
9	Butte Creek at Gridley Road	01/27/01 1205	59	<50
9	Butte Creek at Gridley Road	01/27/01 1800	60	<50
9	Butte Creek at Gridley Road	01/28/01 0745	55	<50
9	Butte Creek at Gridley Road	02/09/01 1225	32	<50
9	Butte Creek at Gridley Road	02/09/01 1815	28	<50
9	Butte Creek at Gridley Road	02/09/01 2217	28	<50
9	Butte Creek at Gridley Road	02/10/01 0220	26	<50
9	Butte Creek at Gridley Road	02/10/01 0615	28	<50
9	Butte Creek at Gridley Road	02/10/01 1030	24	<50
9	Butte Creek at Gridley Road	02/10/01 1525	23	<50
9	Butte Creek at Gridley Road	02/10/01 1855	22	<50
9	Butte Creek at Gridley Road	02/10/01 2205	22	<50
9	Butte Creek at Gridley Road	02/11/01 0210	25	<50

Appendix 2. Table 1. Diazinon and methidathion concentrations in environmental samples from the Sacramento River Basin, California, analyzed by the California Dept. of Fish and Game Water Pollution Control Laboratory—*Continued.*

Site no.	Site name	Date Time	Diazinon (ng/L)	Methidathion (ng/L)
9	Butte Creek at Gridley Road	02/11/01 0610	20	<50
9	Butte Creek at Gridley Road	02/11/01 1015	23	<50
9	Butte Creek at Gridley Road	02/11/01 1405	24	<50
9	Butte Creek at Gridley Road	02/11/01 2205	<20	<50
9	Butte Creek at Gridley Road	02/12/01 0005	<20	<50
9	Butte Creek at Gridley Road	02/12/01 0210	<20	<50
9	Butte Creek at Gridley Road	02/12/01 0620	<20	<50
9	Butte Creek at Gridley Road	02/12/01 1130	20	<50
9	Butte Creek at Gridley Road	02/12/01 1430	20	<50
9	Butte Creek at Gridley Road	02/12/01 1815	<20	<50
9	Butte Creek at Gridley Road	02/13/01 1030	21	<50
9	Butte Creek at Gridley Road	2/11/01 1800	20	<50
10	Main Canal at Gridley Road	01/24/01 1220	92	<50
10	Main Drainage Canal at Gridley Road	01/24/01 2135	69	<50
10	Main Drainage Canal at Gridley Road	01/25/01 1045	68	<50
10	Main Drainage Canal at Gridley Road	01/25/01 1510	63	<50
10	Main Drainage Canal at Gridley Road	01/25/01 1830	67	<50
10	Main Drainage Canal at Gridley Road	01/25/01 2230	101	<50
10	Main Drainage Canal at Gridley Road	01/26/01 0230	96	<50
10	Main Drainage Canal at Gridley Road	01/26/01 0635	93	<50
10	Main Drainage Canal at Gridley Road	01/26/01 1025	79	<50
10	Main Drainage Canal at Gridley Road	01/26/01 1440	68	<50
10	Main Drainage Canal at Gridley Road	01/26/01 1830	63	<50
10	Main Drainage Canal at Gridley Road	01/26/01 2230	65	<50
10	Main Drainage Canal at Gridley Road	01/27/01 0030	53	<50
10	Main Drainage Canal at Gridley Road	01/27/01 0230	55	<50
10	Main Drainage Canal at Gridley Road	01/27/01 0650	61	<50
10	Main Drainage Canal at Gridley Road	01/27/01 1240	53	<50
10	Main Drainage Canal at Gridley Road	01/27/01 1830	57	<50
10	Main Drainage Canal at Gridley Road	01/28/01 0810	49	<50
10	Main Drainage Canal at Gridley Road	02/09/01 1250	20	<50
10	Main Drainage Canal at Gridley Road	02/09/01 1836	23	<50
10	Main Drainage Canal at Gridley Road	02/09/01 2240	101	<50
10	Main Drainage Canal at Gridley Road	02/10/01 0238	83	<50
10	Main Drainage Canal at Gridley Road	02/10/01 0635	61	<50
10	Main Drainage Canal at Gridley Road	02/10/01 1055	51	<50

Appendix 2. Table 1. Diazinon and methidathion concentrations in environmental samples from the Sacramento River Basin, California, analyzed by the California Dept. of Fish and Game Water Pollution Control Laboratory—*Continued.*

Site no.	Site name	Date Time	Diazinon (ng/L)	Methidathion (ng/L)
10	Main Drainage Canal at Gridley Road	02/10/01 1540	47	<50
10	Main Drainage Canal at Gridley Road	02/10/01 1910	44	<50
10	Main Drainage Canal at Gridley Road	02/10/01 2220	54	<50
10	Main Drainage Canal at Gridley Road	02/11/01 0220	92	<50
10	Main Drainage Canal at Gridley Road	02/11/01 0700	91	4720
10	Main Drainage Canal at Gridley Road	02/11/01 1030	95	3810
10	Main Drainage Canal at Gridley Road	02/11/01 1430	175	2580
10	Main Drainage Canal at Gridley Road	02/11/01 1815	134	2180
10	Main Drainage Canal at Gridley Road	02/11/01 2220	101	2220
10	Main Drainage Canal at Gridley Road	02/12/01 0015	83	920
10	Main Drainage Canal at Gridley Road	02/12/01 0220	97	2000
10	Main Drainage Canal at Gridley Road	02/12/01 0640	89	1030
10	Main Drainage Canal at Gridley Road	02/12/01 1200	101	698
10	Main Drainage Canal at Gridley Road	02/12/01 1440	104	829
10	Main Drainage Canal at Gridley Road	02/12/01 1830	75	1100
10	Main Drainage Canal at Gridley Road	02/13/01 1045	47	465
11	Butte Slough at Lower Pass Road	01/24/01 1144	<20	<50
11	Butte Slough at Lower Pass Road	01/25/01 1125	28	<50
11	Butte Slough at Lower Pass Road	01/26/01 1120	32	<50
11	Butte Slough at Lower Pass Road	01/27/01 1120	40	<50
11	Butte Slough at Lower Pass Road	01/28/01 1115	53	<50
11	Butte Slough at Lower Pass Road	02/09/01 1200	30	<50
11	Butte Slough at Lower Pass Road	02/10/01 1120	36	<50
11	Butte Slough at Lower Pass Road	02/11/01 1135	38	<50
11	Butte Slough at Lower Pass Road	02/12/01 1115	27	<50
11	Butte Slough at Lower Pass Road	02/13/01 1115	20	<50
11	Butte Slough at Lower Pass Road	02/14/01 1115	25	<50
12	Wadsworth canal at South Butte Road	01/24/01 2240	171	<50
12	Wadsworth canal at South Butte Road	01/25/01 1140	101	<50
12	Wadsworth canal at South Butte Road	01/25/01 1900	140	<50
12	Wadsworth canal at South Butte Road	01/25/01 2300	277	<50
12	Wadsworth canal at South Butte Road	01/26/01 0300	210	<50
12	Wadsworth canal at South Butte Road	01/26/01 0730	200	<50
12	Wadsworth canal at South Butte Road	01/26/01 1245	352	<50
12	Wadsworth canal at South Butte Road	01/26/01 1650	345	<50
12	Wadsworth canal at South Butte Road	01/26/01 1900	433	<50

Appendix 2. Table 1. Diazinon and methidathion concentrations in environmental samples from the Sacramento River Basin, California, analyzed by the California Dept. of Fish and Game Water Pollution Control Laboratory—*Continued.*

Site no.	Site name	Date Time	Diazinon (ng/L)	Methidathion (ng/L)
12	Wadsworth canal at South Butte Road	01/26/01 2300	355	<50
12	Wadsworth canal at South Butte Road	01/27/01 0300	256	<50
12	Wadsworth canal at South Butte Road	01/27/01 0740	232	<50
12	Wadsworth canal at South Butte Road	01/27/01 1505	221	<50
12	Wadsworth canal at South Butte Road	01/27/01 1900	146	<50
12	Wadsworth canal at South Butte Road	01/28/01 0100	161	<50
12	Wadsworth canal at South Butte Road	01/28/01 1025	109	<50
12	Wadsworth canal at South Butte Road	02/09/01 1605	38	<50
12	Wadsworth canal at South Butte Road	02/09/01 1920	61	<50
12	Wadsworth canal at South Butte Road	02/09/01 2320	358	<50
12	Wadsworth canal at South Butte Road	02/10/01 0320	207	<50
12	Wadsworth canal at South Butte Road	02/10/01 0735	1380	<50
12	Wadsworth canal at South Butte Road	02/10/01 1410	513	<50
12	Wadsworth canal at South Butte Road	02/10/01 2000	872	<50
12	Wadsworth canal at South Butte Road	02/10/01 2300	630	<50
12	Wadsworth canal at South Butte Road	02/11/01 0300	453	<50
12	Wadsworth canal at South Butte Road	02/11/01 0825	418	<50
12	Wadsworth canal at South Butte Road	02/11/01 1300	770	<50
12	Wadsworth canal at South Butte Road	02/11/01 1900	829	50
12	Wadsworth canal at South Butte Road	02/11/01 2300	323	<50
12	Wadsworth canal at South Butte Road	02/12/01 0055	368	<50
12	Wadsworth canal at South Butte Road	02/12/01 0305	381	<50
12	Wadsworth canal at South Butte Road	02/12/01 0725	293	<50
12	Wadsworth canal at South Butte Road	02/12/01 1520	322	<50
12	Wadsworth canal at South Butte Road	02/12/01 1915	419	<50
12	Wadsworth canal at South Butte Road	02/13/01 0930	292	<50
13	DWR Pumping Plant 2, North	01/24/01 1230	86	<50
13	DWR Pumping Plant 2, North	01/25/01 1240	80	<50
13	DWR Pumping Plant 2, North	01/26/01 1300	70	<50
13	DWR Pumping Plant 2, North	01/27/01 1300	63	<50
13	DWR Pumping Plant 2, North	01/28/01 1230	78	<50
13	DWR Pumping Plant 2, North	02/09/01 1310	24	<50
13	DWR Pumping Plant 2, North	02/10/01 1239	25	<50
13	DWR Pumping Plant 2, North	02/11/01 1217	38	<50
13	DWR Pumping Plant 2, North	02/12/01 1240	61	<50
13	DWR Pumping Plant 2, North	02/13/01 1245	38	<50

