CENTRAL VALLEY REGIONAL WATER QUALITY CONTROL BOARD

BASIN PLAN AMENDMENTS TO THE WATER QUALITY CONTROL PLAN FOR THE SACRAMENTO RIVER AND SAN JOAQUIN RIVER BASINS

FOR

THE CONTROL OF DIAZINON AND CHLORPYRIFOS RUNOFF INTO THE SACRAMENTO AND FEATHER RIVERS

MAY 2007 FINAL STAFF REPORT

CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY

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DISCLAIMER
This publication is a report by staff of the California Regional Water Quality Control Board, Central Valley Region. This report contains the evaluation of alternatives and technical support for the adoption of a Basin Plan Amendment to the Water Quality Control Plan for the Sacramento and San Joaquin River Basins (Resolution No R5-2007-0034). Mention of specific products does not represent endorsement of those products by the Central Valley Water Board.

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The authors would like to recognize the significant contributions made to this report by authors of previous Basin Plan Amendment s, most specifically, the Delta Diazinon and Chlorpyrifos (McClure et al., 2006), the San Joaquin River OP Pesticide (Beaulaurier et al., 2005) and the Sacramento Feather River Diazinon (Karkoski et al., 2003) Basin Plan Amendments. Due to the significant overlap in purpose and subject matter, large portions of this report are partial or complete incorporations of the previous reports.

LIST OF ACRONYMS AND ABBREVIATIONS

§	Section
µg/L	micrograms/liter (0.10 µg/L = 100 ng/L)
ACR	acute to chronic ratio
avg	average
Basin Plan	Water Quality Control Plan for the Sacramento River and San Joaquin River Basins
CCC	Criterion Continuous Concentration
CDFG	California Department of Fish and Game
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
CMC	Criterion Maximum Concentration
CVRWQCB	California Regional Water Quality Control Board – Central Valley Region
CWA	Federal Clean Water Act
CWC	California Water Code
DPR	California Department of Pesticide Regulation
DWR	California Department of Water Resources
ESA	Endangered Species Act
g/day	grams/day
LA	Load Allocation
lbs	pounds
LC	Loading Capacity
MAA	Management Agency Agreement
ng/L	nanograms/liter (100 ng/L = 0.10 µg/L)
NPDES	National Pollution Discharge Elimination System
NPS	nonpoint source
nr	near
OP	organophosphorous
ppm	parts per million
PERA	Probabilistic Ecological Risk Assessment
Porter-Cologne	Porter-Cologne Water Quality Control Act
QA	quality assurance
QC	quality control
PUR	Pesticide Use Report
Central Valley Water Board	California Regional Water Quality Control Board – Central Valley Region
Sac R	Sacramento River

SNARL	Suggested No Adverse Response Level
State Water Board	State Water Resources Control Board
TEQ	toxic equivalents
TMDL	Total Maximum Daily Load
USDA	United States Department of Agriculture
U.S. EPA	United States Environmental Protection Agency
USGS	United States Geological Survey
Water Code	California Water Code
WDR	Waste Discharge Requirements
WLA	Wasteload Allocation
WQC	Water Quality Criteria
WQO	Water Quality Objective

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1.0 EXECUTIVE SUMMARY

This report provides the technical and policy foundation for a proposed Basin Plan Amendment to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins (Basin Plan). The proposed Basin Plan Amendment addresses discharges of diazinon and chlorpyrifos into the Sacramento and Feather Rivers (Sacramento and Feather Rivers) caused by the organophosphorous (OP) insecticides diazinon and chlorpyrifos. For each of the major provisions of the proposed Basin Plan Amendment, alternatives are analyzed and recommendations are made based on the technical and policy analysis described. The proposed Basin Plan Amendment includes new numeric water quality objectives and Total Maximum Daily Loads (TMDLs) for both diazinon and chlorpyrifos and diazinon and chlorpyrifos wasteload allocations for point sources and load allocations for non-point sources.

The proposed Basin Plan Amendments are largely based upon the technical and policy framework established in recently adopted Basin Plan Amendments addressing diazinon and/or chlorpyrifos in the Sacramento, Feather and San Joaquin Rivers and the Delta, (CVRWQCB Resolutions R5-2003-0148, R5-2005-0138 and R5-2006-0061, respectively). Some of the language in this report was taken directly from the staff reports supporting those three Basin Plan Amendment s (Karkoski et al., 2003; Beaulaurier et al., 2005; McClure et al., 2006). In all cases when they were used, the analysis, language, and technical and policy framework from the previous three Basin Plan Amendments were reviewed for applicability to addressing diazinon and chlorpyrifos in the Sacramento and Feather Rivers.

Monitoring since the early 1990s by State and federal agencies and other groups has confirmed the presence of diazinon and chlorpyrifos at levels of concern in the Sacramento and Feather Rivers. The Sacramento and Feather Rivers are currently listed on the Clean Water Act Section 303(d) List for aquatic toxicity due to diazinon and chlorpyrifos (SWRCB, 2006). The sources of these compounds are agricultural and urban runoff. Agriculture will be the dominant source in the near future since the United States Environmental Protection Agency (U.S. EPA) has banned the sale of all non-agricultural uses of diazinon and most non-agricultural uses of chlorpyrifos.

In 2003, the California Regional Water Quality Control Board, Central Valley Region (Central Valley Water Board) adopted Resolution R5-2003-0148, which approved a Basin Plan Amendment establishing TMDLs and a program of implementation plans for diazinon in the Sacramento and Feather Rivers. In establishing the TMDLs and program of implementation, the Central Valley Water Board also established new water quality objectives for diazinon in the Sacramento and Feather Rivers of 0.080 µg/L (one hour

maximum) and 0.050 µg/L (four day average). The compliance date associated with these water quality objectives is June 30, 2008.

The 2003 Basin Plan Amendment included the requirement to review the diazinon allocations and the implementation provisions in the Basin Plan at least once every 5 years, beginning no later than June 30, 2007. In addition to the Basin Plan requirements, a review of the water quality objectives has also been incorporated into a judgment denying writ, issued on 22 July 2005 by the Sacramento County Superior Court (Makhteshim Agan of North America v State Water Resources Control Board; Regional Water Quality Control Board-Central Valley Region, Sac. Cty. Sup. Ct. - Case No. 04CS00871).

Designated Uses - This Basin Plan Amendment recommends that no changes be made to existing designated uses for the Sacramento and Feather Rivers. The use that is most sensitive to diazinon and chlorpyrifos (freshwater habitat beneficial use designation) has already been designated, and was reviewed and found to be appropriate in this water body.

Water quality objectives – This Basin Plan Amendment proposes to revise the diazinon water quality objectives and adopt new water quality objectives for chlorpyrifos. For both diazinon and chlorpyrifos, this Staff Report recommends adoption of water quality objectives derived using the U.S. EPA water quality criteria derivation methodology as applied to datasets screened by the California Department of Fish and Game (CDFG). The proposed change to diazinon would increase the current objective to approximately twice the existing objective. The change to the diazinon water quality objective is required to address new information made available since the existing water quality objective was adopted.

TMDL Elements - This Basin Plan Amendment establishes the loading capacity, wasteload allocations, and load allocations for diazinon and chlorpyrifos discharges to the Sacramento and Feather Rivers. The loading capacity and allocations are established at levels necessary to attain the applicable numeric water quality objectives within the Sacramento and Feather Rivers. A combined additive toxicity formula, previously adopted in the Basin Plan, is used to set a loading capacity that accounts for the combined toxicity of diazinon and chlorpyrifos. Equating the allocations to the loading capacity provides an implicit margin of safety, since no dilution credit is given. Since the loading capacity, load allocations and wasteload allocations are not dependant on a particular flow regime, they would not be changed by changes in flows, water diversions or flow routing within the Sacramento and Feather Rivers.

Implementation and Time Schedule - This Basin Plan Amendment is implemented through the Irrigated Lands Conditional Waiver which addresses agricultural sources of waste constituents, including diazinon and chlorpyrifos discharges, and the Clean Water Act NPDES permit requirements, which address point sources of diazinon and chlorpyrifos. A conditional prohibition is kept as a regulatory backstop for the Irrigated Lands Program.

Current data indicates that the Sacramento and Feather Rivers appear to be meeting the proposed water quality objectives. With recent changes in the diazinon labeling and the new California Department of Pesticide Regulation (DPR) dormant spray regulations, loading capacity should be met by the time the Basin Plan Amendment is approved by the U.S. EPA. Therefore, the compliance date for both diazinon and chlorpyrifos is proposed to be the effective date of the Basin Plan Amendment.

Submission of Management Plans - Dischargers must submit a management plan that describes the actions that the discharger will take to reduce diazinon and chlorpyrifos discharges during the dormant season and the irrigation season, and to meet the applicable allocations by the required compliance dates.

Surveillance and Monitoring - Surveillance and monitoring required of dischargers will include water quality monitoring, evaluation of changes in pesticide use, surveys of adoption of management practices to reduce diazinon and chlorpyrifos in runoff, and evaluation of the effectiveness of the management practices in reducing pesticide runoff.

Consideration of Economics and the California Environmental Quality Act (CEQA)
An evaluation of economic considerations related to the proposed Basin Plan Amendment, and a CEQA checklist are provided in this Staff Report. This Basin Plan Amendment is designed to reduce diazinon and chlorpyrifos concentrations in the Sacramento and Feather Rivers, and to ensure that increased use of alternatives to those pesticides will not degrade water quality. The water quality objectives and TMDLs established by this Basin Plan Amendment are designed to eliminate the impacts of diazinon and chlorpyrifos to aquatic life in the Sacramento and Feather Rivers. This Basin Plan Amendment does not require or allow any changes in pesticide application practices that could degrade the quality of the environment, or have environmental effects that could cause substantial indirect or direct adverse effects on human beings.

Peer Review - Staff has determined that the scientific portions and scientific basis of the proposed Amendment to control discharges of diazinon and chlorpyrifos into the Sacramento and Feather Rivers are based on source material that has already been peer reviewed. The proposed Amendment is itself just a new application of earlier,

adequately peer reviewed work products, specifically, the 2005 San Joaquin River (Resolution No. R5-2005-0138) and 2006 Delta (Resolution No. R5-2006-0061) Basin Plan Amendments to Control Diazinon and Chlorpyrifos. The proposed amendment does not depart from the scientific approach of the other Basin Plan Amendments from which it is derived. Therefore, the proposed amendment has already satisfied the peer review requirement of HSC 57004 and does not require additional peer review. The State Board's peer review coordinator has been consulted on this decision and has concurred with staff's assessment. A summary of previous peer review comments and a copy of the evaluation letter and the State Board Coordinator's response are included as Appendix E.

Public Participation and Comments - Three public workshops have been held to in the preparation of this proposed Basin Plan Amendment. A public workshop was held on 23 May 2006 in Yuba City to obtain comments on the proposed scope of the Basin Plan Amendment. Three letters commenting on the scope of this proposed Basin Plan Amendment were received following the meeting. A public review draft was made available in March 2007. Another public workshop and CEQA Scoping Meeting was held on 15 February 2007 in Yuba City to address the inclusion of chlorpyrifos objectives. A third meeting is scheduled for 2 April 2007 to provide information and obtain comments related to this draft Staff Report and the proposed Basin Plan Amendment. The proposed Basin Plan Amendment is scheduled for action by the Central Valley Water Board during a public hearing at the Board's May 3/4, 2007 meeting.

Both written and verbal comments can be provided up to and during the Central Valley Water Board hearing. Written comments on this Staff Report and proposed Basin Plan Amendment submitted by 18 April 2007 will be responded to in writing. To assist staff in identifying and responding to comments, comments should be submitted (hard copy and electronic) in the format suggested in **Appendix G**. The suggested format is to number the comment, state in one sentence the topic of the comment, followed by supporting discussion, and a specific recommendation. If you have any questions concerning this staff report or the proposed Basin Plan Amendment please contact Paul Hann at (916) 464-4628 or by email at phann@waterboards.ca.gov.

2.0 BACKGROUND

2.1 Watershed Areas to Be Considered

The following section provides essential details about the nature and function of the Sacramento and Feather Rivers and their surrounding watersheds. Because, the scope of this Staff Report has been defined to match the 2003 Staff Report the following information has been largely taken from then 2003 Staff Report, with updates as appropriate.

2.1.1 Environmental Characteristics of the Sacramento and Feather River Watersheds

The Central Valley extends more than 400 miles from near the City of Redding in the north to the Tehachapi Mountains in the south. The Sacramento Valley comprises the northern third of the Central Valley. It extends from just north of the City of Redding to the confluence of the Sacramento River with the Delta near downtown Sacramento, and from the Coast Ranges east to the Sierra Nevada. This area covers approximately 5,200 square miles. In 2003, about 3,400 square miles were irrigated to grow crops and approximately 290 square miles of those crops were devoted to stone fruit and almonds (Karkoski et al., 2003).

This proposed Basin Plan Amendment addresses the diazinon and chlorpyrifos concentrations within the Sacramento and Feather Rivers and the sources of diazinon and chlorpyrifos within the Sacramento and Feather River watersheds. The geographic scope of this Basin Plan Amendment is defined as the Sacramento Valley floor below the major reservoirs (**Figure 2.1**).

In October 2006, the State Water Resources Control Board (State Water Board) adopted Resolution 2006-0079 Approving the Proposed Federal Clean Water Act Section 303(d) List of Water Quality Limited Segments for California. This Resolution included a list (in three parts) of surface waters considered impaired under the federal Clean Water Act. The Sacramento River between Knights Landing and the Delta has been listed as impaired for diazinon. The Feather River from the Lake Oroville Dam to the Confluence with the Sacramento River has been listed as impaired for Chlorpyrifos (SWRCB, 2006).