Appendix 2. Table 1. Diazinon and methidathion concentrations in environmental samples from the Sacramento River Basin, California, analyzed by the California Dept. of Fish and Game Water Pollution Control Laboratory—*Continued.*

Site no.	Site name	Date Time	Diazinon (ng/L)	Methidathion (ng/L)
14	DWR Pumping Plant 1	01/24/01 1140	171	<50
14	DWR Pumping Plant 2, South	01/24/01 1245	32	<50
14	DWR Pumping Plant 1	01/25/01 1210	275	<50
14	DWR Pumping Plant 2, South	01/25/01 1255	55	179
14	DWR Pumping Plant 2, South	01/26/01 1315	50	80
14	DWR Pumping Plant 1	01/26/01 1413	355	<50
14	DWR Pumping Plant 1	01/27/01 1210	156	69
14	DWR Pumping Plant 2, South	01/27/01 1245	135	956
14	DWR Pumping Plant 1	01/28/01 1140	191	<50
14	DWR Pumping Plant 2, South	01/28/01 1240	255	156
14	DWR Pumping Plant 1	02/09/01 1210	111	<50
14	DWR Pumping Plant 2, South	02/09/01 1250	<20	<50
14	DWR Pumping Plant 1	02/10/01 1055	125	<50
14	DWR Pumping Plant 2, South	02/10/01 1222	58	<50
14	DWR Pumping Plant 1	02/11/01 1130	141	<50
14	DWR Pumping Plant 2, South	02/11/01 1203	143	<50
14	DWR Pumping Plant 2, South	02/12/01 1250	31	<50
14	DWR Pumping Plant 2, South	02/13/01 1254	31	370
14	DWR Pumping Plant 1	2/12/01 1200	107	<50
14	DWR Pumping Plant 1	2/13/01 1209	75	<50
16	Jack Slough near Doc Adams Road	01/24/01 1400	103	<50
16	Jack Slough near Doc Adams Road	01/25/01 1400	95	<50
16	Jack Slough near Doc Adams Road	01/26/01 1320	69	<50
16	Jack Slough near Doc Adams Road	01/27/01 1315	86	<50
16	Jack Slough near Doc Adams Road	01/28/01 1255	105	<50
16	Jack Slough near Doc Adams Road	02/09/01 1315	96	<50
16	Jack Slough near Doc Adams Road	02/10/01 1245	86	<50
16	Jack Slough near Doc Adams Road	02/11/01 1245	102	<50
16	Jack Slough near Doc Adams Road	02/12/01 1300	66	<50
16	Jack Slough near Doc Adams Road	02/13/01 1230	68	<50
16	Jack Slough near Doc Adams Road	02/14/01 1220	53	<50
17	Feather River near Yuba City	01/24/01 1342	18	<50
17	Feather River near Yuba City	01/25/01 1325	<20	<50
17	Feather River near Yuba City	01/26/01 1240	<20	<50
17	Feather River near Yuba City	01/27/01 1240	<20	<50
17	Feather River near Yuba City	01/28/01 1230	<20	<50

Appendix 2. Table 1. Diazinon and methidathion concentrations in environmental samples from the Sacramento River Basin, California, analyzed by the California Dept. of Fish and Game Water Pollution Control Laboratory—*Continued.*

Site no.	Site name	Date Time	Diazinon (ng/L)	Methidathion (ng/L)
17	Feather River near Yuba City	02/10/01 1210	<20	<50
17	Feather River near Yuba City	02/11/01 1210	<20	<50
17	Feather River near Yuba City	02/12/01 1230	<20	<50
17	Feather River near Yuba City	02/13/01 1200	<20	<50
17	Feather River near Yuba City	02/14/01 1150	20	<50
18	Feather River at Star Bend	01/24/01 1520	24	<50
18	Feather River at Star Bend	01/25/01 1300	<20	<50
18	Feather River at Star Bend	01/26/01 1400	22	<50
18	Feather River at Star Bend	01/27/01 1330	<20	<50
18	Feather River at Star Bend	01/28/01 1230	<20	<50
18	Feather River at Star Bend	02/10/01 1300	<20	<50
18	Feather River at Star Bend	02/11/01 1300	<20	<50
18	Feather River at Star Bend	2/12/01 1300	<20	<50
18	Feather River at Star Bend	2/13/01 1130	<20	<50
18	Feather River at Star Bend	2/14/01 1040	<20	<50
19	Bear River near Berry Road	01/24/01 1720	55	<50
19	Bear River near Berry Road	01/25/01 0930	48	<50
19	Bear River near Berry Road	01/26/01 1120	54	<50
19	Bear River near Berry Road	01/27/01 1030	55	<50
19	Bear River near Berry Road	01/28/01 1000	40	<50
19	Bear River near Berry Road	02/09/01 1050	50	<50
19	Bear River near Berry Road	02/10/01 1030	42	<50
19	Bear River near Berry Road	02/11/01 1030	26	<50
19	Bear River near Berry Road	02/12/01 1100	43	<50
19	Bear River near Berry Road	02/13/01 1000	33	<50
20	Sacramento River at Alamar	01/24/01 (1)	<20	<50
20	Sacramento River at Alamar	01/25/01 1115	28	<50
20	Sacramento River at Alamar	01/26/01 (1)	<20	<50
20	Sacramento River at Alamar	01/27/01 1115	41	<50
20	Sacramento River at Alamar	01/28/01 1053	69	<50
20	Sacramento River at Alamar	01/29/01 (1)	48	<50
20	Sacramento River at Alamar	02/09/01 (1)	<20	<50
20	Sacramento River at Alamar	02/10/01 1050	<20	<50
20	Sacramento River at Alamar	2/11/01 1100	<20	<50
20	Sacramento River at Alamar	2/12/01 1115	20	<50
20	Sacramento River at Alamar	2/13/01 1115	<20	<50

Appendix 2. Table 2. Pesticide concentrations in environmental samples from the Sacramento River Basin, California, and surrogate recovery analyzed by the U.S. Geological Survey National Water Quality Laboratory.

[<, less than; E, estimated value; ng/L, nanogram per liter; USGS station identification numbers: Sacramento River at Colusa, 11389500; Feather River below Star Bend 390020121344201; Sacramento River at Alamar, 384030121373601; Sacramento River at Tower Bridge, 383430121302001]

Site no.	Site name	Date	Time	2,6-Diethyl aniline (ng/L)	Acetochlor (ng/L)	Alachlor (ng/L)	Alpha-BHC (ng/L)	Atrazine (ng/L)	Benfluralin (ng/L)	Butylate (ng/L)
8	Sacramento River at Colusa	1/24/01	0940	<2	<4	<2	<5	<7	<10	<2
8	Sacramento River at Colusa	1/25/01	1020	<2	<4	<2	<5	<7	<10	<2
8	Sacramento River at Colusa	1/26/01	0940	<2	<4	<2	<5	<7	<10	<2
8	Sacramento River at Colusa	1/27/01	1040	<2	<4	<2	<5	E3	<10	<2
8	Sacramento River at Colusa	1/28/01	0940	<2	<4	<2	<5	<7	<10	<2
8	Sacramento River at Colusa	2/10/01	0930	<2	<4	<2	<5	<7	<10	<2
8	Sacramento River at Colusa	2/11/01	1040	<2	<4	<2	<5	<7	<10	<2
8	Sacramento River at Colusa	2/12/01	1040	<2	<4	<2	<5	<7	<10	<2
8	Sacramento River at Colusa	2/13/01	0930	<2	<4	<2	<5	<7	<10	<2
8	Sacramento River at Colusa	2/14/01	1000	<2	<4	<2	<5	<7	<10	<2
18	Feather River Below Star Bend	1/24/01	1520	<2	<4	<2	<5	<7	<10	<2
18	Feather River Below Star Bend	1/25/01	1300	<2	<4	<2	<5	<7	<10	<2
18	Feather River Below Star Bend	1/26/01	1400	<2	<4	<2	<5	<7	<10	<2
18	Feather River Below Star Bend	1/27/01	1330	<2	<4	<2	<5	E3	<10	<2
18	Feather River Below Star Bend	1/28/01	1230	<2	<4	<2	<5	E2	<10	<2
18	Feather River Below Star Bend	2/10/01	1300	<2	<4	<2	<5	<7	<10	<2
18	Feather River Below Star Bend	2/11/01	1330	<2	<4	<2	<5	<7	<10	<2
18	Feather River Below Star Bend	2/12/01	1300	<2	<4	<2	<5	<7	<10	<2
18	Feather River Below Star Bend	2/13/01	1130	<2	<4	<2	<5	<7	<10	<2
18	Feather River Below Star Bend	2/14/01	1040	<2	<4	<2	<5	<7	<10	<2
20	Sacramento River at Alamar	1/24/01	1010	<2	<4	<2	<5	<7	<10	<2
20	Sacramento River at Alamar	1/25/01	1110	<2	<4	<2	<5	<7	<10	<2
20	Sacramento River at Alamar	1/26/01	0840	<2	<4	<2	<5	E1	<10	<2
20	Sacramento River at Alamar	1/27/01	1110	<2	<4	<2	<5	<7	<10	<2
20	Sacramento River at Alamar	1/28/01	1050	<2	<4	<2	<5	<7	<10	<2
20	Sacramento River at Alamar	2/9/01	0930	<2	<4	<2	<5	<7	<10	<2
20	Sacramento River at Alamar	2/10/01	1050	<2	<4	<2	<5	<7	<10	<2
20	Sacramento River at Alamar	2/11/01	1030	<2	<4	<2	<5	<7	<10	<2
20	Sacramento River at Alamar	2/12/01	1040	<2	<4	<2	<5	<7	<10	<2
20	Sacramento River at Alamar	2/13/01	1110	<2	<4	<2	<5	<7	<10	<2
20	Sacramento River at Alamar	2/14/01	1010	<2	<4	<2	<5	<7	<10	<2
21	Sacramento River at Tower Bridge	1/25/01	0900	<2	<4	<2	<5	<7	<10	<2
21	Sacramento River at Tower Bridge	1/26/01	1100	<2	<4	<2	<5	<7	<10	<2
21	Sacramento River at Tower Bridge	1/27/01	1100	<2	<4	<2	<5	<7	<10	<2
21	Sacramento River at Tower Bridge	1/28/01	0800	<2	<4	<2	<5	<7	<10	<2
21	Sacramento River at Tower Bridge	1/29/01	1100	<2	<4	<2	<5	<7	<10	<2
21	Sacramento River at Tower Bridge	1/31/01	1130	<2	<4	<2	<5	<7	<10	<2
21	Sacramento River at Tower Bridge	2/10/01	1600	<2	<4	<2	<5	<7	<10	<2
21	Sacramento River at Tower Bridge	2/11/01	1300	<2	<4	<2	<5	<7	<10	<2
21	Sacramento River at Tower Bridge	2/12/01	1300	<2	<4	<2	<5	<7	<10	<2
21	Sacramento River at Tower Bridge	2/13/01	1330	<2	<4	<2	<5	<7	<10	<2
21	Sacramento River at Tower Bridge	2/14/01	1400	<2	<4	<2	<5	<7	<10	<2
21	Sacramento River at Tower Bridge	2/16/01	1230	<2	<4	<2	<5	<7	<10	<2

Appendix 2. Table 2. Pesticide concentrations in environmental samples from the Sacramento River Basin, California, and surrogate recovery analyzed by the U.S. Geological Survey National Water Quality Laboratory—*Continued.*

Site no.	Site name	Date	Time	Carbaryl (ng/L)	Carbofuran (ng/L)	Chlorpyrifos (ng/L)	Cyanazine (ng/L)	DCPA (ng/L)	Desethyl atrazine (ng/L)	Diazinon surrogate (percent)
8	Sacramento River at Colusa	1/24/01	0940	<41	<20	<5	<.018	<3	<6	98
8	Sacramento River at Colusa	1/25/01	1020	<41	<20	<5	<.018	<3	<6	101
8	Sacramento River at Colusa	1/26/01	0940	<41	<20	<5	<.018	<3	<6	97
8	Sacramento River at Colusa	1/27/01	1040	<41	<20	<5	<.018	<3	<6	122
8	Sacramento River at Colusa	1/28/01	0940	<41	<20	<5	<.018	<3	<6	79
8	Sacramento River at Colusa	2/10/01	0930	<41	<20	<5	<.018	<3	<6	89
8	Sacramento River at Colusa	2/11/01	1040	<41	<20	<5	<.018	<3	<6	94
8	Sacramento River at Colusa	2/12/01	1040	<41	<20	<5	<.018	<3	<6	101
8	Sacramento River at Colusa	2/13/01	0930	<41	<20	<5	<.018	<3	<6	104
8	Sacramento River at Colusa	2/14/01	1000	<41	<20	<5	<.018	<3	<6	99
18	Feather River Below Star Bend	1/24/01	1520	<41	<20	<5	<.018	<3	<6	102
18	Feather River Below Star Bend	1/25/01	1300	E4	<20	<5	<.018	<3	<6	103
18	Feather River Below Star Bend	1/26/01	1400	<40	<20	E2	<.018	<3	<6	111
18	Feather River Below Star Bend	1/27/01	1330	<41	<20	E2	<.018	<3	<6	113
18	Feather River Below Star Bend	1/28/01	1230	<41	<20	<5	<.018	<3	<6	111
18	Feather River Below Star Bend	2/10/01	1300	<41	<20	<5	<.018	<3	<6	86
18	Feather River Below Star Bend	2/11/01	1330	<41	<20	<5	<.018	<3	<6	98
18	Feather River Below Star Bend	2/12/01	1300	<41	<20	<5	<.018	<3	<6	102
18	Feather River Below Star Bend	2/13/01	1130	<41	<20	<5	<.018	<3	<6	105
18	Feather River Below Star Bend	2/14/01	1040	<41	E9	<5	<.018	<3	<6	131
20	Sacramento River at Alamar	1/24/01	1010	E4	E6	<5	<.018	<3	<6	101
20	Sacramento River at Alamar	1/25/01	1110	E4	E6	<5	<.018	<3	<6	104
20	Sacramento River at Alamar	1/26/01	0840	E21	<20	E2	<.018	<3	<6	60
20	Sacramento River at Alamar	1/27/01	1110	E34	<20	E2	<.018	<3	<6	87
20	Sacramento River at Alamar	1/28/01	1050	E4	<20	<5	<.018	<3	<6	101
20	Sacramento River at Alamar	2/9/01	0930	<41	<20	<5	<.018	<3	<6	96
20	Sacramento River at Alamar	2/10/01	1050	<41	<20	<5	<.018	<3	<6	97
20	Sacramento River at Alamar	2/11/01	1030	E3	E7	<5	<.018	<3	<6	108
20	Sacramento River at Alamar	2/12/01	1040	<41	<20	<5	<.018	<3	<6	98
20	Sacramento River at Alamar	2/13/01	1110	E3	<20	<5	<.018	<3	<6	101
20	Sacramento River at Alamar	2/14/01	1010	E3	E5	<5	<.018	<3	<6	107
21	Sacramento River at Tower Bridge	1/25/01	0900	E4	E7	<5	<.018	<3	<6	97
21	Sacramento River at Tower Bridge	1/26/01	1100	E4	<20	<5	<.018	<3	<6	101
21	Sacramento River at Tower Bridge	1/27/01	1100	<41	<20	<5	<.018	<3	<6	97
21	Sacramento River at Tower Bridge	1/28/01	0800	<41	<20	<5	<.018	<3	<6	90
21	Sacramento River at Tower Bridge	1/29/01	1100	<41	<20	<5	<.018	<3	<6	95
21	Sacramento River at Tower Bridge	1/31/01	1130	<41	<20	<5	<.018	<3	<6	128
21	Sacramento River at Tower Bridge	2/10/01	1600	<41	<20	<5	<.018	<3	<6	91
21	Sacramento River at Tower Bridge	2/11/01	1300	<41	<20	<5	<.018	<3	<6	101
21	Sacramento River at Tower Bridge	2/12/01	1300	<41	<20	<5	<.018	<3	<6	97
21	Sacramento River at Tower Bridge	2/13/01	1330	<41	<20	<5	<.018	<3	<6	112
21	Sacramento River at Tower Bridge	2/14/01	1400	<41	<20	<5	<.018	<3	<6	111
21	Sacramento River at Tower Bridge	2/16/01	1230	E4	<20	<5	<.018	<3	<6	121

Appendix 2. Table 2. Pesticide concentrations in environmental samples from the Sacramento River Basin, California, and surrogate recovery analyzed by the U.S. Geological Survey National Water Quality Laboratory—*Continued.*