2.1.2 Hydrology

The Sacramento River Hydrologic Region includes the entire drainage area of the state's largest river and its tributaries, extending from the Oregon border downstream to the Sacramento – San Joaquin Delta. The region covers 27,246 square miles including all or a portion of 20 predominately rural Northern California counties, and extends from

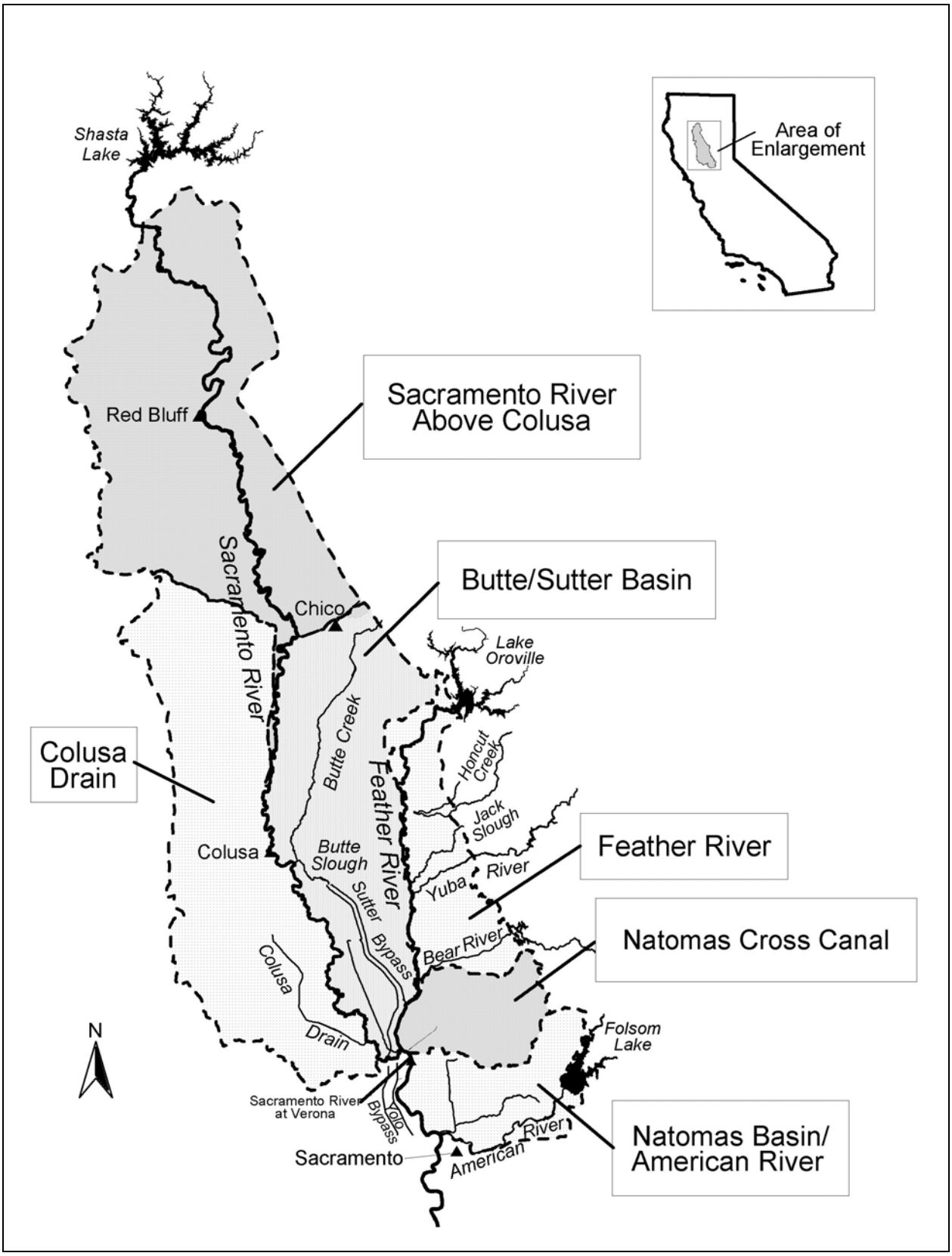


Figure 2.1. The Sacramento Valley

the crest of the Sierra Nevada in the east to the summit of the Coast Range in the west. The northernmost area, mainly high desert plateau, is characterized by cold, snowy winters with only moderate rainfall, and hot, dry summers. The mountainous parts in the north and east typically have cold, wet winters with large amounts of snow providing runoff for summer water supplies. The Sacramento Valley floor has mild winters with less precipitation and hot dry summers. Overall annual precipitation in the region generally increases as you move from south to north and west to east. The heavy snow and rain that falls in this region contributes to the overall water supply for the entire state (DWR, 2005).

The Sacramento River, in terms of both flow and drainage area, is the largest river in California. On average, over 22 million acre-feet of water flow from the Sacramento River watershed each year. The Sacramento River is 370 miles long and can be divided into three stretches. The upper Sacramento flows from just south of the Oregon border into Lake Shasta, the middle Sacramento flows from Lake Shasta to Red Bluff, and the lower Sacramento flows from Red Bluff to the Delta. (Dileanis et al., 2002). The lower Feather River is the largest natural tributary to the Sacramento River and flows approximately 60 miles through the Sacramento Valley from Oroville Dam to the confluence with the Sacramento River at Verona.

Hydrologically, the Sacramento Valley is a highly managed area, with reservoirs that are used for water supply and flood control on all the major tributaries of the lower Sacramento River, as well as diversions for municipal and agricultural uses and levies and bypasses for additional flood control. Both the Sutter and Yolo Bypasses can convey excess flow from the main channel of the Sacramento River. Areas reclaimed by these hydrologic manipulations are now highly productive agricultural lands and urban areas that are located in the historic flood plains of the Sacramento and Feather Rivers.

Inflow to the Sacramento and Feather Rivers comes from a variety of sources. In addition to the natural hydrologic processes of rainfall runoff, snowmelt, and base flow from groundwater discharge, flows are greatly affected by reservoir releases, water diversions, irrigation return flows, and diversions through bypasses. Both the Sutter and Yolo bypasses have the capacity to carry larger volumes of water than the Sacramento River channel when they are utilized to prevent flooding during high flows.

Both the Sacramento and Feather Rivers receive runoff from agricultural and urban land. The runoff from the agricultural land is often conveyed in a series of ditches before finally discharging to a river or stream. In some cases, the discharge may collect in a common conveyance maintained by a water district. In other instances, the conveyances to a river or stream may be farmer operated.

2.1.3 Surrounding Land Uses

Agriculture is the dominant land use in the Sacramento Valley, followed by urban development. About 3,400 square miles of Sacramento Valley land are irrigated to sustain a variety of crops such as rice, fruits, nuts, tomatoes, sugar beets, alfalfa, corn and wheat. About 290 square miles in the Sacramento Valley are devoted to stone fruit and almond orchards, mostly in the northern and central parts of the valley (DWR, 2001). More than 2 million people reside in the Sacramento Valley. The largest cities within the Sacramento Valley include Redding, Red Bluff, Chico, and Sacramento. Most of the urban area is concentrated in the southern part of the Sacramento Valley, near the city of Sacramento.

In the Sacramento Valley, total agricultural land use comprises 2,159,903 acres with the greatest percentage, 25.3 percent (547,301 acres), used for growing and cultivating rice. About 16 percent (336,366 acres) of the agricultural land in the Sacramento River Watershed is used to grow deciduous fruits and nuts, and grain and hay crops are grown on nearly 15 percent (322,569 acres) (DWR, 2001).

2.2 Sources, Transport and Effects of Diazinon and Chlorpyrifos in Surface Water

Diazinon and chlorpyrifos are man-made pesticides. The sources of the diazinon and chlorpyrifos found in Sacramento and Feather Rivers are urban and agricultural applications. In the Central Valley, diazinon and chlorpyrifos are used to exterminate destructive pests and insects such as aphids, spider mites, fleas, ants, roaches, and boring insects. A fraction of urban and agricultural diazinon and chlorpyrifos applications can reach surface water during rainfall or irrigation events, when residual diazinon and chlorpyrifos can migrate with stormwater runoff, irrigation return water, or rainwater, and enter the Sacramento or Feather Rivers or their tributaries.

Diazinon is moderately mobile and persistent in the environment. Due to its mobility and widespread use, diazinon has been detected in air, rain, fog, soil, surface water, and groundwater (U.S. EPA, 2000a). Diazinon has a moderately low vapor pressure (ranging from 6.4 to 18.7 milliPascals (mPa) at 20 degrees C (USDA, 1995a)) and Henry's law constant (estimated at 0.072 Pa-m^3/mol (USDA, 1995a)), indicating that a small fraction of applied diazinon is expected to volatilize from soil, crops, surface water or other surfaces into the atmosphere. Atmospheric diazinon can exist in particulate and vapor forms, as well as a solute dissolved in fog (Seiber et al., 1993). Atmospheric vapor-phase diazinon is degraded by reacting with photochemically-produced hydroxyl radicals, and the estimated half-life for this reaction is 4 hours (NLM, 2002). Particulate-phase diazinon may be removed from the air by wet and dry deposition (NLM, 2002). Diazinon also absorbs light in the environmental spectrum and has the potential for

direct photolysis in the atmosphere (NLM, 2002). Once in the atmosphere, diazinon can be transported by bulk movement of air and is subject to deposition processes (Larkin and Tjeerdema, 2000). Atmospheric transport of diazinon from the Central Valley to the Sierra Nevada Mountains has been found to occur, although diazinon levels decreased significantly with distance and elevation (Zabik and Seiber, 1993). Both dry and wet deposition processes can deposit atmospheric diazinon onto the ground surface, onto vegetation, or directly into surface waters.

Diazinon has a low to moderate tendency to adsorb to soil, with reported organic carbon adsorption coefficient (Koc) values of 1,007 to 1,842 (USDA, 1995a). In soils, diazinon can be degraded by hydrolysis, microbial degradation and photolysis, lost to surface and/or groundwater via runoff and/or leaching, and lost to the atmosphere via volatilization. Diazinon degrades more rapidly in acidic soils than neutral or alkaline soils, and degrades more rapidly in non-sterilized soils than sterilized soils (Larkin and Tjeerdema, 2000). Field dissipation half-life is a measure of the overall rate of disappearance of a pesticide from soil by leaching, runoff, hydrolysis, photolysis and microbial degradation. Reported diazinon field dissipation half-life values range from 3 to 54 days, with the range of 3 to 13 days considered to be the most representative of actual field conditions (USDA, 1995a). As a rule of thumb, the time needed for about 90 percent of the pesticide residue to dissipate is 4 times the field dissipation half-life (USDA, 1995a). Reported values for diazinon's half-life on vegetation range between 2 and 14 days (Sheipline, 1993).

Diazinon is moderately soluble in water with reported solubility values ranging from 40 to 60 parts per million (ppm) at 20 to 30ºC (USDA, 1995a). The solubility of diazinon is relatively high for a pesticide (Larkin and Tjeerdema, 2000) and diazinon's solubility values indicate that solubility is probably not limiting the movement of diazinon into solution for transport in moving water. Due to diazinon's moderate solubility and low to moderate tendency to adsorb to soil, it can move off of crops, soil and other surfaces and into surface water in runoff from rainfall and irrigation runoff. Atmospheric deposition has the potential to directly contribute to surface water diazinon concentrations. Sediment associated diazinon can also be mobilized by sediment runoff and transport of sediments in surface waters, but this may not be as important a mechanism of transport for diazinon, as approximately 98% of the diazinon in San Francisco Bay is reported to occur in the dissolved phase (Domagalski and Kuivila, 1993). In water, diazinon can be degraded by hydrolysis, photolysis, and microbial degradation, and lost via volatilization. All of these processes are strongly influenced by the pH, temperature, salinity and purity of water. The rate of hydrolysis of aqueous diazinon increases with high or low pH. Reported values for diazinon's hydrolysis half-life in water have been reported at 12 days (pH 5), 138 days (pH 7), and 77 days (pH 9) (Giddings et al., 2000). Reported values for diazinon's photolysis half-life in water range

from 15 to 25 days (Giddings et al., 2000). Estimates of diazinon's half-life in water in incubated bottles range from 14 to 99 days, and from 5 to 25 days in larger, open, outdoor experimental systems (Giddings et al., 2000).

Diazinon has a low to moderate potential to bioconcentrate in aquatic organisms with reported bioconcentration factors ranging form 4.9 to 152 (NLM, 2002). Depuration of accumulated diazinon is rapid, with experimental results showing 96 to 97 percent of accumulated diazinon residues eliminated from fish tissues within seven days (U.S. EPA, 2000a).

Chlorpyrifos can pollute surface water via spray drift at the time of application or as runoff up to several months after application (U.S. EPA, 2000b). Degradation of chlorpyrifos in soil, water and air may occur by hydrolysis, photolysis and microbial degradation. Chlorpyrifos has a moderately low volatility, with reported vapor pressures ranging from 2.3 to 12 milliPascals (mPa) at 20 to 35ºC (USDA, 1995b), and a moderately low Henry's law constant of 0.743 Pa-m3/mol at 25ºC (USDA, 1995b), indicating that a small fraction of applied chlorpyrifos is expected to volatilize from soil, crops, surface water or other surfaces into the atmosphere. When released into the atmosphere, the half-life of the vapor phase of chlorpyrifos is 6.43 hours when reacting with photochemically produced hydroxyls (Linde, 1994).

Reported values for the field dissipation half-life of chlorpyrifos in soil range from 4 to 139 days (USDA, 1995b), with an average half-life in soil of 30 days (U.S. EPA, 2000b). Chlorpyrifos has a greater tendency than diazinon to adsorb to soil and sediment, with reported organic carbon adsorption coefficient (Koc) values of 6,070 to 14,000 (USDA, 1995b). Chlorpyrifos is moderately soluble in water for a pesticide, with reported solubility values ranging from 0.45 to 1.18 parts per million at temperatures between 10 and 30ºC (USDA, 1995b). Available data indicate that most chlorpyrifos runoff is generally via adsorption to eroding soil rather than by dissolution in runoff water. However, under some conditions, dissolution in runoff water may be significant (U.S. EPA, 2000b).

The relatively low to moderate susceptibility of chlorpyrifos to hydrolysis (half-lives of 72 days at pHs 5 and 7 and 16 days at pH 9), direct aqueous photolysis (half-life of 30 days in sunlight), and low volatilization, and degradation under aerobic conditions indicate that chlorpyrifos will be somewhat persistent in the water columns of some aqueous systems that have relatively long hydrological residence times (U.S. EPA, 2000b). However, volatilization and/or adsorption to sediment may substantially reduce the persistence of dissolved chlorpyrifos in shallow waters and in waters receiving influxes of uncontaminated sediment, respectively (U.S. EPA, 2000b). The relatively low to moderate susceptibility of chlorpyrifos to degradation under anaerobic conditions

indicates that it will also be somewhat persistent in anaerobic bottom sediment (U.S. EPA, 2000b). Chlorpyrifos half-lives in pond sediment typically range from 14 to 64 days, with some longer times observed (Poletika and Robb, 1998).