Site no.	Site name	Date	Time	Diazinon (ng/L)	Dieldrin (ng/L)	Disulfoton (ng/L)	EPTC (ng/L)	Ethalfluralin (ng/L)	Ethoprop (ng/L)	Fonofos (ng/L)
8	Sacramento River at Colusa	1/24/01	0940	12	<5	<.021	<2	<9	<5	<3
8	Sacramento River at Colusa	1/25/01	1020	16	<5	<.021	<2	<9	<5	<3
8	Sacramento River at Colusa	1/26/01	0940	36	<5	<.021	<2	<9	<5	<3
8	Sacramento River at Colusa	1/27/01	1040	53	<5	<.021	<2	<9	<5	<3
8	Sacramento River at Colusa	1/28/01	0940	27	<5	<.021	<2	<9	<5	<3
8	Sacramento River at Colusa	2/10/01	0930	<5	<5	<.021	<2	<9	<5	<3
8	Sacramento River at Colusa	2/11/01	1040	7	<5	<.021	<2	<9	<5	<3
8	Sacramento River at Colusa	2/12/01	1040	15	<5	<.021	<2	<9	<5	<3
8	Sacramento River at Colusa	2/13/01	0930	9	<5	<.021	<2	<9	<5	<3
8	Sacramento River at Colusa	2/14/01	1000	10	<5	<.021	<2	<9	<5	<3
18	Feather River Below Star Bend	1/24/01	1520	31	<5	<.021	<2	<9	<5	<3
18	Feather River Below Star Bend	1/25/01	1300	15	<5	<.021	<2	<9	<5	<3
18	Feather River Below Star Bend	1/26/01	1400	26	<5	<.021	<2	<9	<5	<3
18	Feather River Below Star Bend	1/27/01	1330	15	<5	<.021	<2	<9	<5	<3
18	Feather River Below Star Bend	1/28/01	1230	9	<5	<.021	<2	<9	<5	<3
18	Feather River Below Star Bend	2/10/01	1300	15	<5	<.021	<2	<9	<5	<3
18	Feather River Below Star Bend	2/11/01	1330	12	<5	<.021	<2	<9	<5	<3
18	Feather River Below Star Bend	2/12/01	1300	13	<5	<.021	<2	<9	<5	<3
18	Feather River Below Star Bend	2/13/01	1130	14	<5	<.021	<2	<9	<5	<3
18	Feather River Below Star Bend	2/14/01	1040	24	<5	<.021	<2	<9	<5	<3
20	Sacramento River at Alamar	1/24/01	1010	20	<5	<.021	<2	<9	<5	<3
20	Sacramento River at Alamar	1/25/01	1110	24	<5	<.021	<2	<9	E5	<3
20	Sacramento River at Alamar	1/26/01	0840	16	<5	<.021	<2	<9	<5	<3
20	Sacramento River at Alamar	1/27/01	1110	37	<5	<.021	<2	<9	<5	<3
20	Sacramento River at Alamar	1/28/01	1050	84	<5	<.021	<2	<9	<5	<3
20	Sacramento River at Alamar	2/9/01	0930	13	<5	<.021	<2	<9	<5	<3
20	Sacramento River at Alamar	2/10/01	1050	13	<5	<.021	<2	<9	<5	<3
20	Sacramento River at Alamar	2/11/01	1030	17	<5	<.021	<2	<9	<5	<3
20	Sacramento River at Alamar	2/12/01	1040	21	<5	<.021	<2	<9	<5	<3
20	Sacramento River at Alamar	2/13/01	1110	21	<5	<.021	<2	<9	<5	<3
20	Sacramento River at Alamar	2/14/01	1010	27	<5	<.021	<2	<9	<5	<3
21	Sacramento River at Tower Bridge	1/25/01	0900	18	<5	<.021	<2	<9	<5	<3
21	Sacramento River at Tower Bridge	1/26/01	1100	20	<5	<.021	<2	<9	<5	<3
21	Sacramento River at Tower Bridge	1/27/01	1100	45	<5	<.021	<2	<9	<5	<3
21	Sacramento River at Tower Bridge	1/28/01	0800	96	<5	<.021	<2	<9	<5	<3
21	Sacramento River at Tower Bridge	1/29/01	1100	61	<5	<.021	<2	<9	<5	<3
21	Sacramento River at Tower Bridge	1/31/01	1130	30	<5	<.021	<2	<9	<5	<3
21	Sacramento River at Tower Bridge	2/10/01	1600	9	<5	<.021	<2	<9	<5	<3
21	Sacramento River at Tower Bridge	2/11/01	1300	11	<5	<.021	<2	<9	<5	<3
21	Sacramento River at Tower Bridge	2/12/01	1300	14	<5	<.021	<2	<9	<5	<3
21	Sacramento River at Tower Bridge	2/13/01	1330	16	<5	<.021	<2	<9	<5	<3
21	Sacramento River at Tower Bridge	2/14/01	1400	28	<5	<.021	<2	<9	<5	<3
21	Sacramento River at Tower Bridge	2/16/01	1230	18	<5	<.021	<2	<9	<5	<3

Appendix 2. Table 2. Pesticide concentrations in environmental samples from the Sacramento River Basin, California, and surrogate recovery analyzed by the U.S. Geological Survey National Water Quality Laboratory—*Continued.*

Site no.	Site name	Date	Time	alpha D6 HCH (percent)	Lindane (ng/L)	Linuron (ng/L)	Malathion (ng/L)	Methyl azinphos (ng/L)	Methyl parathion (ng/L)	Metolachlor (ng/L)
8	Sacramento River at Colusa	1/24/01	0940	97	<4	<35	<27	<50	<6	<13
8	Sacramento River at Colusa	1/25/01	1020	103	<4	<35	<27	<50	<6	<13
8	Sacramento River at Colusa	1/26/01	0940	85	<4	<35	<27	<50	<6	E4
8	Sacramento River at Colusa	1/27/01	1040	122	<4	<35	<27	<50	<6	<13
8	Sacramento River at Colusa	1/28/01	0940	69	<4	<35	<27	<50	<6	<13
8	Sacramento River at Colusa	2/10/01	0930	70	<4	<35	<27	<50	<6	<13
8	Sacramento River at Colusa	2/11/01	1040	79	<4	<35	<27	<50	<6	<13
8	Sacramento River at Colusa	2/12/01	1040	77	<4	<35	<27	<50	<6	<13
8	Sacramento River at Colusa	2/13/01	0930	99	<4	<35	<27	<50	<6	<13
8	Sacramento River at Colusa	2/14/01	1000	114	<4	<35	<27	<50	<6	<13
18	Feather River Below Star Bend	1/24/01	1520	106	<4	<35	<27	<50	<6	<13
18	Feather River Below Star Bend	1/25/01	1300	100	<4	<35	<27	<50	<6	<13
18	Feather River Below Star Bend	1/26/01	1400	108	<4	<35	<27	<50	<6	<13
18	Feather River Below Star Bend	1/27/01	1330	108	<4	<35	<27	<50	<6	<13
18	Feather River Below Star Bend	1/28/01	1230	106	<4	<35	<27	<50	<6	<13
18	Feather River Below Star Bend	2/10/01	1300	75	<4	<35	<27	<50	<6	<13
18	Feather River Below Star Bend	2/11/01	1330	84	<4	<35	<27	<50	<6	<13
18	Feather River Below Star Bend	2/12/01	1300	80	<4	<35	<27	<50	<6	<13
18	Feather River Below Star Bend	2/13/01	1130	111	<4	<35	<27	<50	<6	<13
18	Feather River Below Star Bend	2/14/01	1040	182	<4	<35	<27	<50	<6	<13
20	Sacramento River at Alamar	1/24/01	1010	100	<4	<35	<27	<50	<6	E1
20	Sacramento River at Alamar	1/25/01	1110	103	<4	<35	<27	<50	<6	E1
20	Sacramento River at Alamar	1/26/01	0840	60	<4	<35	<27	<50	<6	E5
20	Sacramento River at Alamar	1/27/01	1110	84	<4	<35	<27	<50	<6	E5
20	Sacramento River at Alamar	1/28/01	1050	99	<4	<35	<27	<50	<6	E3
20	Sacramento River at Alamar	2/9/01	0930	76	<4	<35	<27	<50	<6	<13
20	Sacramento River at Alamar	2/10/01	1050	66	<4	<35	<27	<50	<6	<13
20	Sacramento River at Alamar	2/11/01	1030	107	<4	<35	<27	<50	<6	E2
20	Sacramento River at Alamar	2/12/01	1040	106	<4	<35	<27	<50	<6	<13
20	Sacramento River at Alamar	2/13/01	1110	95	<4	<35	<27	<50	<6	E5
20	Sacramento River at Alamar	2/14/01	1010	110	<4	<35	<27	<50	<6	E6
21	Sacramento River at Tower Bridge	1/25/01	0900	99	<4	<35	<27	<50	<6	E1
21	Sacramento River at Tower Bridge	1/26/01	1100	101	<4	<35	<27	<50	<6	E2
21	Sacramento River at Tower Bridge	1/27/01	1100	80	<4	<35	<27	<50	<6	<13
21	Sacramento River at Tower Bridge	1/28/01	0800	76	<4	<35	<27	<50	<6	<13
21	Sacramento River at Tower Bridge	1/29/01	1100	75	<4	<35	<27	<50	<6	<13
21	Sacramento River at Tower Bridge	1/31/01	1130	120	<4	<35	<27	<50	<6	E5
21	Sacramento River at Tower Bridge	2/10/01	1600	67	<4	<35	<27	<50	<6	<13
21	Sacramento River at Tower Bridge	2/11/01	1300	71	<4	<35	<27	<50	<6	<13
21	Sacramento River at Tower Bridge	2/12/01	1300	76	<4	<35	<27	<50	<6	<13
21	Sacramento River at Tower Bridge	2/13/01	1330	109	<4	<35	<27	<50	<6	E3
21	Sacramento River at Tower Bridge	2/14/01	1400	132	<4	<35	<27	<50	<6	E5
21	Sacramento River at Tower Bridge	2/16/01	1230	113	<4	<35	<27	<50	<6	E1

Appendix 2. Table 2. Pesticide concentrations in environmental samples from the Sacramento River Basin, California, and surrogate recovery analyzed by the U.S. Geological Survey National Water Quality Laboratory—*Continued.*

Site no.	Site name	Date	Time	Metribuzin (ng/L)	Molinate (ng/L)	Naprop-amide (ng/L)	*p,p'*-DDE (ng/L)	Parathion (ng/L)	Pebulate (ng/L)	Pendi-methalin (ng/L)
8	Sacramento River at Colusa	1/24/01	0940	<6	<2	<7	<3	<7	<2	<10
8	Sacramento River at Colusa	1/25/01	1020	<6	<2	<7	<3	<7	<2	<10
8	Sacramento River at Colusa	1/26/01	0940	<6	<2	<7	<3	<7	<2	<10
8	Sacramento River at Colusa	1/27/01	1040	<6	<2	<7	<3	<7	<2	<10
8	Sacramento River at Colusa	1/28/01	0940	<6	<2	<7	<3	<7	<2	<10
8	Sacramento River at Colusa	2/10/01	0930	<6	<2	<7	<3	<7	<2	<10
8	Sacramento River at Colusa	2/11/01	1040	<6	<2	<7	<3	<7	<2	<10
8	Sacramento River at Colusa	2/12/01	1040	<6	<2	<7	<3	<7	<2	<10
8	Sacramento River at Colusa	2/13/01	0930	<6	<2	<7	<3	<7	<2	<10
8	Sacramento River at Colusa	2/14/01	1000	<6	<2	<7	<3	<7	<2	<10
18	Feather River Below Star Bend	1/24/01	1520	<6	27	<7	<3	<7	<2	<10
18	Feather River Below Star Bend	1/25/01	1300	<6	20	<7	<3	<7	<2	<10
18	Feather River Below Star Bend	1/26/01	1400	<6	25	<7	<3	<7	<2	<10
18	Feather River Below Star Bend	1/27/01	1330	<6	14	<7	<3	<7	<2	<10
18	Feather River Below Star Bend	1/28/01	1230	<6	11	<7	<3	<7	<2	<10
18	Feather River Below Star Bend	2/10/01	1300	<6	16	<7	<3	<7	<2	<10
18	Feather River Below Star Bend	2/11/01	1330	<6	15	<7	<3	<7	<2	<10
18	Feather River Below Star Bend	2/12/01	1300	<6	11	10	<3	<7	<2	<10
18	Feather River Below Star Bend	2/13/01	1130	<6	11	<7	<3	<7	<2	<10
18	Feather River Below Star Bend	2/14/01	1040	<6	7	<7	<3	<7	<2	<10
20	Sacramento River at Alamar	1/24/01	1010	<6	18	<7	<3	<7	<2	<10
20	Sacramento River at Alamar	1/25/01	1110	<6	23	<7	<3	<7	<2	<10
20	Sacramento River at Alamar	1/26/01	0840	<6	26	E3	<3	<7	<2	<10
20	Sacramento River at Alamar	1/27/01	1110	E5	15	E5	<3	<7	<2	<10
20	Sacramento River at Alamar	1/28/01	1050	<6	14	<7	<3	<7	<2	<10
20	Sacramento River at Alamar	2/9/01	0930	<6	19	<7	<3	<7	<2	<10
20	Sacramento River at Alamar	2/10/01	1050	<6	18	<7	<3	<7	<2	<10
20	Sacramento River at Alamar	2/11/01	1030	<6	20	<7	<3	<7	<2	<10
20	Sacramento River at Alamar	2/12/01	1040	<6	21	<7	<3	<7	<2	<10
20	Sacramento River at Alamar	2/13/01	1110	6	19	9	<3	<7	<2	<10
20	Sacramento River at Alamar	2/14/01	1010	10	18	<7	<3	<7	<2	<10
21	Sacramento River at Tower Bridge	1/25/01	0900	<6	21	<7	<3	<7	<2	<10
21	Sacramento River at Tower Bridge	1/26/01	1100	<6	25	<7	<3	<7	<2	<10
21	Sacramento River at Tower Bridge	1/27/01	1100	<6	14	E7	<3	<7	<2	<10
21	Sacramento River at Tower Bridge	1/28/01	0800	<6	<2	<7	<3	<7	<2	<10
21	Sacramento River at Tower Bridge	1/29/01	1100	<6	11	<7	<3	<7	<2	<10
21	Sacramento River at Tower Bridge	1/31/01	1130	<6	21	E6	<3	<7	<2	<10
21	Sacramento River at Tower Bridge	2/10/01	1600	<6	19	<7	<3	<7	<2	<10
21	Sacramento River at Tower Bridge	2/11/01	1300	<6	22	<7	<3	<7	<2	<10
21	Sacramento River at Tower Bridge	2/12/01	1300	<6	19	<7	<3	<7	<2	<10
21	Sacramento River at Tower Bridge	2/13/01	1330	<6	16	<7	<3	<7	<2	<10
21	Sacramento River at Tower Bridge	2/14/01	1400	16	16	<7	<3	<7	<2	<10
21	Sacramento River at Tower Bridge	2/16/01	1230	<6	12	<7	<3	<7	<2	<10

Appendix 2. Table 2. Pesticide concentrations in environmental samples from the Sacramento River Basin, California, and surrogate recovery analyzed by the U.S. Geological Survey National Water Quality Laboratory—*Continued.*

Site no.	Site name	Date	Time	Permethrin (ng/L)	Phorate (ng/L)	Prometon (ng/L)	Pronamide (ng/L)	Propachlor (ng/L)	Propanil (ng/L)	Propargite (ng/L)
8	Sacramento River at Colusa	1/24/01	0940	<6	<11	<.015	<4	<10	<11	<23
8	Sacramento River at Colusa	1/25/01	1020	<6	<11	<.015	<4	<10	<11	<23
8	Sacramento River at Colusa	1/26/01	0940	<6	<11	<.015	<4	<10	<11	<23
8	Sacramento River at Colusa	1/27/01	1040	<6	<11	<.015	<4	<10	<11	<23
8	Sacramento River at Colusa	1/28/01	0940	<6	<11	<.015	<4	<10	<11	<23
8	Sacramento River at Colusa	2/10/01	0930	<6	<11	<.015	<4	<10	<11	<23
8	Sacramento River at Colusa	2/11/01	1040	<6	<11	<.015	<4	<10	<11	<23
8	Sacramento River at Colusa	2/12/01	1040	<6	<11	<.015	<4	<10	<11	<23
8	Sacramento River at Colusa	2/13/01	0930	<6	<11	<.015	<4	<10	<11	<23
8	Sacramento River at Colusa	2/14/01	1000	<6	<11	<.015	<4	<10	<11	<23
18	Feather River Below Star Bend	1/24/01	1520	<6	<11	<.015	<4	<10	<11	<23
18	Feather River Below Star Bend	1/25/01	1300	<6	<11	<.015	<4	<10	<11	<23
18	Feather River Below Star Bend	1/26/01	1400	<6	<11	<.015	<4	<10	<11	<23
18	Feather River Below Star Bend	1/27/01	1330	<6	<11	<.015	<4	<10	E3	<23
18	Feather River Below Star Bend	1/28/01	1230	<6	<11	<.015	<4	<10	E2	<23
18	Feather River Below Star Bend	2/10/01	1300	<6	<11	<.015	<4	<10	<11	<23
18	Feather River Below Star Bend	2/11/01	1330	<6	<11	<.015	<4	<10	<11	<23
18	Feather River Below Star Bend	2/12/01	1300	<6	<11	<.015	<4	<10	<11	<23
18	Feather River Below Star Bend	2/13/01	1130	<6	<11	<.015	<4	<10	<11	<23
18	Feather River Below Star Bend	2/14/01	1040	<6	<11	<.015	<4	<10	<11	<23
20	Sacramento River at Alamar	1/24/01	1010	<6	<11	<.015	4	<10	<11	<23
20	Sacramento River at Alamar	1/25/01	1110	<6	<11	<.015	<4	<10	<11	<23
20	Sacramento River at Alamar	1/26/01	0840	<6	<11	<.015	<4	<10	E2	<23
20	Sacramento River at Alamar	1/27/01	1110	<6	<11	<.015	E3	<10	E2	<23
20	Sacramento River at Alamar	1/28/01	1050	<6	<11	<.015	<4	<10	<11	<23
20	Sacramento River at Alamar	2/9/01	0930	<6	<11	<.015	<4	<10	<11	<23
20	Sacramento River at Alamar	2/10/01	1050	<6	<11	<.015	7	<10	<11	<23
20	Sacramento River at Alamar	2/11/01	1030	<6	<11	<.015	10	<10	<11	<23
20	Sacramento River at Alamar	2/12/01	1040	<6	<11	<.015	5	<10	<11	<23
20	Sacramento River at Alamar	2/13/01	1110	<6	<11	<.015	6	<10	<11	<23
20	Sacramento River at Alamar	2/14/01	1010	<6	<11	<.015	9	<10	<11	<23
21	Sacramento River at Tower Bridge	1/25/01	0900	<6	<11	<.015	E4	<10	<11	<23
21	Sacramento River at Tower Bridge	1/26/01	1100	<6	<11	<.015	<4	<10	<11	<23
21	Sacramento River at Tower Bridge	1/27/01	1100	<6	<11	<.015	<4	<10	<11	<23
21	Sacramento River at Tower Bridge	1/28/01	0800	<6	<11	<.015	<4	<10	<11	<23
21	Sacramento River at Tower Bridge	1/29/01	1100	<6	<11	<.015	21	<10	<11	<23
21	Sacramento River at Tower Bridge	1/31/01	1130	<6	<11	<.015	17	<10	<11	<23
21	Sacramento River at Tower Bridge	2/10/01	1600	<6	<11	<.015	<4	<10	<11	<23
21	Sacramento River at Tower Bridge	2/11/01	1300	<6	<11	<.015	7	<10	<11	<23
21	Sacramento River at Tower Bridge	2/12/01	1300	<6	<11	<.015	<4	<10	<11	<23
21	Sacramento River at Tower Bridge	2/13/01	1330	<6	<11	<.015	<4	<10	<11	<23
21	Sacramento River at Tower Bridge	2/14/01	1400	<6	<11	<.015	<4	<10	<11	<23
21	Sacramento River at Tower Bridge	2/16/01	1230	<6	<11	<.015	10	<10	<11	<23

Appendix 2. Table 2. Pesticide concentrations in environmental samples from the Sacramento River Basin, California, and surrogate recovery analyzed by the U.S. Geological Survey National Water Quality Laboratory—*Continued.*