Atmospheric transport and deposition of diazinon and chlorpyrifos can significantly affect surface water concentrations in the Central Valley (Majewski et al., 2005). Atmospheric deposition tends to be correlated to proximity to application areas as well as the timing and amount of pesticide used (Majewski et al., 2005). In the Central Valley, wet deposition appears to be the more important mechanism of diazinon deposition, while dry deposition appears to be the more important mechanism of chlorpyrifos deposition (Majewski et al., 2005).

Diazinon and chlorpyrifos can be acutely toxic to aquatic life, wildlife, and humans. Aquatic invertebrates appear to be the aquatic organisms most sensitive to chlorpyrifos and diazinon exposure (Giddings et al., 2000). When ingested by an organism, diazinon and chlorpyrifos cause toxicity through inactivation of the enzyme acetylcholinesterase (AChE) that is involved in nerve impulse transmission. This inactivation of the AChE enzyme results in a variety of lethal and sub-lethal toxic effects (Larkin and Tjeerdema, 2000). When present in a mixture, diazinon and chlorpyrifos display additive toxicity (Bailey et al., 1997). After uptake, aquatic organisms remove diazinon and chlorpyrifos from the body relatively rapidly (Giddings et al., 2000). Partly due to these rapid depuration rates, diazinon and chlorpyrifos have only a moderate tendency to bioconcentrate in aquatic organisms (Giddings et al., 2000), and are not expected to biomagnify in aquatic food webs.

2.3 Diazinon and Chlorpyrifos in the Sacramento and Feather Rivers

This section describes the available information about the sources of diazinon and chlorpyrifos in the Sacramento and Feather Rivers (study area), and the magnitude, timing and seasonality of diazinon and chlorpyrifos concentrations in surface waters within the study area. When appropriate, additional information, results and observations from previous studies are also included.

The 2003 Staff Report (Karkoski et al., 2003) included a detailed review of diazinon use within the Sacramento Valley and an evaluation of surface water quality data in Sacramento Valley watersheds. The source of the use-data was the Department of Pesticide Regulation's Pesticide Use Report (PUR) database, which at that time was current up through 2001. The 2003 Staff Report did not cover chlorpyrifos. At the time of this writing, new pesticide use data has been released by DPR, current through 2004. This section discusses overall use patterns for diazinon and chlorpyrifos during the last 5 years, including the new 2002 through 2004 data from the PUR database.

Consistent with the methodology used for the 2003 report, diazinon and chlorpyrifos use data were obtained from the Pesticide Use Report (PUR) database (DPR, 2006a) and summed for each cartographic section (an area of roughly one square mile) within the Sacramento Valley for the period of study 2000-2004. Additional data on pesticide use from 1994 on was used for long-term use-trend analysis. Database software and Geographic Information Systems (GIS) was then used to prepare use summaries.

Diazinon and chlorpyrifos concentration data were obtained from numerous studies and programs funded and conducted by several agencies and institutions that sampled surface water in the Sacramento and Feather Rivers and their tributaries from 1994 through 2006. This data was used to prepare concentration trend summaries which are compared to use-trend information. The titles of the studies used, as well as the sites, timing and frequency of sampling are summarized in **Appendix A**.

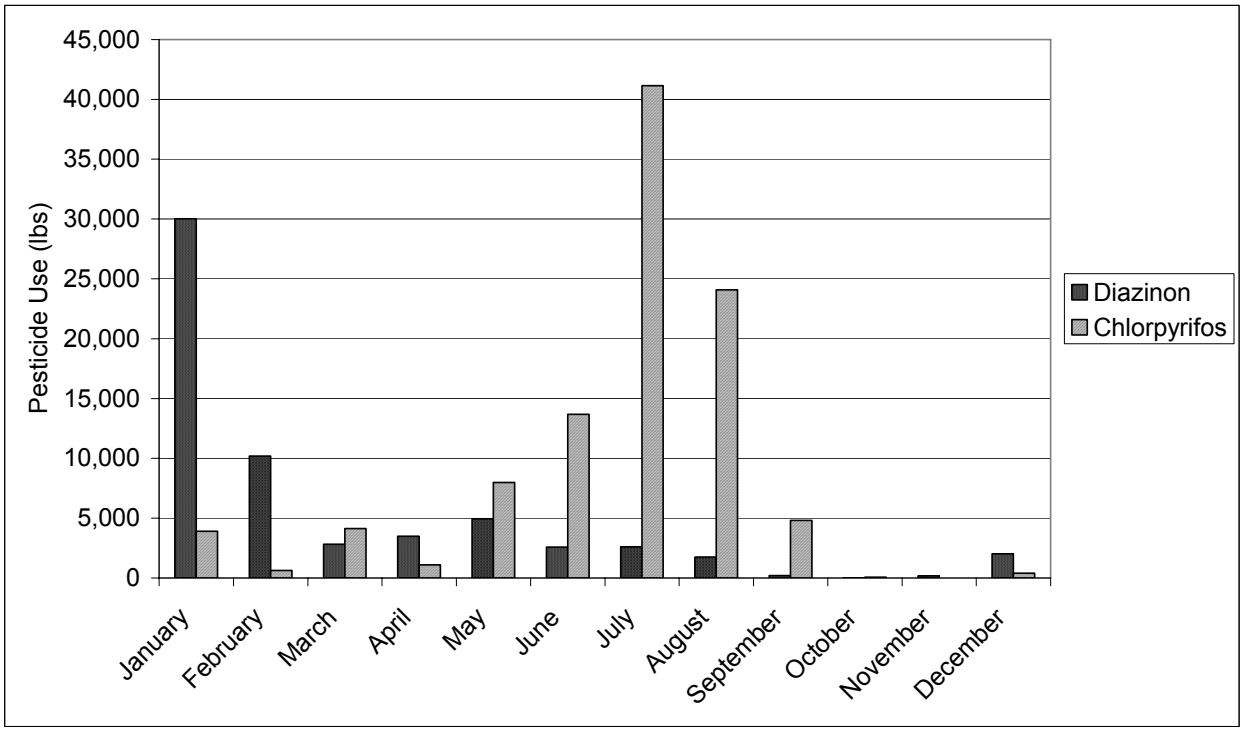
2.3.1 Diazinon and Chlorpyrifos Use in the Sacramento Valley

Agricultural uses[1] of diazinon and chlorpyrifos in the study area averaged 60,847 and 101,945 lbs/year respectively, using the most recent five years of available data, 2000 through 2004. **Figure 2.2** shows the average agricultural use of diazinon and chlorpyrifos by month in the Sacramento Valley. Use of diazinon and chlorpyrifos during the year can be grouped into two main seasons: the dormant season, December through February; and the irrigation season, March through November. Diazinon is primarily used during the dormant season and chlorpyrifos during the irrigation season. However, significant seasonal overlap in usage does occur, and is discussed further in **Section 2.3.2.2**.

During the dormant season, dormant orchards of nuts and stone fruits and other tree crops are sprayed to limit damage from several potential pests. Diazinon is heavily used in the dormant spray season (42,230 lbs on average between 2000 and 2004, or 69% of average annual agricultural diazinon use), while chlorpyrifos dormant season use is relatively light (4,964 lbs on average between 2000 and 2004 or 5% of average annual agricultural chlorpyrifos use). The “irrigation season” includes the month of November, when irrigation typically does not occur, though minimal amounts of diazinon (169 Lbs) and chlorpyrifos (2 Lbs) are still applied to some crops. During the irrigation season, agricultural chlorpyrifos use averages 97,022 lbs (95% of average

[1] As discussed at the end of this section, since most non-agricultural uses of chlorpyrifos and diazinon have been cancelled recently, most of the tables, figures and discussion in this section focuses on agricultural uses.

Figure 2.2. Monthly Agricultural Diazinon and Chlorpyrifos Applications in the Sacramento Valley (2000-2004 average)



annual agricultural use), which is much higher than diazinon, but significant quantities of diazinon are also used. Agricultural diazinon use averages approximately 18,617 lbs for the irrigation season (31% of average annual agricultural use).

Table 2.1 shows the top ten (based on annual average) reported agricultural uses of diazinon between 2000 and 2004. These uses account for 98% of the reported uses during the study period. All other reported uses were only 2% of the total use for this period. Based on this data, the predominant sites of diazinon use are, in decreasing total annual amounts, plum (fresh and dried), peach, almond, walnut, and tomato, and to a lesser extent, melon, cherry, apple, pear, and watermelon. This is consistent with the findings of the 2003 staff report.

Table 2.2 summarizes the major diazinon uses (uses averaging approximately 1,000 lbs or 5% of seasonal use, or greater) for the dormant and irrigation seasons. During the dormant spray season, dormant orchards are sprayed with a mixture of pesticides and dormant oils to limit crop and tree damage from several potential pests. Dormant orchard sprays are typically applied via a tractor-pulled airblast sprayer. During this season, diazinon is used principally on of plum (fresh and dried), peach and almond orchards. These three crops represent 97% of dormant season use and 67% of total annual use. These were also the major uses identified in the 2003 Staff Report.

Table 2.1. Top 10 Reported Diazinon Uses In the Sacramento Valley 2000-2004

Crop[2]	2000		2001		2002		2003		2004		2000-2004 Average	
	Lbs	%	Lbs	%	Lbs	%	Lbs	%	Lbs	%	Lbs	%
Plum (Fresh and Dried)	33,630	51%	25,791	45%	28,932	38%	24,371	41%	13,032	28%	25,151	41%
Peach	8,665	13%	9,564	17%	16,365	22%	22,793	38%	12,648	27%	14,007	23%
Almond	6,080	9%	11,557	20%	12,117	16%	5,167	9%	11,939	26%	9,372	15%
Walnut	6,031	9%	3,707	7%	7,247	10%	3,713	6%	5,437	12%	5,227	9%
Tomato	6,175	9%	4,870	9%	10,124	13%	2,023	3%	2,502	5%	5,139	8%
Melon	1,944	3%	1	<1%	51	<1%	14	<1%	86	<1%	419	1%
Cherry	422	1%	70	<1%	500	1%	637	1%	459	1%	418	1%
Apple	436	1%	6	<1%	10	<1%	382	1%	314	1%	230	0.4%
Pear	7	<1%	625	1%	39	<1%	379	1%	61	<1%	222	0.4%
Watermelon	346	1%	96	<1%	52	<1%	24	<1%	55	<1%	115	0.2%
Other	1,625	2%	569	1%	215	<1%	228	<1%	103	<1%	548	1%
Total	65,362 Lbs		56,856 Lbs		75,652 Lbs		59,731 Lbs		46,636 Lbs		60,847 Lbs	

Table 2.2. Seasonal Agricultural Diazinon Applications in the Study Area (2000-2004 Average)

Dormant Season (Dec-Feb)			**Irrigation Season (Mar-Nov)**		
Crop	**Lbs Applied**	**% Of Dormant Season Use**	**Crop**	**Lbs Applied**	**% Of Irrigation Season Use**
Plum (Fresh and Dried)	18,093	43%	Plum (Fresh and Dried)	7,058	38%
Peach	13,565	32%	Walnut	5,202	28%
Almond	9,329	22%	Tomato	4,869	26%
Total of Uses Shown	40,987	97%	Total of Uses Shown	17,129	92%
Dormant Season Use	42,230 lbs		Irrigation Season Use	18,617 lbs	
% of Annual Use	69%		% of Annual Use	31%	

During the irrigation season most of the agricultural diazinon uses are on (in descending order of amount used) plums, walnuts and tomatoes. The main use of diazinon during March, April and May is application to plum (fresh and dried) and tomato crops. The

[2] Some crop classifications listed in this report have been grouped based on similar growth patterns and pesticide use. For example the PUR database list separate entries for fresh plums and dried plums (prunes). In addition, the PUR database includes some distinctions in categories based on final end use. For example the PUR database provides separate listings for Tomato and Tomato for processing. These are not critical distinctions for this report. Finally, some non-specific PUR categories have been grouped with specific categories of similar crops. For example, the melon category listed above includes the general PUR category of "melons" and also cantaloupes.

main uses of diazinon during June, July and August are applications to walnut with some additional use on plum in June. During October and November the most significant use of diazinon is a minor application (less than 200 Lbs) to plum and peach orchards following harvest.

There has been a dramatic reduction in total diazinon use over the most recent ten years reported. **Figure 2.3** provides a graph showing annual diazinon use by season for the period of 1995 through 2004. **Figure 2.4** provides the same data but presented as a 3-year running average to attenuate year-to-year fluctuations not related to overall long-term use trend. During the ten-year study period, diazinon use dropped from 140,000 lb/year to 46,000 per year, or a 67% reduction. However, most of that reduction occurred in the irrigation season. Dormant season diazinon use has been cut in half, but the most dramatic reductions occurred prior to 2001. Between 2001 and 2004, there has been no significant reduction in dormant season diazinon use and only a minor decrease in total diazinon use.

Table 2.3 shows the top ten reported agricultural uses of chlorpyrifos between 2000 and 2004. These uses account for more than 98% of the reported uses during the study period. All other reported uses were less than 2% of the total use for this period. Based on this data, the predominant sites of chlorpyrifos use are, in decreasing total annual amounts, walnut, almond, alfalfa, plum (fresh and dried), peach, cotton, sugar beet, apple and corn.