Site no.	Site name	Date	Time	Simazine (ng/L)	Tebuthiuron (ng/L)	Terbacil (ng/L)	Terbufos (ng/L)	Thiobencarb (ng/L)	Triallate (ng/L)	Trifluralin (ng/L)
8	Sacramento River at Colusa	1/24/01	0940	<11	36	<34	<17	<5	<2	<9
8	Sacramento River at Colusa	1/25/01	1020	<11	<16	<34	<17	<5	<2	<9
8	Sacramento River at Colusa	1/26/01	0940	21	<16	<34	<17	<5	<2	<9
8	Sacramento River at Colusa	1/27/01	1040	64	<16	<34	<17	<5	<2	<9
8	Sacramento River at Colusa	1/28/01	0940	34	<16	<34	<17	<5	<2	<9
8	Sacramento River at Colusa	2/10/01	0930	<11	<16	<34	<17	<5	<2	<9
8	Sacramento River at Colusa	2/11/01	1040	12	<16	<34	<17	<5	<2	<9
8	Sacramento River at Colusa	2/12/01	1040	22	<16	<34	<17	<5	<2	<9
8	Sacramento River at Colusa	2/13/01	0930	15	<16	<34	<17	<5	<2	<9
8	Sacramento River at Colusa	2/14/01	1000	21	<16	<34	<17	<5	<2	<9
18	Feather River Below Star Bend	1/24/01	1520	E9	E10	<34	<17	8	<2	<9
18	Feather River Below Star Bend	1/25/01	1300	E10	E9	<34	<17	7	<2	<9
18	Feather River Below Star Bend	1/26/01	1400	25	E8	<34	<17	7	<2	<9
18	Feather River Below Star Bend	1/27/01	1330	19	E8	<34	<17	E5	<2	<9
18	Feather River Below Star Bend	1/28/01	1230	17	E9	<34	<17	E4	<2	<9
18	Feather River Below Star Bend	2/10/01	1300	<11	<16	<34	<17	<5	<2	<9
18	Feather River Below Star Bend	2/11/01	1330	E5	<16	<34	<17	6	<2	<9
18	Feather River Below Star Bend	2/12/01	1300	12	<16	<34	<17	<5	<2	<9
18	Feather River Below Star Bend	2/13/01	1130	17	<16	<34	<17	E4	<2	<9
18	Feather River Below Star Bend	2/14/01	1040	23	<16	<34	<17	5	<2	<9
20	Sacramento River at Alamar	1/24/01	1010	E7	E7	<34	<17	7	<2	<9
20	Sacramento River at Alamar	1/25/01	1110	E11	E7	<34	<17	9	<2	<9
20	Sacramento River at Alamar	1/26/01	0840	E7	E6	<34	<17	7	<2	<9
20	Sacramento River at Alamar	1/27/01	1110	19	E7	<34	<17	6	<2	<9
20	Sacramento River at Alamar	1/28/01	1050	73	<16	<34	<17	<5	<2	<9
20	Sacramento River at Alamar	2/9/01	0930	<11	<16	<34	<17	6	<2	<9
20	Sacramento River at Alamar	2/10/01	1050	<11	<16	<34	<17	6	<2	<9
20	Sacramento River at Alamar	2/11/01	1030	E9	<16	<34	<17	8	<2	<9
20	Sacramento River at Alamar	2/12/01	1040	31	<16	<34	<17	6	<2	<9
20	Sacramento River at Alamar	2/13/01	1110	37	<16	<34	<17	7	<2	<9
20	Sacramento River at Alamar	2/14/01	1010	25	<16	<34	<17	7	<2	<9
21	Sacramento River at Tower Bridge	1/25/01	0900	E6	E5	<34	<17	10	<2	<9
21	Sacramento River at Tower Bridge	1/26/01	1100	E6	<16	<34	<17	9	<2	E3
21	Sacramento River at Tower Bridge	1/27/01	1100	20	<16	<34	<17	<5	<2	<9
21	Sacramento River at Tower Bridge	1/28/01	0800	70	<16	<34	<17	<5	<2	<9
21	Sacramento River at Tower Bridge	1/29/01	1100	78	<16	<34	<17	<5	<2	<9
21	Sacramento River at Tower Bridge	1/31/01	1130	26	E9	<34	<17	8	<2	<9
21	Sacramento River at Tower Bridge	2/10/01	1600	<11	<16	<34	<17	5	<2	<9
21	Sacramento River at Tower Bridge	2/11/01	1300	<11	<16	<34	<17	8	<2	<9
21	Sacramento River at Tower Bridge	2/12/01	1300	15	<16	<34	<17	5	<2	<9
21	Sacramento River at Tower Bridge	2/13/01	1330	33	<16	<34	<17	7	<2	<9
21	Sacramento River at Tower Bridge	2/14/01	1400	30	<16	<34	<17	6	<2	<9
21	Sacramento River at Tower Bridge	2/16/01	1230	22	E6	<34	<17	<6	<2	<9

Appendix 2. Table 3. Field measurements at sites in the Sacramento River Basin, California.

[—, no data reported, E, estimated value; ºC, degrees centigrade; mg/L, milligrams per liter; µS/cm, microsiemans per centimeter; ft^3/s, cubic feet per second]

Site no.	Site name	Date	Time	Temperature (ºC)	Dissolved oxygen (mg/L)	Specific conductance (µS/cm)	pH	Stream discharge (ft^3/s)
1	Sacramento River at Hamilton City	02/10/01	1210	—	—	160	—	5,925
1	Sacramento River at Hamilton City	02/11/01	1115	—	—	134	—	11,700
1	Sacramento River at Hamilton City	02/12/01	1050	—	—	138	—	12,700
1	Sacramento River at Hamilton City	02/13/01	1010	—	—	121	—	11,600
1	Sacramento River at Hamilton City	02/14/01	1110	—	—	124	—	7,840
2	Mud Creek at Chico	02/10/01	1310	—	—	710	—	—
3	Lindo Creek at Chico	02/10/01	1340	—	—	474	—	—
4	Big Chico Creek at Chico	02/09/01	1210	5.8	—	132	7.3	—
4	Big Chico Creek at Chico	02/10/01	0850	—	—	141	—	—
4	Big Chico Creek at Chico	02/10/01	1525	—	—	293	—	—
4	Big Chico Creek at Chico	02/11/01	0855	—	—	129	—	—
4	Big Chico Creek at Chico	02/11/01	1510	—	—	100	—	—
4	Big Chico Creek at Chico	02/12/01	1445	—	—	162	—	—
4	Big Chico Creek at Chico	02/13/01	0825	—	—	121	—	—
4	Big Chico Creek at Chico	02/12/01	0835	—	—	146	—	—
5	Little Chico Creek	02/09/01	1335	7.2	9.8	120	7.1	—
5	Little Chico Creek	02/10/01	1450	—	—	196	—	—
6	Big Chico Creek at River Road	02/09/01	0920	7.1	4.7	187	7.4	47
6	Big Chico Creek at River Road	02/09/01	1755	—	—	—	—	E47
6	Big Chico Creek at River Road	02/10/01	1020	—	—	92	—	393
6	Big Chico Creek at River Road	02/10/01	1600	—	—	216	—	1,030
6	Big Chico Creek at River Road	02/11/01	0945	—	—	75	—	1,490
6	Big Chico Creek at River Road	02/11/01	1725	—	—	—	—	1,430
6	Big Chico Creek at River Road	02/12/01	0920	—	—	98	—	883
6	Big Chico Creek at River Road	02/12/01	1515	—	—	80	—	870
6	Big Chico Creek at River Road	02/13/01	0900	—	—	91	—	397
7	Stony Creek at HW 45	02/09/01	1055	7.6	—	335	8.3	—
7	Stony Creek at HW 45	02/10/01	1120	—	—	344	—	—
8	Sacramento River at Colusa	01/24/01	1020	9.1	10.9	171	7.9	5,930
8	Sacramento River at Colusa	01/25/01	0944	9.2	6.9	168	8.1	12,600
8	Sacramento River at Colusa	01/26/01	0940	7.6	8.3	116	7.6	15,770
8	Sacramento River at Colusa	01/27/01	1040	6.6	8.5	100	7.7	22,900
8	Sacramento River at Colusa	01/28/01	1020	6.4	8.5	108	7.7	16,100
8	Sacramento River at Colusa	02/10/01	1020	8.0	9.9	184	7.6	5,900
8	Sacramento River at Colusa	02/11/01	1045	7.5	10.2	166	7.9	9,830
8	Sacramento River at Colusa	02/12/01	1045	7.2	10.3	148	7.7	14,100
8	Sacramento River at Colusa	02/13/01	1030	6.7	10.5	—	—	14,200
8	Sacramento River at Colusa	02/14/01	1000	7.3	10.0	132	7.6	12,200
9	Butte Creek at Gridley Road	01/24/01	1155	9.1	9.0	244	7.7	—
9	Butte Creek at Gridley Road	01/24/01	2100	9.4	9.7	223	7.8	—
9	Butte Creek at Gridley Road	01/25/01	1025	9.0	9.2	221	7.7	—
9	Butte Creek at Gridley Road	01/25/01	1445	8.5	9.5	223	7.7	—
9	Butte Creek at Gridley Road	01/25/01	1800	8.2	9.5	225	7.7	—

Appendix 2. Table 3. Field measurements at sites in the Sacramento River Basin, California—*Continued.*

Site no.	Site name	Date	Time	Temperature (ºC)	Dissolved oxygen (mg/L)	Specific conductance (µS/cm)	pH	Stream discharge (ft^3/s)
9	Butte Creek at Gridley Road	01/25/01	2200	7.7	9.9	223	7.7	—
9	Butte Creek at Gridley Road	01/26/01	0200	7.4	10.0	216	7.7	—
9	Butte Creek at Gridley Road	01/26/01	0620	6.7	9.1	179	7.7	—
9	Butte Creek at Gridley Road	01/26/01	1010	6.6	10.6	154	7.7	—
9	Butte Creek at Gridley Road	01/26/01	1410	7.2	10.5	167	7.8	—
9	Butte Creek at Gridley Road	01/26/01	1800	7.3	10.3	182	7.6	—
9	Butte Creek at Gridley Road	01/26/01	2200	7.7	10.4	181	7.6	—
9	Butte Creek at Gridley Road	01/27/01	0000	7.4	10.5	202	8.1	—
9	Butte Creek at Gridley Road	01/27/01	0200	8.0	10.0	190	7.7	—
9	Butte Creek at Gridley Road	01/27/01	0625	7.6	9.9	192	7.6	—
9	Butte Creek at Gridley Road	01/27/01	1205	7.0	9.7	197	7.8	—
9	Butte Creek at Gridley Road	01/27/01	1800	7.3	10.4	201	7.8	—
9	Butte Creek at Gridley Road	01/28/01	0745	7.4	9.5	208	7.8	—
9	Butte Creek at Gridley Road	02/09/01	1815	8.0	8.5	296	8.0	—
9	Butte Creek at Gridley Road	02/09/01	2217	7.8	9.2	296	7.8	—
9	Butte Creek at Gridley Road	02/10/01	0220	7.5	9.8	290	7.9	—
9	Butte Creek at Gridley Road	02/10/01	0615	7.2	—	—	7.7	—
9	Butte Creek at Gridley Road	02/10/01	1030	7.1	—	—	7.7	—
9	Butte Creek at Gridley Road	02/10/01	1855	7.3	10.5	232	7.8	—
9	Butte Creek at Gridley Road	02/10/01	2205	7.4	10.2	—	7.9	—
9	Butte Creek at Gridley Road	02/11/01	0210	7.3	9.9	189	7.8	—
9	Butte Creek at Gridley Road	02/11/01	0610	7.6	12.4	—	7.8	—
9	Butte Creek at Gridley Road	02/11/01	2205	7.2	10.6	142	7.7	—
9	Butte Creek at Gridley Road	02/12/01	0005	7.2	10.6	173	7.7	—
9	Butte Creek at Gridley Road	02/12/01	0210	7.5	10.4	152	7.6	—
9	Butte Creek at Gridley Road	02/12/01	0620	7.4	10.0	162	7.7	—
9	Butte Creek at Gridley Road	02/12/01	1815	7.2	11.7	—	7.8	—
9	Butte Creek at Gridley Road	02/13/01	1030	6.9	10.6	208	7.7	—
9	Butte Creek at Gridley Road	02/11/01	1800	7.2	10.7	182	7.9	—
10	Main Drainage Canal at Gridley Road	01/24/01	1220	10.6	8.8	274	7.7	118
10	Main Drainage Canal at Gridley Road	01/24/01	2135	11.4	8.0	274	—	120
10	Main Drainage Canal at Gridley Road	01/25/01	1045	8.3	8.5	285	7.7	107
10	Main Drainage Canal at Gridley Road	01/25/01	1510	8.2	9.7	280	7.8	128
10	Main Drainage Canal at Gridley Road	01/25/01	1830	8.0	5.8	253	7.8	159
10	Main Drainage Canal at Gridley Road	01/25/01	2230	7.7	9.1	240	7.6	217
10	Main Drainage Canal at Gridley Road	01/26/01	0230	7.2	8.8	218	7.8	215
10	Main Drainage Canal at Gridley Road	01/26/01	0635	7.2	7.7	228	7.6	203
10	Main Drainage Canal at Gridley Road	01/26/01	1025	7.6	9.0	239	7.5	194
10	Main Drainage Canal at Gridley Road	01/26/01	1440	9.8	9.5	240	7.7	182
10	Main Drainage Canal at Gridley Road	01/26/01	1830	10.1	9.5	244	7.6	169
10	Main Drainage Canal at Gridley Road	01/26/01	2230	9.2	8.7	253	7.6	158
10	Main Drainage Canal at Gridley Road	01/27/01	0030	9.1	8.8	280	7.7	153
10	Main Drainage Canal at Gridley Road	01/27/01	0230	8.2	8.6	260	7.6	143
10	Main Drainage Canal at Gridley Road	01/27/01	0650	6.7	8.9	266	7.6	133

Appendix 2. Table 3. Field measurements at sites in the Sacramento River Basin, California—*Continued.*

Site no.	Site name	Date	Time	Temperature (ºC)	Dissolved oxygen (mg/L)	Specific conductance (µS/cm)	pH	Stream discharge (ft^3/s)
10	Main Drainage Canal at Gridley Road	01/27/01	1240	7.8	10.2	270	7.9	131
10	Main Drainage Canal at Gridley Road	01/27/01	1830	10.2	10.4	278	8.0	136
10	Main Drainage Canal at Gridley Road	01/28/01	0810	7.1	8.5	295	7.6	139
10	Main Drainage Canal at Gridley Road	02/09/01	1836	8.9	10.2	349	8.1	80
10	Main Drainage Canal at Gridley Road	02/09/01	2240	8.5	8.5	307	7.8	99
10	Main Drainage Canal at Gridley Road	02/10/01	0238	7.5	8.0	281	7.9	95
10	Main Drainage Canal at Gridley Road	02/10/01	0635	6.6	—	—	7.6	93
10	Main Drainage Canal at Gridley Road	02/10/01	1055	8.0	—	—	7.7	90
10	Main Drainage Canal at Gridley Road	02/10/01	1540	—	—	—	—	88
10	Main Drainage Canal at Gridley Road	02/10/01	1910	10.5	9.4	330	7.7	88
10	Main Drainage Canal at Gridley Road	02/10/01	2220	6.8	11.8	0	7.8	103
10	Main Drainage Canal at Gridley Road	02/11/01	0220	8.8	5.9	297	7.6	117
10	Main Drainage Canal at Gridley Road	02/11/01	0700	7.7	8.5	278	7.7	131
10	Main Drainage Canal at Gridley Road	02/11/01	1030	—	—	—	—	158
10	Main Drainage Canal at Gridley Road	02/11/01	1430	—	—	—	—	173
10	Main Drainage Canal at Gridley Road	02/11/01	1815	9.6	8.8	242	7.8	176
10	Main Drainage Canal at Gridley Road	02/11/01	2220	9.0	8.5	247	7.5	168
10	Main Drainage Canal at Gridley Road	02/12/01	0015	8.7	9.0	287	7.6	161
10	Main Drainage Canal at Gridley Road	02/12/01	0220	8.6	8.3	266	7.5	153
10	Main Drainage Canal at Gridley Road	02/12/01	0640	8.1	7.8	276	7.6	165
10	Main Drainage Canal at Gridley Road	02/12/01	1200	—	—	—	—	198
10	Main Drainage Canal at Gridley Road	02/12/01	1449	—	—	—	—	196
10	Main Drainage Canal at Gridley Road	02/12/01	1830	9.3	9.6	257	7.7	184
10	Main Drainage Canal at Gridley Road	02/13/01	1045	6.8	9.8	336	7.7	127
11	Butte Slough at Lower Pass Road	01/24/01	1144	8.9	9.1	281	7.5	457
11	Butte Slough at Lower Pass Road	01/25/01	1125	8.7	6.5	281	7.7	664
11	Butte Slough at Lower Pass Road	01/26/01	1120	7.9	6.7	265	7.6	1,220
11	Butte Slough at Lower Pass Road	01/27/01	1120	7.3	6.9	200	7.7	1,430
11	Butte Slough at Lower Pass Road	01/28/01	1115	7.5	6.9	243	7.7	1,360
11	Butte Slough at Lower Pass Road	02/09/01	1200	7.6	9.0	306	7.6	431
11	Butte Slough at Lower Pass Road	02/10/01	1120	7.3	8.6	312	7.7	394
11	Butte Slough at Lower Pass Road	02/11/01	1135	7.9	8.8	274	7.6	542
11	Butte Slough at Lower Pass Road	02/12/01	1115	7.7	8.8	223	7.4	995
11	Butte Slough at Lower Pass Road	02/13/01	1115	7.1	8.6	202	7.6	1,100
11	Butte Slough at Lower Pass Road	02/14/01	1115	7.6	8.5	219	6.9	1,030
12	Wadsworth canal at South Butte Road	01/24/01	2240	10.7	9.0	418	8.0	—
12	Wadsworth canal at South Butte Road	01/25/01	1140	9.9	8.7	412	7.9	—
12	Wadsworth canal at South Butte Road	01/25/01	1900	9.6	9.5	390	7.9	—
12	Wadsworth canal at South Butte Road	01/25/01	2300	6.7	9.7	230	7.2	—
12	Wadsworth canal at South Butte Road	01/26/01	0300	7.6	9.1	333	7.9	—
12	Wadsworth canal at South Butte Road	01/26/01	0730	8.0	—	314	7.8	—
12	Wadsworth canal at South Butte Road	01/26/01	1245	9.0	9.5	327	7.8	—
12	Wadsworth canal at South Butte Road	01/26/01	1650	9.8	9.5	240	7.7	—
12	Wadsworth canal at South Butte Road	01/26/01	1900	9.6	9.5	334	7.8	—
12	Wadsworth canal at South Butte Road	01/26/01	2300	6.9	9.6	340	6.8	—

Appendix 2. Table 3. Field measurements at sites in the Sacramento River Basin, California—*Continued.*