Table 2.3. Highest Reported Chlorpyrifos Uses in the Sacramento Valley 2000-2004

CROP	2000		2001		2002		2003		2004		2000-2004 AVERAGE	
	Lbs	%	Lbs	%	Lbs	%	Lbs	%	Lbs	%	Lbs	%
Walnut	56,635	61%	57,635	69%	63,993	64%	72,199	65%	78,819	65%	65,856	65%
Almond	19,767	21%	11,664	14%	16,571	17%	20,595	18%	29,616	24%	19,642	19%
Alfalfa	4,090	4%	4,643	6%	13,302	13%	8,149	7%	4,580	4%	6,953	7%
Plum (Fresh and Dried)	4,756	5%	1,456	2%	2,052	2%	4,230	4%	982	1%	2,695	3%
Peach	142	<1%	955	1%	665	1%	4,830	4%	4,790	4%	2,276	2%
Cotton	1,940	2%	4,525	5%	489	<1%	205	0%	2,114	2%	1,855	2%
Sugar beet	1,991	2%	0	0%	0	0%	0	0%	0	0%	398	0.4%
Apple	1,790	2%	0	0%	12	<1%	10	<1%	2	<1%	363	0.4%
Corn	595	1%	15	<1%	676	1%	380	<1%	0	0%	333	0.3%
Other	1,650	1.8%	2,150	2.6%	2,110	2.1%	916	0.8%	1,039	0.9%	1,573	1.5%
Total	93,357 Lbs		83,042 Lbs		99,870 Lbs		111,514 Lbs		121,941 Lbs		101,945 Lbs	

Figure 2.3. Annual Diazinon Use by Season (1995-2004)

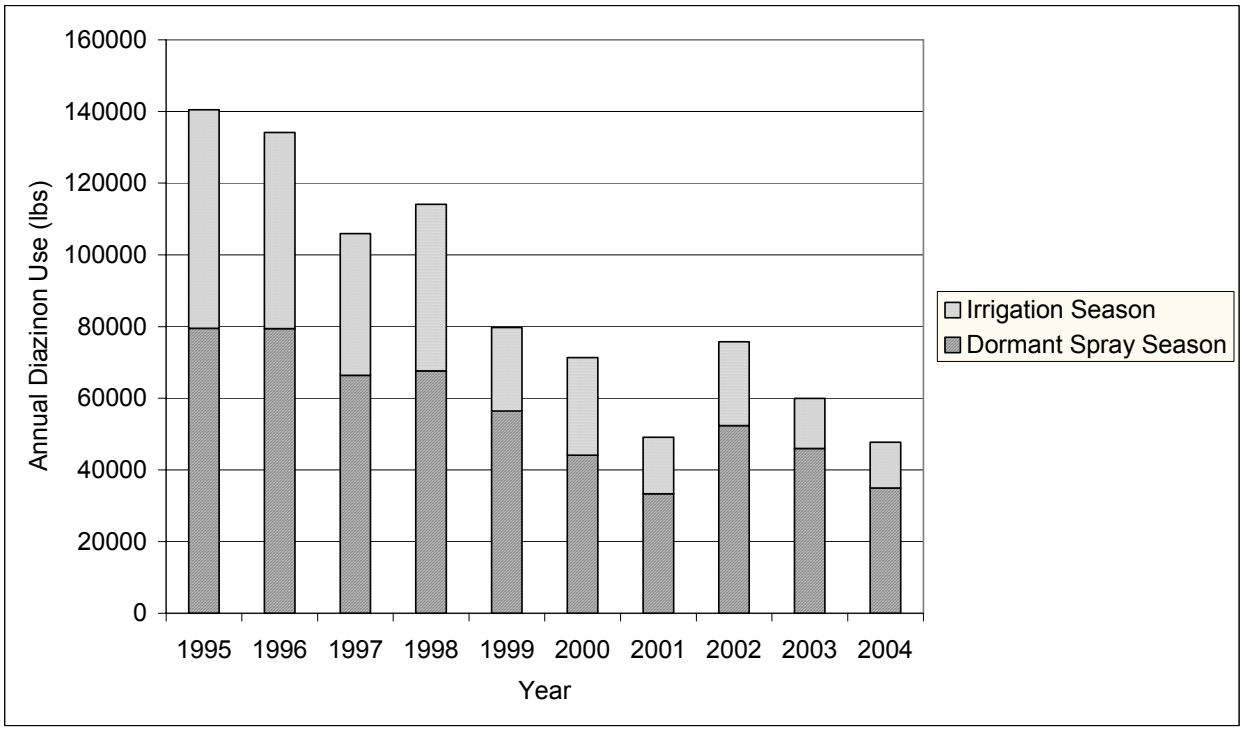


Figure 2.4. 3-Year Running Annual Average Diazinon Use by Season (1995-2004)

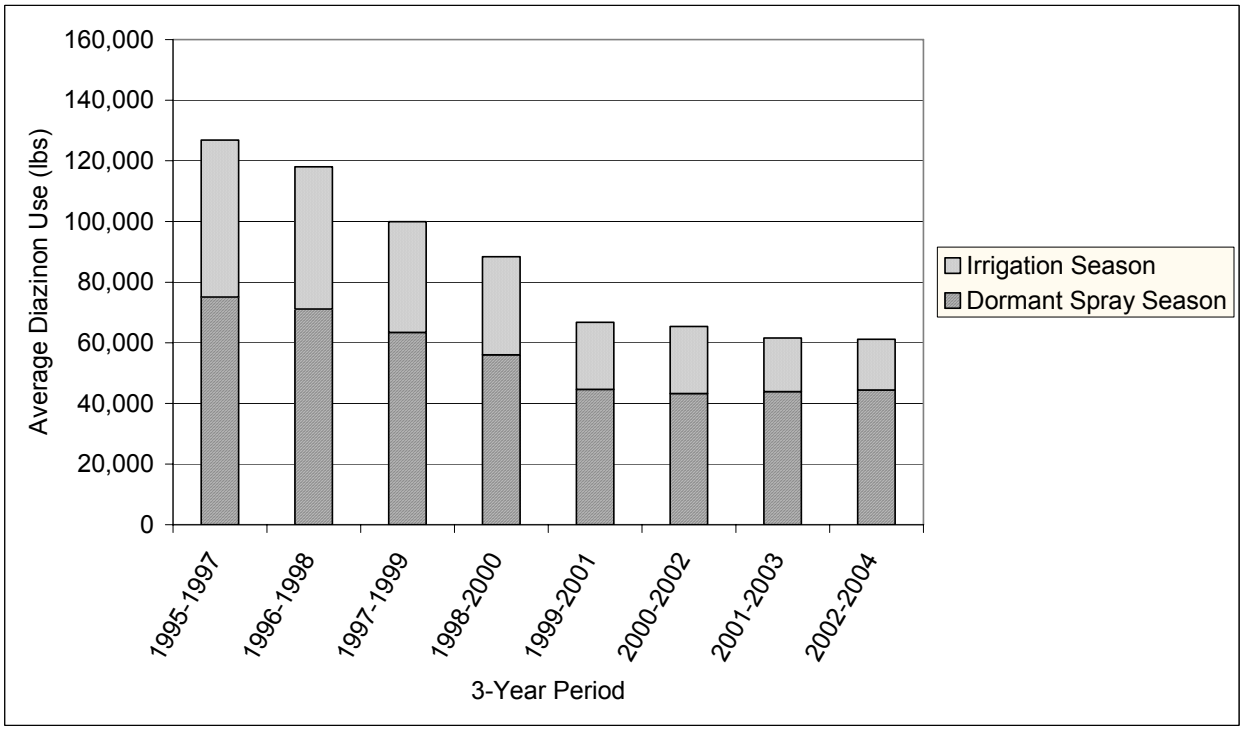


Table 2.4 summarizes the major chlorpyrifos uses (greater than 500 lbs or 5% of seasonal use) for the dormant and irrigation seasons. During the dormant season, when approximately 5% of the annual chlorpyrifos use occurs, the main chlorpyrifos uses are dormant season spraying of plum (fresh and dried) and peach orchards. During the irrigation season most of the agricultural use of chlorpyrifos is on (in order of descending amount applied) walnuts, almonds, alfalfa and cotton. During March, the predominant use of chlorpyrifos is on alfalfa. Chlorpyrifos is also used on alfalfa in significant amounts in August. Beginning in May and continuing through September, the main use of chlorpyrifos is on walnuts, but almonds, cotton and, as discussed above, alfalfa also receive significant applications in those months. Use of chlorpyrifos in October and November is minimal and consists of minor applications (less than 100 lbs total) to grasses and oranges.

A review of total annual chlorpyrifos use over the last ten reported years is provided in **Figure 2.5** and a rolling 3-year average is provided as **Figure 2.6**. Annual use of chlorpyrifos varied significantly from 1995 to 2001, but as shown in **Figure 2.6**, the overall trend was towards less annual usage. Beginning in 2001 and continuing through 2004, there was an increasing trend in total annual chlorpyrifos use. In addition, dormant season use, though minor compared to overall chlorpyrifos use, shows a general upward trend throughout the ten-year period.

Unlike agricultural pesticide use, which must be reported to the DPR in pesticide use reports, pesticides used in the urban environment include both reported and unreported uses. Only professional urban applications must be reported to DPR. Professional

Table 2.4. Seasonal Agricultural Chlorpyrifos Applications in the Study Area (2000-2004 Average)

Dormant Season (Dec-Feb)			Irrigation Season (Mar-Nov)		
Crop	**Lbs Applied**	**% Of Dormant Season Use**	**Crop**	**Lbs Applied**	**% Of Irrigation Season Use**
Plum (Fresh and Dried)	2,425	49%	Walnuts	65,802	68%
Peach	2,269	46%	Almonds	19,550	20%
			Alfalfa	6,940	7%
			Cotton	1,855	2%
Total Of Uses Shown	4,694	95%	Total Of Uses Shown	94,147	97%
Total Dormant Season Use	4,922		Total Irrigation Season Use	97,022	
% Of Annual Average	5%		% Of Annual Average	95%	

Figure 2.5. Annual Chlorpyrifos Use by Season (1995-2004)

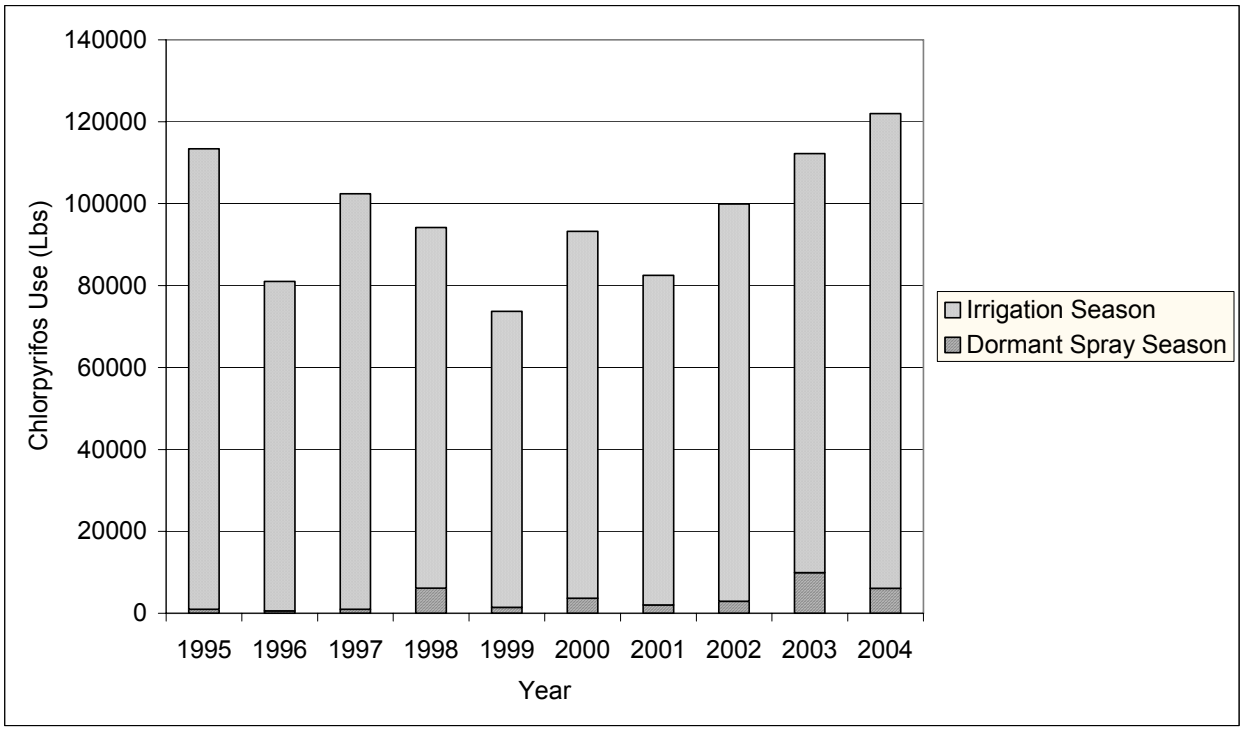
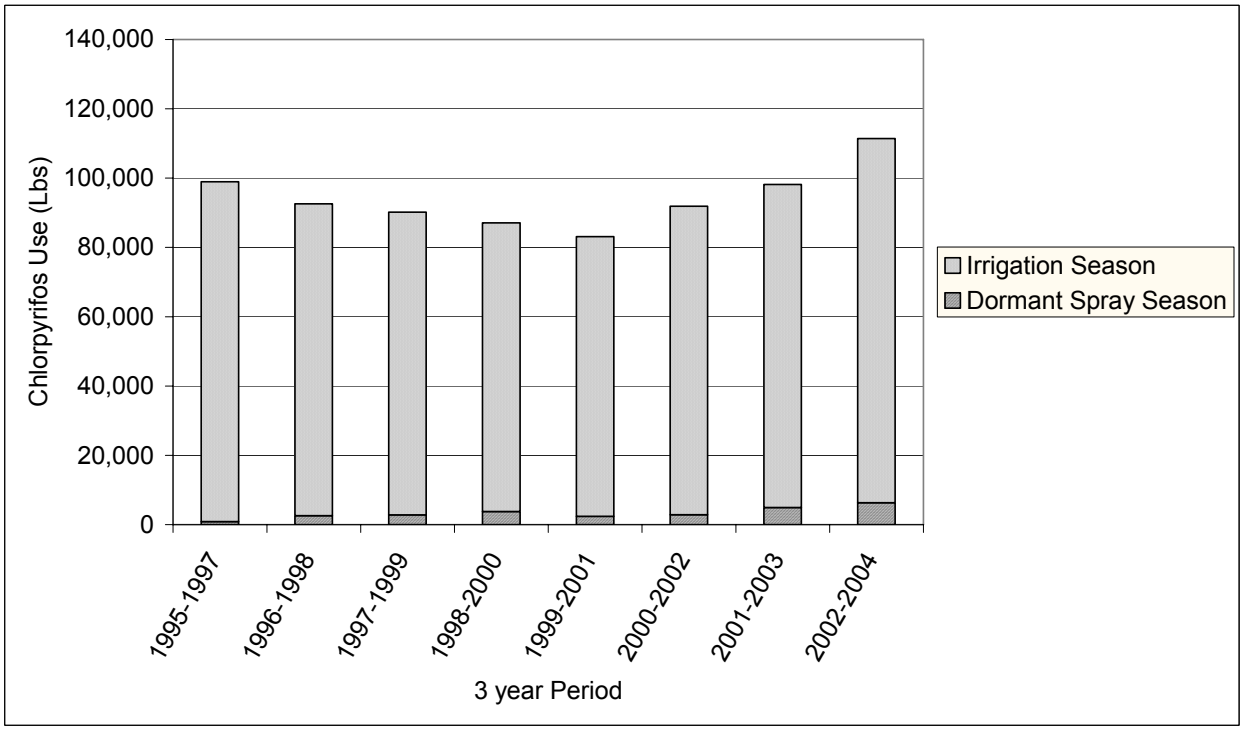


Figure 2.6. 3-Year Running Annual Average Chlorpyrifos Use by Season (1995-2004)



applications include structural and landscape pest control, and restaurant and commercial building pest control. Residential pesticide use, such as animal-care products, and home and garden pest control are not reported, but previous to their phase-out, their use was very common in urban areas.