Site no.	Site name	Date	Time	Temperature (ºC)	Dissolved oxygen (mg/L)	Specific conductance (µS/cm)	pH	Stream discharge (ft^3/s)
12	Wadsworth canal at South Butte Road	01/27/01	0300	9.2	8.6	353	7.8	—
12	Wadsworth canal at South Butte Road	01/27/01	0740	8.4	9.2	363	7.9	—
12	Wadsworth canal at South Butte Road	01/27/01	1505	10.2	9.9	376	8.0	—
12	Wadsworth canal at South Butte Road	01/27/01	1900	9.8	10.0	381	7.9	—
12	Wadsworth canal at South Butte Road	01/28/01	0100	9.2	10.0	382	8.0	—
12	Wadsworth canal at South Butte Road	01/28/01	1025	8.7	9.0	386	7.9	—
12	Wadsworth canal at South Butte Road	02/09/01	1920	9.3	8.8	535	8.2	—
12	Wadsworth canal at South Butte Road	02/09/01	2320	9.1	—	—	7.9	—
12	Wadsworth canal at South Butte Road	02/10/01	0320	8.4	9.0	491	7.9	—
12	Wadsworth canal at South Butte Road	02/10/01	0735	8.3	—	—	7.8	—
12	Wadsworth canal at South Butte Road	02/10/01	2000	9.2	8.9	437	7.9	—
12	Wadsworth canal at South Butte Road	02/10/01	2300	9.3	—	—	7.8	—
12	Wadsworth canal at South Butte Road	02/11/01	0300	9.0	8.9	205	7.8	—
12	Wadsworth canal at South Butte Road	02/11/01	0825	8.0	9.1	350	7.8	—
12	Wadsworth canal at South Butte Road	02/11/01	1900	9.0	9.6	267	7.7	—
12	Wadsworth canal at South Butte Road	02/11/01	2300	9.2	9.2	235	7.7	—
12	Wadsworth canal at South Butte Road	02/12/01	0055	8.5	9.6	301	7.7	—
12	Wadsworth canal at South Butte Road	02/12/01	0305	9.3	8.9	203	7.6	—
12	Wadsworth canal at South Butte Road	02/12/01	0725	8.1	9.5	240	7.6	—
12	Wadsworth canal at South Butte Road	02/12/01	1915	8.5	10.1	271	7.7	—
13	DWR Pumping Plant 2, North	01/24/01	1230	10.1	6.0	316	7.3	—
13	DWR Pumping Plant 2, North	01/25/01	1240	9.5	7.6	321	—	—
13	DWR Pumping Plant 2, North	01/26/01	1300	8.6	8.1	318	7.4	—
13	DWR Pumping Plant 2, North	01/27/01	1300	8.7	8.8	342	7.7	—
13	DWR Pumping Plant 2, North	01/28/01	1230	8.9	7.2	326	7.5	—
13	DWR Pumping Plant 2, North	02/09/01	1310	8.3	7.7	293	8.0	—
13	DWR Pumping Plant 2, North	02/10/01	1239	8.7	7.9	386	8.1	—
13	DWR Pumping Plant 2, North	02/11/01	1217	9.7	8.2	345	7.9	—
13	DWR Pumping Plant 2, North	02/12/01	1240	9.1	7.8	305	7.6	—
13	DWR Pumping Plant 2, North	02/13/01	1245	8.0	8.2	299	7.7	—
14	DWR Pumping Plant 2, South	01/24/01	1245	10.4	6.3	252	7.3	—
14	DWR Pumping Plant 2, South	01/25/01	1255	9.3	7.9	340	—	—
14	DWR Pumping Plant 2, South	01/26/01	1315	8.9	7.9	335	7.3	—
14	DWR Pumping Plant 2, South	01/27/01	1245	9.2	7.7	410	7.6	—
14	DWR Pumping Plant 2, South	01/28/01	1240	8.1	6.1	280	7.6	—
14	DWR Pumping Plant 2, South	02/09/01	1250	9.0	8.0	287	8.0	—
14	DWR Pumping Plant 2, South	02/10/01	1222	8.5	10.4	691	8.5	—
14	DWR Pumping Plant 2, South	02/11/01	1203	9.2	8.8	538	8.3	—
14	DWR Pumping Plant 2, South	02/12/01	1250	9.5	6.6	316	7.7	—
14	DWR Pumping Plant 2, South	02/13/01	1254	9.1	5.6	362	7.8	—
15	DWR Pumping Plant 1	01/24/01	1140	9.0	7.4	—	7.6	—
15	DWR Pumping Plant 1	01/25/01	1210	7.9	9.4	568	—	—
15	DWR Pumping Plant 1	01/26/01	1413	8.4	9.5	540	7.6	—
15	DWR Pumping Plant 1	01/27/01	1210	7.8	8.5	648	7.6	—

Appendix 2. Table 3. Field measurements at sites in the Sacramento River Basin, California—*Continued.*

Site no.	Site name	Date	Time	Temperature (ºC)	Dissolved oxygen (mg/L)	Specific conductance (µS/cm)	pH	Stream discharge (ft^3/s)
15	DWR Pumping Plant 1	01/28/01	1140	7.6	8.5	530	7.6	—
15	DWR Pumping Plant 1	02/09/01	1210	7.4	7.8	335	8.1	—
15	DWR Pumping Plant 1	02/10/01	1055	7.3	6.4	503	7.9	—
15	DWR Pumping Plant 1	02/11/01	1130	8.5	6.8	482	8.0	—
15	DWR Pumping Plant 1	02/12/01	1200	8.2	7.4	457	7.7	—
15	DWR Pumping Plant 1	02/13/01	1209	7.7	10.5	602	7.9	—
16	Jack Slough near Doc Adams Road	01/24/01	1400	9.3	10.2	120	7.3	133
16	Jack Slough near Doc Adams Road	01/25/01	1400	7.7	7.4	125.8	7.4	135
16	Jack Slough near Doc Adams Road	01/26/01	1320	7.3	7.6	115	7.4	181
16	Jack Slough near Doc Adams Road	01/27/01	1315	7.1	7.7	—	7.5	118
16	Jack Slough near Doc Adams Road	01/28/01	1255	7.2	7.4	131	7.5	109
16	Jack Slough near Doc Adams Road	02/09/01	1315	7.3	7.7	154	7.9	65
16	Jack Slough near Doc Adams Road	02/10/01	1245	6.8	9.4	131	7.0	142
16	Jack Slough near Doc Adams Road	02/11/01	1245	7.5	9.2	127	7.1	206
16	Jack Slough near Doc Adams Road	02/12/01	1300	7.2	9.2	111	6.8	254
16	Jack Slough near Doc Adams Road	02/13/01	1230	6.4	9.4	118	6.8	164
16	Jack Slough near Doc Adams Road	02/14/01	1220	8.2	8.8	130	6.7	125
17	Feather River near Yuba City	01/24/01	1342	9.1	7.8	110	7.5	—
17	Feather River near Yuba City	01/25/01	1325	8.4	7.1	119	7.3	—
17	Feather River near Yuba City	01/26/01	1240	8.6	5.5	115	7.9	—
17	Feather River near Yuba City	01/27/01	1240	8.1	5.6	100	7.8	—
17	Feather River near Yuba City	01/28/01	1230	8.1	6.1	115	8.0	—
17	Feather River near Yuba City	02/10/01	1210	8.1	7.8	110	7.0	—
17	Feather River near Yuba City	02/11/01	1210	7.7	9.1	124	7.0	—
17	Feather River near Yuba City	02/12/01	1230	7.6	7.0	99	7.0	—
17	Feather River near Yuba City	02/13/01	1200	7.7	8.4	105	6.9	—
17	Feather River near Yuba City	02/14/01	1150	8.2	8.9	109	6.8	—
18	Feather River at Star Bend	01/24/01	1520	—	—	—	—	3,130
18	Feather River at Star Bend	01/25/01	1300	—	—	—	—	3,120
18	Feather River at Star Bend	01/26/01	1400	—	—	—	—	3,870
18	Feather River at Star Bend	01/27/01	1330	—	—	—	—	3,630
18	Feather River at Star Bend	01/28/01	1230	—	—	—	—	3,170
18	Feather River at Star Bend	02/10/01	1300	—	—	—	—	3,140
18	Feather River at Star Bend	02/11/01	1300	—	—	—	—	4,250
18	Feather River at Star Bend	02/12/01	1300	—	—	—	—	5,520
18	Feather River at Star Bend	02/13/01	1130	—	—	—	—	4,470
18	Feather River at Star Bend	02/14/01	1040	—	—	—	—	3,570
19	Bear River near Berry Road	01/24/01	1720	8.7	—	—	—	77
19	Bear River near Berry Road	01/25/01	0930	7.5	—	—	—	120
19	Bear River near Berry Road	01/26/01	1120	—	—	—	—	223
19	Bear River near Berry Road	01/27/01	1030	—	—	—	—	270
19	Bear River near Berry Road	01/28/01	1000	—	—	—	—	210
19	Bear River near Berry Road	02/09/01	1050	7.0	—	—	—	79
19	Bear River near Berry Road	02/10/01	1030	6.9	—	—	—	119

Appendix 2. Table 3. Field measurements at sites in the Sacramento River Basin, California—*Continued.*

Site no.	Site name	Date	Time	Temperature (ºC)	Dissolved oxygen (mg/L)	Specific conductance (µS/cm)	pH	Stream discharge (ft^3/s)
19	Bear River near Berry Road	02/11/01	1030	—	—	—	—	340
19	Bear River near Berry Road	02/12/01	1100	—	—	—	—	855
19	Bear River near Berry Road	02/13/01	1000	—	—	—	—	550
20	Sacramento River at Alamar	01/24/01	0900	—	—	—	—	12,600
20	Sacramento River at Alamar	01/25/01	1115	8.8	10.7	222	—	13,100
20	Sacramento River at Alamar	01/26/01	0900	—	—	—	—	17,800
20	Sacramento River at Alamar	01/27/01	1115	7.9	11.5	192	7.5	24,700
20	Sacramento River at Alamar	01/28/01	1053	7.1	10.8	158	7.0	26,700
20	Sacramento River at Alamar	02/09/01	0900	—	—	—	—	11,000
20	Sacramento River at Alamar	02/10/01	1050	8.0	10.6	223	8.2	11,500,
20	Sacramento River at Alamar	02/11/01	1100	8.3	10.6	197	8.0	12,500
20	Sacramento River at Alamar	02/12/01	1115	8.1	10.9	204	7.8	17,800
20	Sacramento River at Alamar	02/13/01	1115	7.3	11.1	200	7.7	22,000
20	Sacramento River at Alamar	02/14/01	1010	—	—	—	—	21,600
21	Sacramento River at Tower Bridge	01/25/01	0900	—	—	—	—	14,800
21	Sacramento River at Tower Bridge	01/26/01	1100	—	—	—	—	16,600
21	Sacramento River at Tower Bridge	01/27/01	1100	—	—	—	—	22,800
21	Sacramento River at Tower Bridge	01/28/01	0800	—	—	—	—	29,600
21	Sacramento River at Tower Bridge	01/29/01	1100	—	—	—	—	26,500
21	Sacramento River at Tower Bridge	01/31/01	1130	—	—	—	—	18,700
21	Sacramento River at Tower Bridge	02/10/01	1600	—	—	—	—	15,700
21	Sacramento River at Tower Bridge	02/11/01	1300	—	—	—	—	9,640
21	Sacramento River at Tower Bridge	02/12/01	1300	—	—	—	—	14,700
21	Sacramento River at Tower Bridge	02/13/01	1330	—	—	—	—	20,900
21	Sacramento River at Tower Bridge	02/14/01	1400	—	—	—	—	20,700
21	Sacramento River at Tower Bridge	02/16/01	1230	—	—	—	—	19,200