Sale of both diazinon and chlorpyrifos for use in indoor and outdoor areas where children could be exposed (schools, playgrounds, parks) was cancelled by recent U.S. EPA regulations. Sales of chlorpyrifos and diazinon for indoor uses were cancelled effective December 31, 2001 and December 31, 2002, respectively. Manufacturers of diazinon were required to stop the sale of diazinon formulations for outdoor non-agricultural uses by August 2003. Retailers were required to stop the sale of diazinon for outdoor non-agricultural uses after December 2004. Consumers will be able to use their remaining supplies until depleted. A few "low risk" structural uses of chlorpyrifos, where children are not exposed, are still permitted. These uses include ship holds, railroad boxcars, industrial plants, manufacturing plants, food processing plants, golf courses, road medians, treatment of utility poles and other outdoor wood products, fire ant mounds and mosquito control. The ban on residential urban use of chlorpyrifos and diazinon should reduce the potential for water quality impacts from these pesticides in urban areas. Pyrethroids and carbamates are being used as replacements for many urban (and agricultural) uses, and these may also cause aquatic toxicity impacts (TDC Environmental, 2003).

2.3.2 Diazinon and Chlorpyrifos in Surface Water in the Sacramento and Feather Rivers

Over the past 15 years (1991 to 2006), a considerable amount of pesticide sampling has taken place in the Sacramento and Feather Rivers watersheds. Multiple studies (summarized in **Appendix A)** conducted by the United States Geological Survey, California Regional Water Quality Control Board-Central Valley Region, and others have detected diazinon and chlorpyrifos concentrations at levels of concern in the Sacramento and Feather Rivers and many of their tributaries. Beneficial uses potentially affected by the concentrations of diazinon and chlorpyrifos in the Sacramento and Feather Rivers include Warm (WARM) and Cold (COLD) Freshwater Habitat (CVRWQCB, 2006a).

Figure 2.7 shows major sampling locations that are useful in understanding the transport and presence of diazinon and chlorpyrifos within the Sacramento and Feather Rivers due their location, hydrology and data availability. **Tables 2.5** and **2.6** summarize diazinon and chlorpyrifos data for key sites. **Figures 2.8** and **2.9** provide box plots of the sampling data. Data for additional sampling sites are summarized in

Figure 2.7. Major Sampling Locations along the Sacramento and Feather Rivers

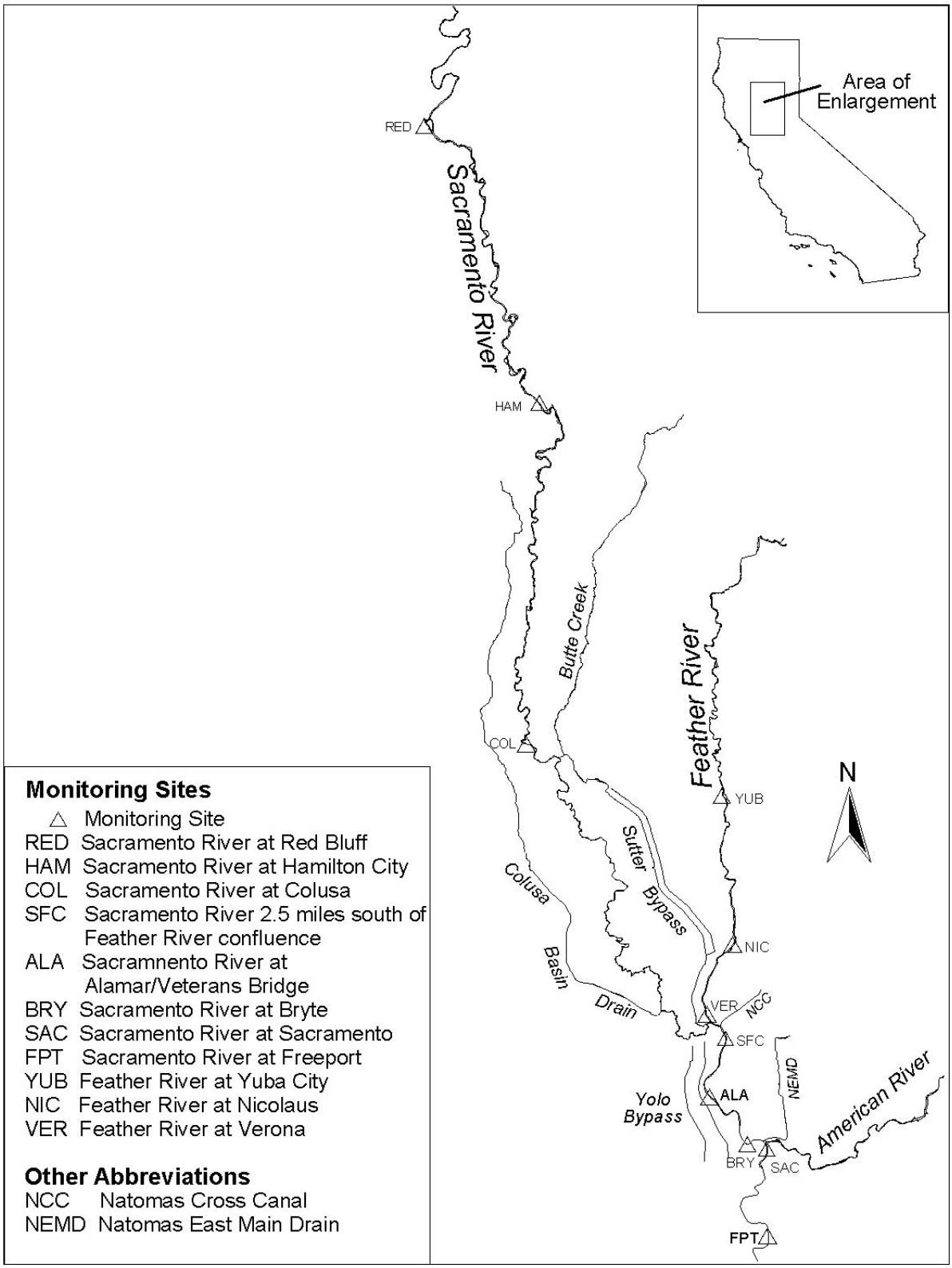


Table 2.5. Diazinon Concentrations in Key Sacramento and Feather Rivers Watersheds Sites, 1999-2006

Location	Water Year	# Of Samples	Concentration (Ng/L)			Samples Exceeding Objective							
						4-Day Average[3]				1-Hour Average			
						Current (50 ng/L)		Proposed (100 ng/L)		Current (80 ng/L)		Proposed (160 ng/L)	
			Median	90th Percentile	Max	#	%	#	%	#	%	#	%
Feather R at Yuba City	1994	28	ND	**100**	**166**	**8 (4)**	29%	**4 (2)**	7%	**6**	21%	**1**	4%
	2000	9	**52**	**93**	**97**	**5 (2)**	56%	0	0%	**2**	22%	0	0%
	2001	10	ND	18	20	0	0%	0	0%	0	0%	0	0%
	2002	2	ND	ND	ND	0	0%	0	0%	0	0%	0	0%
	2003	4	ND	ND	ND	0	0%	0	0%	0	0%	0	0%
	2004	4	ND	ND	ND	0	0%	0	0%	0	0%	0	0%
	2005	1	ND	ND	ND	0	0%	0	0%	0	0%	0	0%
	2006	5	ND	4	7	0	0%	0	0%	0	0%	0	0%
Feather R nr outlet	1994	30	14	**260**	**834**	**9 (8)**	30%	**6 (4)**	20%	**7**	23%	**4**	13%
	1996	10	ND	ND	ND	0	0%	0	0%	0	0%	0	0%
	1997	13	ND	ND	98	**1 (1)**	8%	0	0%	**1**	8%	0	0%
	1998	6	ND	**257**	**515**	**1 (1)**	17%	**1 (0)**	17%	**1**	17%	**1**	17%
	2000	20	24	**60**	**130**	**4 (2)**	20%	**1 (1)**	5%	**1**	5%	0	0%
	2001	18	5	16	28	0	0%	0	0%	0	0%	0	0%
	2002	16	7	33	47	0	0%	0	0%	0	0%	0	0%
	2003	21	8	14	22	0	0%	0	0%	0	0%	0	0%
	2004	21	14	40	**110**	**1 (0)**	5%	**1 (0)**	5%	**1**	5%	0	0%
	2005	10	13	15	19	0	0%	0	0%	0	0%	0	0%
	2006	5	ND	3	5	0	0%	0	0%	0	0%	0	0%
Sac R at Hamilton City	1994	4	**60**	**115**	**134**	**2 (2)**	50%	**1 (0)**	25%	**1**	25%	0	0%
	1999	6	ND	ND	ND	0	0%	0	0%	0	0%	0	0%
	2000	9	ND	ND	ND	0	0%	0	0%	0	0%	0	0%
	2001	14	ND	ND	ND	0	0%	0	0%	0	0%	0	0%
	2002	4	ND	ND	ND	0	0%	0	0%	0	0%	0	0%
	2003	4	ND	ND	ND	0	0%	0	0%	0	0%	0	0%
	2004	4	ND	28	40	0	0%	0	0%	0	0%	0	0%

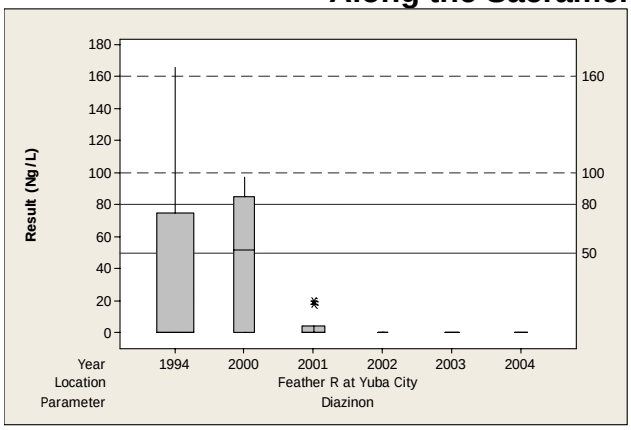
Table continues on next page

[3] Numbers in the 4-Day Average Column indicate the number of days where the daily average exceeded 15 ng/l. Because the objective is stated as a 4 day average, the actual number of exceedances does not necessarily equal the number of days that exceeded 15 ng/L. In these cases, the number of exceedances is indicated as the number in paragraphs.

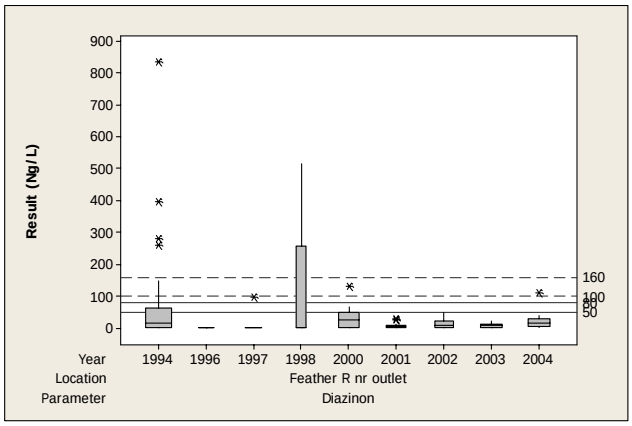
Table 2.5 (cont.). Diazinon Concentrations in Key Sacramento and Feather Rivers Watersheds Sites, 1999-2006

Location	Water Year	# Of Samples	Concentration (Ng/L)			Samples Exceeding Objective							
						4-Day Average				1-Hour Average			
						Current (50 ng/L)		Proposed (100 ng/L)		Current (80 ng/L)		Proposed (160 ng/L)	
			Median	90th Percentile	Max	#	%	#	%	#	%	#	%
Sac R at Colusa	1994	29	20	**91**	**200**	**6 (4)**	21%	**3 (0)**	10%	**4**	14%	**1**	3%
	1999	7	ND	ND	ND	0	0%	0	0%	0	0%	0	0%
	2000	19	ND	34	**77**	**2 (0)**	11%	0	0%	0	0%	0	0%
	2001	25	ND	26	43	0	0%	0	0%	0	0%	0	0%
	2002	13	8	13	24	0	0%	0	0%	0	0%	0	0%
	2003	20	ND	11	**55**	**1 (0)**	5%	0	0%	0	0%	0	0%
	2004	19	14	**85**	**160**	**4 (0)**	21%	**2 (0)**	11%	**2**	11%	0	0%
	2005	11	ND	ND	ND	0	0%	0	0%	0	0%	0	0%
	2006	5	8	15	16	0	0%	0	0%	0	0%	0	0%
Sac R at Alamar	1995	3	50	**66**	**70**	**1 (1)**	33%	0	0%	0	0%	0	0%
	1997	11	ND	11	21	0	0%	0	0%	0	0%	0	0%
	1998	40	ND	**95**	**171**	**14 (11)**	35%	**4**	10%	**7**	18%	**1**	3%
	1999	45	ND	ND	11	0	0%	0	0%	0	0%	0	0%
	2000	60	ND	39	**65**	**3 (0)**	5%	0	0%	0	0%	0	0%
	2001	33	ND	37	**77**	**1 (0)**	3%	0	0%	0	0%	0	0%
	2002	37	ND	24	28	0	0%	0	0%	0	0%	0	0%
	2003	35	ND	15	**51**	**1 (0)**	3%	0	0%	0	0%	0	0%
	2004	27	19	**54**	**220**	**3 (1)**	11%	**2 (0)**	7%	**2**	7%	**1**	4%
	2005	17	ND	8	11	0	0%	0	0%	0	0%	0	0%
	2006	15	ND	8	9	0	0%	0	0%	0	0%	0	0%
Sac R at Sacramento	1991	48	ND	ND	9	0	0%	0	0%	0	0%	0	0%
	1992	139	ND	22	**155**	**4 (3)**	3%	**1 (0)**	1%	**1**	1%	0	0%
	1993	173	ND	**58**	**307**	**20 (21)**	12%	**9 (11)**	5%	**10**	6%	**5**	3%
	1994	78	ND	**78**	**253**	**10 (13)**	13%	**6 (8)**	8%	**8**	10%	**3**	4%
	1995	2	16	26	29	0	0%	0	0%	0	0%	0	0%
	2000	16	27	42	**61**	**1 (0)**	6%	0	0%	0	0%	0	0%
	2001	12	19	**59**	**96**	**2 (2)**	17%	0	0%	**1**	8%	0	0%
	2003	26	8	12	23	0	0%	0	0%	0	0%	0	0%
	2004	18	25	**69**	**78**	**4 (1)**	22%	0	0%	0	0%	0	0%
	2005	13	7	8	8	0	0%	0	0%	0	0%	0	0%

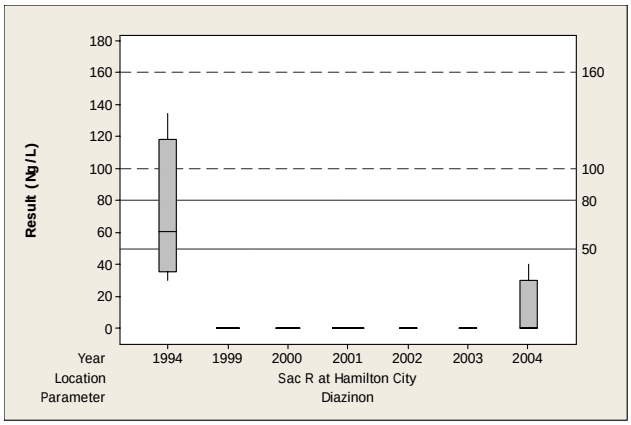
Figure 2.8. Box Plots of Diazinon Concentrations at Key Monitoring Locations Along the Sacramento and Feather Rivers.



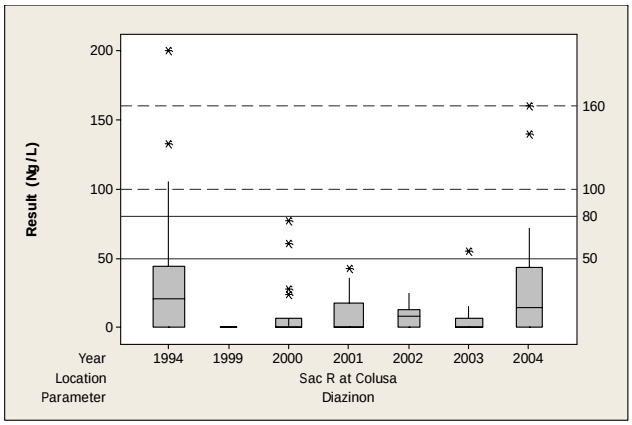
(a)



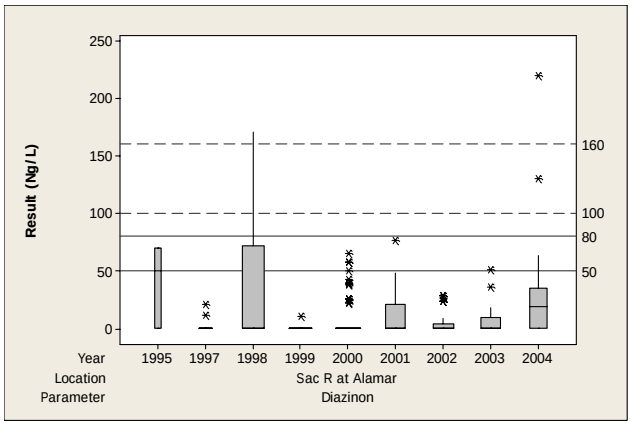
(b)



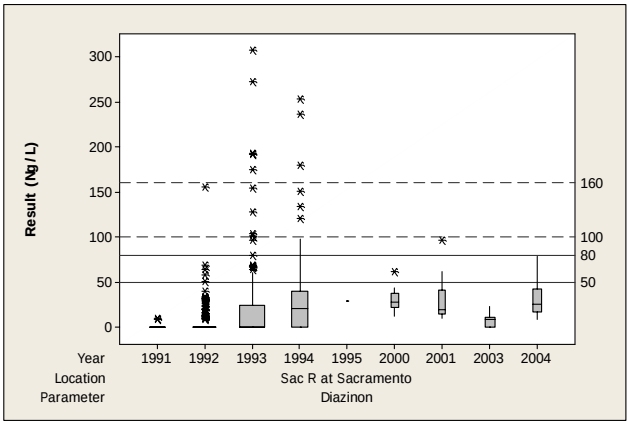
(c)



(d)



(e)



(f)

Note: The above box plots show diazinon concentration trends at major sampling points along the Sacramento and Feather Rivers. The box represents the interquartile range of samples taken during the year. Box widths are relative to size of the sample set. The line inside the box represents the median. Boxes with no apparent line have medians below the analytical detection limits. The vertical lines represent 1.5 times the interquartile range. Stars above the box represent outliers (Samples higher than the median by more than 1.5 times the interquartile range). The horizontal lines at 50, 80, 100 and 160 ng/L represent the current (solid line) and proposed (dashed line) diazinon water quality objectives.

Table 2.6. Chlorpyrifos Concentrations in the Sacramento and Feather Rivers, 1991 – 2006

Location	Water Year	# of Samples	Concentration (ng/L)			Samples Exceeding Objective			
						4-Day Average (15 ng/L)[4]		1-Hour Average (25 ng/L)	
			Median	90th Percentile	Max	#	%	#	%
Feather R at Yuba City	2000	3	ND	ND	ND	0	0%	0	0%
	2002	2	ND	ND	ND	0	0%	0	0%
	2003	4	ND	ND	ND	0	0%	0	0%
	2004	4	ND	ND	ND	0	0%	0	0%
	2005	1	ND	ND	ND	0	0%	0	0%
Feather R nr outlet	1996	10	ND	ND	ND	0	0%	0	0%
	1997	12	ND	ND	ND	0	0%	0	0%
	1998	5	ND	ND	ND	0	0%	0	0%
	2000	19	ND	4	6	0	0%	0	0%
	2001	18	ND	1	2	0	0%	0	0%
	2002	14	ND	ND	ND	0	0%	0	0%
	2003	21	ND	9	**19**	**1 (0)**	**5%**	0	0%
	2004	21	5	14	**51**	**2 (1)**	**10%**	**1**	**5%**
	2005	10	ND	ND	ND	0	0%	0	0%
Sac R at Hamilton City	1999	7	ND	ND	ND	0	0%	0	0%
	2000	10	ND	ND	ND	0	0%	0	0%
	2001	8	ND	ND	ND	0	0%	0	0%
	2002	4	ND	ND	ND	0	0%	0	0%
	2003	4	ND	ND	ND	0	0%	0	0%
	2004	4	ND	**20**	**29**	**1 (1)**	**25%**	**1**	**25%**

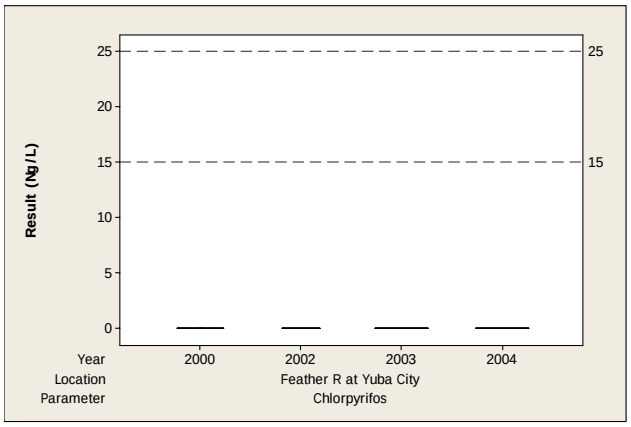
Table continues on next page

[4] Numbers in the 4-Day Average Column indicate the number of days where the daily average exceeded 15 ng/l. Because the objective is stated as a 4 day average, the actual number of exceedances does not necessarily equal the number of days that exceeded 15 ng/L. In these cases, the number of exceedances is indicated as the number in paragraphs.

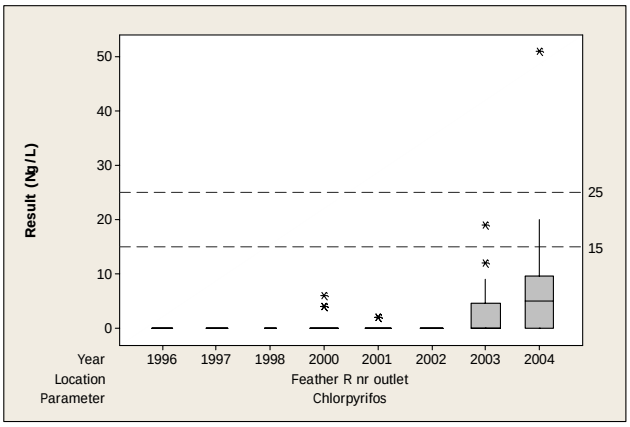
Table 2.6. (cont.) Chlorpyrifos Concentrations in the Sacramento and Feather Rivers, 1991 – 2006

Location	Water Year	# of Samples	Concentration (ng/L)			Samples Exceeding Objective			
						4-Day Average (15 ng/L)		1-Hour Average (25 ng/L)	
			Median	90th Percentile	Max	#	%	#	%
Sac R at Colusa	1999	7	ND	ND	ND	0	0%	0	0%
	2000	13	ND	ND	ND	0	0%	0	0%
	2001	20	ND	ND	ND	0	0%	0	0%
	2002	14	ND	ND	ND	0	0%	0	0%
	2003	20	ND	ND	5	0	0%	0	0%
	2004	19	ND	1	5	0	0%	0	0%
	2005	11	ND	ND	ND	0	0%	0	0%
Sac R at Alamar	1998	30	ND	ND	ND	0	0%	0	0%
	1999	41	ND	ND	ND	0	0%	0	0%
	2000	48	ND	ND	ND	0	0%	0	0%
	2001	57	ND	ND	2	0	0%	0	0%
	2002	26	ND	ND	ND	0	0%	0	0%
	2003	29	ND	4	6	0	0%	0	0%
	2004	27	ND	6	**35**	**2 (0)**	**7%**	**1**	**4%**
	2005	17	ND	ND	ND	0	0%	0	0%
	2006	15	ND	ND	ND	0	0%	0	0%
Sac R at Sacramento	1991	48	ND	ND	ND	0	0%	0	0%
	1992	139	ND	ND	ND	0	0%	0	0%
	1993	173	ND	ND	ND	0	0%	0	0%
	1994	78	ND	ND	ND	0	0%	0	0%
	1995	2	ND	ND	ND	0	0%	0	0%
	2000	16	ND	4	5	0	0%	0	0%
	2001	12	ND	ND	ND	0	0%	0	0%
	2003	26	ND	ND	ND	0	0%	0	0%
	2004	18	ND	9	**30**	**1 (0)**	**6%**	**1**	**6%**
	2005	13	ND	ND	ND	0	0%	0	0%

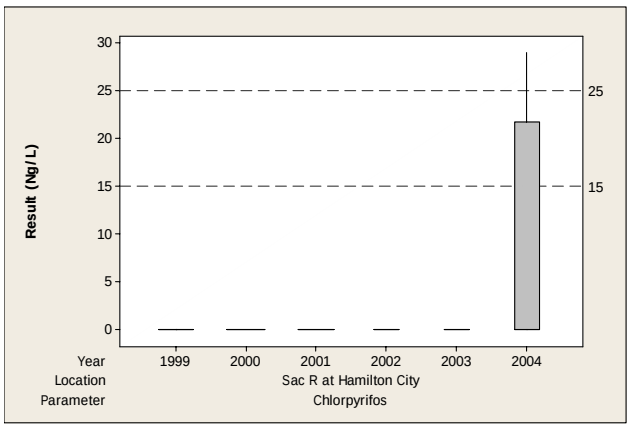
Figure 2.9. Box Plots of Chlorpyrifos Concentrations at Key Monitoring Locations Along the Sacramento and Feather Rivers.



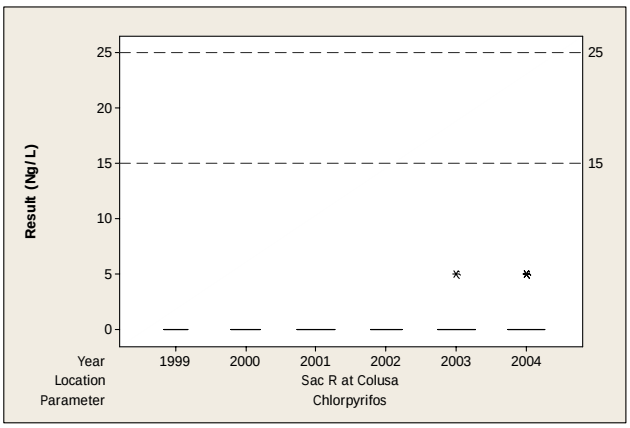
(a)



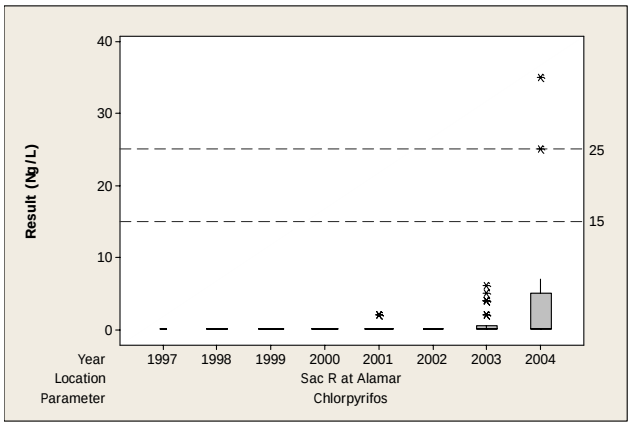
(b)



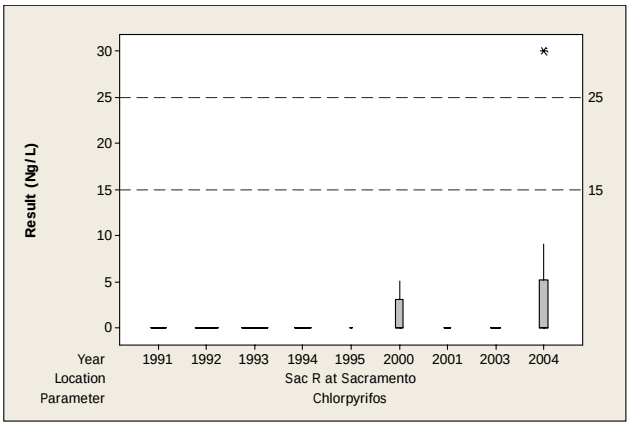
(c)



(d)



(e)



(f)

Note: The horizontal dashed lines represent the proposed chlorpyrifos water quality objectives. Refer to Figure 2.8 for additional explanation of the box plot.

Appendix B. For the purpose of assessing the levels of impairment, **Tables 2.5** and **2.6** also summarize exceedances of the current and proposed diazinon acute water quality objective, and the proposed chlorpyrifos water quality objective. To facilitate discussion of the data, two numbers have been reported for compliance with the 4-day average. The first number is simply the number of samples that were higher than the 4-day water quality objective concentration limit (4-day limit). However, since the compliance with the 4-day water quality objective (4-day objective) is based on the average concentration over 4 days, the number of exceedances does not equal the number of days with sample results above the 4-day limit. As a result, the second number is reported in the table (the number in parenthesis) is the number of times that the levels were high enough and of sufficient duration to cause an exceedance of the 4-day water quality objectives.

The proposed water quality objectives are based on criteria developed for the protection of aquatic life from toxic effects of diazinon or chlorpyrifos. Exceedance of these proposed water quality objectives, therefore, represents a potential impact to aquatic life. The existing Basin Plan includes water quality objectives for diazinon discharges into the Sacramento and Feather River of 80 ng/L (0.080 µg/L) as a one-hour maximum and 50 ng/L (0.050 µg/L) as a four-day average. As of yet, no chlorpyrifos objectives have been established for the Sacramento and Feather Rivers. Under the proposed water quality objectives, the maximum allowable hourly concentrations would be 160 ng/L (0.160µg/L) for diazinon and 25 ng/L (0.025 µg/L) for chlorpyrifos[5], not to be exceeded more than once every three years. Additional discussion on existing and proposed water quality objectives is provided in **Section 5.0**.

There are three issues that complicate a detailed analysis of diazinon and chlorpyrifos trends. First off, analytical methods used have historically had minimum detection limits or reporting limits that are frequently above environmentally relevant concentrations. For example, methods historically used for chlorpyrifos have had reporting limits on the order of 40 to 50 ng/L. Only more recently have methods been developed with reporting limits less than 10 ng/L. As will be discussed in detail below, the highest levels of chlorpyrifos for any of the stations, was 51 ng/L at the Feather River near its outlet. The next highest reported level was 35 at the Sacramento River at Alamar. All but the highest of these levels would have been censored using the older methodology.

Secondly, as more data was gathered on diazinon and chlorpyrifos, seasonal variations in chlorpyrifos and especially diazinon were discovered. These seasonal variations are

[5] For ease of discussion, this report uses the units of nanograms per liter (n/L), or parts per trillion, when discussing diazinon and chlorpyrifos concentrations. The actual proposed Basin Plan Amendment language expresses the diazinon and chlorpyrifos Water Quality Objectives in units of micrograms per liter (µg/L), or parts per billion, for consistency with the Basin Plan. Concentrations expressed in nanograms per liter can be converted to micrograms per liter by dividing by one thousand.

discussed in more detail in **Section 2.3.2.2**. As a result of this greater understanding, many recent monitoring plans have been designed to include increased sampling activity during the times when there is a greater likelihood to find the diazinon and chlorpyrifos (i.e. storm event driven sampling).

Finally, pesticide sampling and analysis techniques have shifted from testing filtered samples to testing whole water samples. Many pesticides, including chlorpyrifos are known to sorb onto suspended solids within the water column. By filtering the sample, any sorbed pesticide is lost and the analytical results potentially reflect lower exposure than what may be occurring in the environment.

The net effect of these issues is that studies performed more recently have generally had a greater tendency to detect diazinon and chlorpyrifos more frequently and at lower levels. Therefore, a trend towards fewer and lower diazinon and chlorpyrifos detections should indicate a true reduction in pesticide concentrations within the tested waters.

2.3.2.1 Concentration Trends

In general, diazinon concentrations have been reduced since the early 1990's, and the number samples exceeding the current and proposed water quality objectives are fewer. However, the Sacramento River occasionally exceeds at several sites. Also, while the Feather River has consistently met water quality objectives for the last 5 years, the short-term median concentration trend is increasing slightly despite the significant reduction in diazinon use discussed above.

In contrast to decreasing diazinon levels, chlorpyrifos concentrations have appeared to increase in the last few years, with the highest levels seen in 2003 and 2004. However, this may be more of an artifact of the sampling methodology inconsistencies (described above), than a true trend.

From 2000 to date, there have been sporadic exceedances of the water quality objectives, with the bulk occurring in 2004. In 2004, the Feather River near it's outlet and a number of stations on the Sacramento River all displayed high concentrations of both diazinon and chlorpyrifos. This could be in part due to the high rainfall that occurred that year. A review of historical precipitation data archived by the California Department of Water Resources (DWR 2005) revealed that rainfall totals in February 2004was 200% of normal. This period corresponds to both the period when the most samples were taken and when diazinon use is historically at its highest levels. However, rainfall cannot completely explain this grouping as the highest chlorpyrifos levels occurred in July, during the summer irrigation season when rainfall would not be expected to be a factor.

Discussion of specific sample locations is provided below.

2.3.2.1.1 Feather River at Yuba City

Data has been taken in numerous locations along the Feather River with the only location for which both long term and short term data are available being the Feather River near its outlet. However, there is some early diazinon data from 1994 from the Feather River at Yuba City and also some recent data at this location from 2000 to 2004 for both diazinon and chlorpyrifos.

In 1994, there were 4 samples that exceeded the current 4-day water quality objective of 50 ng/L and 6 samples that exceeded the current 1-hour objective of 80 ng/L. In contrast to that historical level, the only recent exceedances were in 2000. Levels were high in 2000 exceeding the existing 4-day and 1-hour objective 2 times (22%). None of the samples were high enough to cause any exceedance of either of the proposed objectives. Diazinon has not been detected at this location since 2000. Based on no detections of diazinon within the last three years, this station appears to be meeting the existing and proposed water quality objectives for diazinon[6].

There have been no detections of chlorpyrifos at this location. Based on no detections of chlorpyrifos in the last three years, this station appears to be meeting the proposed water quality objectives for chlorpyrifos.

2.3.2.1.2 Feather River Near It's Outlet

Several discrete sampling locations along the Feather River downstream of Nicholas (inclusive) have been grouped together as the general location the Feather River Near its Outlet. Both long term and short term data are available at this location. Diazinon concentrations have dropped significantly from the peak levels measured in 1994. In 1994, there were 8 samples that exceeded the current 4-day objective, 4 of which would also exceed the proposed 4-day objective. 7 samples (23%) exceeded the current 1-hour objective, 4 (13%) of which would also have exceeded the proposed maximum concentration.

In contrast to that historical level, during the last 5 years (2002-2006), only one sample in 2004 exceeded 50 ng/L. At, 110 ng/L, this would have exceeded the current but not the proposed 1-hour water quality objective. The level is not high enough to exceed either the current or proposed 4-day objective. Based on only one exceedance of the

[6] Throughout the rest of this section, the author will discuss the current diazinon and chlorpyrifos criteria in relation to compliance with the existing and proposed objectives. This comparison is required to provide essential background information for the implementation discussion in **Section 6.0**. However, this discussion is not intended to assess the status of the Sacramento and Feather Rivers as either impaired or not impaired under section 303d of the Federal Clean Water Act. Such analysis is beyond the scope of this report.

existing 1-hour diazinon objective within the most recent three years measured, this station appears to be meeting the existing and proposed water quality objectives for diazinon.

While the location appears to be meeting existing and proposed water quality objectives, median diazinon concentration data from 2000 forward (**Figure 2.8b**) shows a slight upward trend despite stable diazinon use during the same period. However, this trend is not as apparent in either the 90th percentile or maximum values and could simply be an artifact of the study inconstancies discussed in **Section 2.3.2.1**.

Chlorpyrifos levels at this location generally increased between 2000 and 2004, with samples exceeding objective levels in 2003 and 2004. Again, some of this apparent trend could simply be an artifact of inconsistencies between the designs of the various studies. In 2003, one sample exceeded 15 ng/L, however the concentrations on previous and subsequent days were not high enough to have caused an actual exceedance of the proposed 4-day average objective. In 2004, two samples exceeded 15 ng/L. One of the samples was only slightly higher than the 4-day limit and was of sufficiently short duration that the proposed 4-day objective would not have been exceeded. That sample was not high enough to exceed the 1-hour objective. The other sample was high enough that it did exceed the proposed 1-hour objective. This sample was a single grab sample taken during the summer irrigation season. No sample data was available for previous or subsequent days. Under the proposed Basin Plan Amendment , "available samples collected within the applicable averaging period for the water quality objective will be used to determine compliance with the allocations and loading capacity." Since only one sample was available during this averaging period, the 4-day average would be assumed to be 51 ng/L, which would cause an exceedance of the 4-day objective. This is also justifiable since, at 51 ng/L, had any additional sampling shown any detectable amounts of chlorpyrifos in the waterway on other days. the 4-day average would still have exceeded 15 ng/L.

The proposed chlorpyrifos objective would allow one exceedance in a three-year period for both the 1-hour and 4-day objective. Based on only one exceedance of the chlorpyrifos objective within the most recent three years measured, this station appears to be meeting the proposed water quality objectives for chlorpyrifos.

2.3.2.1.3 Sacramento River at Hamilton

Hamilton City is located upstream of the major Sacramento Valley agricultural areas. At Hamilton City, detectable levels of diazinon were found only in 1994 and 2004 (**Figure 2.8c**). Samples from this location have been below current and proposed water quality objectives for every year but 1994, and detections of diazinon are so infrequent as to preclude meaningful discussion about data trends. Chlorpyrifos has only been detected

once at this location. However the level of this detection was high enough to exceed even the proposed 1-hour objective. Based on only one exceedance of chlorpyrifos and no exceedances of diazinon, this location meets both the existing and proposed diazinon and chlorpyrifos water quality objectives.

2.3.2.1.4 Sacramento River at Colusa

The second major monitoring location on the Sacramento River is at Colusa. This location represents the downstream extent of the Sacramento River above Colusa sub-watershed, as described in the 2003 Staff Report. High levels of diazinon are periodically observed at this location. Of the 116 samples taken at this location since 1994, sample results exceeding 50 ng/L were encountered six times in 1994, twice in 2000, once in 2003, and 4 times in 2004. However, none of the events in 2000, 2003, or 2004 were of sufficient magnitude or duration to cause an exceedance of the current or proposed 4-day diazinon objective. Based on this data, the Sacramento River at Colusa appears to be meeting the 4-day diazinon objective.

Because the existing 1-hour objective was exceeded twice in February 2004, the Sacramento River at this location does not meet the existing 1-hour diazinon objective. It should be noted that both exceedances of the 1-hour standard were reported by separate groups monitoring during different hours on the same day. Neither sample was high enough to exceed the proposed 1-hour objective. The Sacramento River at Colusa appears to be meeting the proposed diazinon objective.

Chlorpyrifos was only detected once in 2003 and twice in 2004. All detections were less than either of the proposed objectives. Based on this data the Sacramento River at Colusa appears to be meeting the proposed 1-hour and 4-day chlorpyrifos objectives. Detections of chlorpyrifos are too sporadic to provide for a meaningful discussion on trends.

2.3.2.1.5 Sacramento River at Alamar

Alamar is the third sampling location of interest and is located downstream of the confluence of the Sacramento and Feather River. This location is downstream of the Feather River, Butte/Sutter, Colusa Basin Drain and Sacramento River above Colusa sub-watersheds (see **Figure 2.1**), which are largely dominated by agricultural uses; but is upstream of any contribution by the Sacramento urban area or the American River. Patterns of diazinon concentrations at this location have been very similar to the concentrations seen at the Sacramento River at Colusa.

Sample results exceeding 50 ng/L diazinon were encountered once in 1995, 14 times in 1998, three times in 2000, once in 2001, once in 2003 and three times in 2004. None of the events in 200, 2001 or 2003 were of sufficient magnitude or duration to cause an

exceedance of the current or proposed 4-day objective. One sample in 2004 was high enough to cause a single exceedance of the existing 4-day objective, but was not high enough to cause an exceedance of the proposed 4-day objective. Based on this data, the Sacramento River at Alamar appears to be meeting the existing and proposed 4-day diazinon objectives.

Because two samples exceeded 80 ng/L in 2004, the Sacramento River at this location would not meet the existing 1-hour diazinon objective. As with the Sacramento River at Colusa, both exceedances of the 1-hour objective were reported by separate groups monitoring during different hours of the same day. One of the samples was high enough to exceed the proposed 1-hour objective. The existing and proposed water quality objectives would allow one exceedance in a three-year period, so this location would appear to be meeting the proposed 1-hour water quality objective

Chlorpyrifos was detected in increasing amounts between 2000 and 2004, with the highest levels occurring in 2004. There were two occasions where sample results exceeded 15 ng/L. However neither was of sufficient duration to cause an exceedance of the 4-day objective. Only one sample between 2000 and 2004 was high enough to exceed the proposed 1-hour objective limit. Based on only one exceedance of the 1-hour limit, the Sacramento River at Alamar would be considered to be meeting the proposed water quality objectives.

2.3.2.1.6 Sacramento River at Sacramento

The final sampling location on the Sacramento River is at Sacramento. This location is the furthest downstream sampling point prior to entering the legally defined Delta and provides a picture of all of the sub-watersheds draining into the Sacramento River from all agricultural and urban sources.

Peak diazinon levels in the Sacramento River occurred in 1993 and 1994, similar to other locations. However, the 2004 concentrations spikes observed at other locations during 2004 were not as pronounced as at other locations. In 2000, 2001 and 2004, there were 1, 2 and 4 (respectively) samples with diazinon levels exceeding 50 ng/L, resulting in 2 exceedances of the existing 4-day objective in 2001 and one exceedance in 2004. However, none of the samples were sufficiently high or of sufficient duration to cause an exceedance of the proposed 4-day objective. There was one sample in 2001 that was high enough to exceed the current, but not the proposed 1-hour objective.

There was one sample in 2004 with chlorpyrifos levels exceeding 25 ng/L. This is high enough to exceed the 1-hour chlorpyrifos objective, but neither the magnitude nor the duration were sufficient to cause and exceedance of the 4-day objective.

Based on only one exceedance of the diazinon and chlorpyrifos objectives within the last three years (2003-2005), this location appears to be meeting all of the current and proposed diazinon and chlorpyrifos objectives.

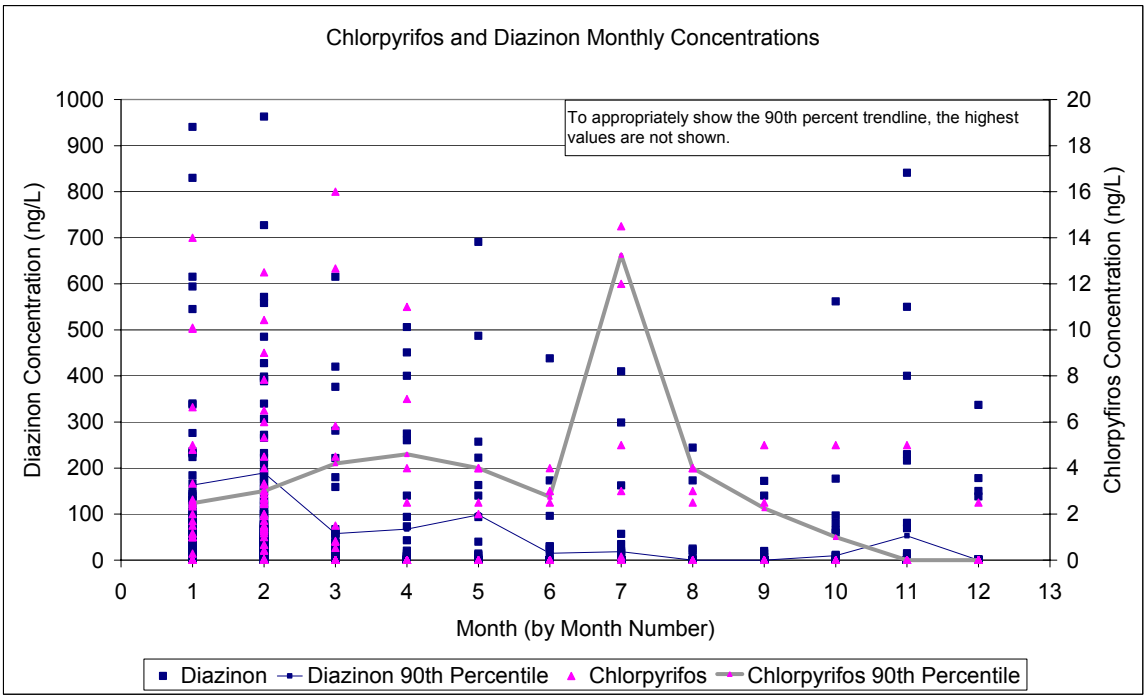
2.3.2.2 Evaluation of Diazinon and Chlorpyrifos Co-Occurrence

Evaluation of combined diazinon and chlorpyrifos concentrations are required to meet several basin plan requirements. First, diazinon and chlorpyrifos have been shown to exhibit additive toxicity when present together (Bailey *et al*., 1997). Where pesticides co-occur, the Basin Plan requires, in the Implementation Section entitled Pesticide Discharges from Nonpoint Sources, that the cumulative impact be considered. Second, the Narrative pesticide objective requires that "No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses." Finally, the proposed Basin Plan Amendment establishes a loading capacity for the Sacramento and Feather Rivers based on combined diazinon and chlorpyrifos concentrations.

Figure 2.10 shows a plot of diazinon and chlorpyrifos concentration data grouped by month for the purpose of determining co-occurrence. The graph includes a data point for each sample result from all of the studies since 1991, and includes a trend line for the 90th percentile value. The 90th percentile value was chosen since the median value was below detectable levels too often to provide meaningful trend information, and the maximum or average numbers were too easily affected by data outliers.

In this graph, 90th percentile diazinon concentrations are shown to be highest in January and February, during the period of peak agricultural use and highest rainfall concentration. Following peak usage, diazinon concentrations drop quickly, remain low and are generally not detected past June. In contrast, chlorpyrifos concentrations peak in the summer months concurrent with peak agricultural use. However, chlorpyrifos levels are also relatively elevated throughout the first half of the year. Surface water data show diazinon and chlorpyrifos co-occurrence typically during winter and spring sampling events.

Figure 2.10. Seasonal Chlorpyrifos And Diazinon Concentration



Combined diazinon and chlorpyrifos concentrations have been evaluated using Equation 2.1 below. This equation is explicitly provided in the Basin Plan for use in evaluating cumulative effects and is also proposed for use to determine the loading capacity of the Sacramento and Feather Rivers.

$$\frac{C_1}{WQO_1} + \frac{C_2}{WQO_2} = S \qquad \textit{[Eq. 2.1]}$$

Where:

C = The concentration of each pesticide.

WQO = The proposed acute toxicity water quality objective for diazinon (0.16 µg/L, or 160 ng/L) and the proposed acute water quality objective for chlorpyrifos (0.025 µg/L or 25 ng/L).

S = The sum. A sum equal to, or exceeding, one (1.0) indicates that the beneficial use may be impacted.

Tables 2.7 and **2.8** provide the combined toxicity ratios and identify events where the loading capacity of the Sacramento or Feather Rivers was exceeded and where cumulative impacts may have occurred. The combined exceedance column shows instances where the sum of the toxicity ratio exceeded one. The tables include both instances where diazinon and chlorpyrifos individually cause an S exceedance (even if

Table 2.7. Exceedances of the Proposed 1-Hour Combined Diazinon and Chlorpyrifos Water Quality Criteria Objectives, 2000 to 2006.

Location	Number of Datapoints [a]	Date	Hour	Chlorpyrifos (Ng/L)	Diazinon (Ng/L)	S-Combined (Exceedance In Bold)
Feather R nr outlet	21	1/28/2004	12	14	110	**1.25**
		7/28/2004	3	51	0	**2.04**
Sac R at Alamar	27	1/28/2004	17	25	27	**1.17**
		2/4/2004	14	0	220	**1.38**
		2/19/2004	13	35	37	**1.63**
Sac R at Colusa	19	2/3/2004	13	5	140	**1.08**
Sac R at Hamilton City	4	7/27/2004	3	29	0	**1.16**
Sac R at Sacramento	18	2/20/2004	9	30	39	**1.44**

[a] "Number of Samples" provides the number of data points taken at the specified location during the year that the exceedances were reported. Where multiple samples were taken in the same hour, they have been averaged as a single datapoint.

Table 2.8. Exceedances of the Proposed 4-Day Combined Diazinon and Chlorpyrifos Water Quality Criteria Objectives, 2000 to 2006.

Location	Number of Datapoints [a]	Date	Chlorpyrifos (Ng/L)	Diazinon (Ng/L)	Single Day S	Number Of Days [b]	4-Day Average S [c]
Feather R nr outlet	19	1/28/04	14	110	2.03	1	N/A[b]
		1/29/04	8	40	0.93	2	N/A[b]
		1/30/04	7	29	0.76	3	**1.24**
		7/28/04	51	0	3.40	1	**3.40**
Sac R at Alamar	25	1/28/04	25	27	1.94	1	**1.94**
		2/20/04	7	35	0.82	4	**1.05**
		2/21/04	6	25	0.65	4	**1.20**
		2/22/04	0	18	0.18	4	**1.09**
Sac R at Hamilton	4	7/27/04	29	0	1.93	1	**1.93**
Sac R at Sacramento	18	2/20/04	30	39	2.39	4	0.94[b]
		2/21/04	5.5	19	0.56	4	**1.06**
		2/22/04	0	18	0.18	4	**1.01**

[a] "Number of Samples" provides the number of data points taken at the specified location during the year that the exceedances were reported. Where multiple samples were taken in the same day, they have been averaged as a single datapoint.

[a] The number of days is the number of preceding days for which data is available. Where a full 4 days is not available, the average is based on the number of days with available data.

[b] The data for the Feather River near its Outlet on 1/28/04 and 1/29/04, and the data for the Sacramento River at Sacramento on 2/2/04 is included to show the day in which concentrations were high enough to push the 4-day average over the water quality objective, even though the exceedance did not occur until subsequent days.

the other is not detected) and where both compounds are required to show an exceedance. This has been done in recognition that all exceedance of diazinon and chlorpyrifos would contribute to a cumulative effect.

A limitation of the data is that very few samples have 4 consecutive days of sampling where the peak concentration falls clearly within the sample period. As a result there are numerous instances where only one or two days of sampling are available or the peak concentration falls on either the first or last day of the sampling period. Where 4 consecutive days of sampling are not available, the reported average is the average for the number of days that data is available. In each of these cases, the actual 4-day average concentration could be either lower or higher than the amount reported in the table.

In some cases, pesticide concentrations were not high enough prior to the pesticide peak concentration for the 4-day objective to be exceeded on the same day as the peak event. In two specific cases in February of 2004, the 4-day average at both the Sacramento River at Alamar and the Sacramento River at Sacramento locations did not exceed the 4-day objective until the day after the peak concentration. The exceedance in this case was due to elevated pesticide levels that continued for several days after the peak concentration.

As with individual pesticide results, exceedances of the cumulative objective occurred in 2004. When using the 1-hour objective to determine combined S values, diazinon and chlorpyrifos levels were high enough to exceed the narrative objective and the proposed loading capacity eight times at the five sites. Two exceedances occurred in the Feather River near its outlet, and three in the Sacramento River at Alamar. However, the exceedances were relatively minor with S values less than 2 in all but one instance.

In addition to exceedances based on the 1-hour objectives, there were a number of instances where combined diazinon and chlorpyrifos levels exceeded narrative objectives and loading capacities based on the 4-day objectives. Between 2000 and 2004, diazinon and chlorpyrifos contributed to a violation of the 4-day narrative toxicity objective on 9 occasions between the five sampling locations. The greatest number of exceedances occurred at the Feather River near its outlet and the Sacramento River at Alamar, though the Sacramento River at Sacramento also exhibited several exceedances. Again, the exceedances were of relatively low magnitude with only one instance exceeding an S value of 2.

2.4 Need for an Basin Plan Amendment to the Basin Plan

The Pesticide Management Plan established under the Management Agency Agreement (MAA) between the State Water Resources Control Board and the Department of Pesticide Regulation, and existing Central Valley Water Board Basin Plan pesticide policies outline approaches that could result in the establishment of an implementation program and performance measures to assess attainment of water quality objectives. Each of those plans or policies suggests that the Central Valley Water Board should take action if an implementation program has not been established and water quality is not protected.

Federal law requires the establishment of TMDLs for waters not attaining water quality standards (CWA § 303(d)(1)(C)). Federal regulations require the incorporation of approved TMDLs into the State's water quality management plan (40 CFR § 130.7(d)(2)). Every region's Basin Plan and any statewide plans or policies constitute California's water quality management plan. Based on the federal and State requirements and policies discussed above, the Central Valley Water Board must develop a control program to address diazinon and chlorpyrifos discharges into the Sacramento and Feather Rivers.

In 2003, the Central Valley Water Board adopted Resolution R5-2003-0148, which approved a Basin Plan Amendment establishing total maximum daily loads (TMDL) and implementation plans for diazinon in the Sacramento and Feather Rivers. The Basin Plan Amendment included a provision to review the diazinon allocations and the implementation provisions at least once every five years, beginning no later than June 30, 2007.

Following adoption of the 2003 Basin Plan Amendment, a lawsuit was filed in the Sacramento County Superior Court (*Makhteshim Agan of North America v State Water Resources Control Board; Regional Water Quality Control Board-Central Valley Region*, Sac. Cty. Sup. Ct. - Case No. 04CS00871). The lawsuit included the assertion that the Central Valley Water Board abused its discretion by failing to reconsider the diazinon objectives after new information was submitted showing that one of the studies relied upon to derive water quality objectives contained a reporting error[7]. The complaint was denied; however, a review of the water quality objectives was incorporated into the 22 July 2005 judgment denying writ. Consistent with the language of the Basin Plan Amendment, the review is to be completed no later than June 30, 2007.

This staff report has been written to comply with both the Basin Plan review requirement and the requirements of the court case.

[7] Refer to **Sections 5.1.1** and **5.1.3** for discussion of the reporting error

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3.0 PROPOSED BASIN PLAN AMENDMENTS TO THE BASIN PLAN

The proposed Basin Plan Amendment consists of additions and modifications to several sections of the current Water Quality Control Plan for the Sacramento River and San Joaquin River Basins (Basin Plan). This section contains the proposed changes to the Basin Plan. Deletions are shown in strikeout, and additions are shown by underline.

3.1 Changes to Chapter III, Water Quality Objectives

Modify Table III-2A as follows:

TABLE III-2A

SPECIFIC PESTICIDE OBJECTIVES

PESTICIDE	MAXIMUM CONCENTRATION AND AVERAGING PERIOD	APPLICABLE WATER BODIES
Chlorpyrifos	0.025 µg/L ; 1-hour average (acute) 0.015 µg/L ; 4-day average (chronic) Not to be exceeded more than once in a three year period.	San Joaquin River from Mendota Dam to Vernalis (Reaches include Mendota Dam to Sack Dam (70), Sack Dam to Mouth of Merced River (71), Mouth of Merced River to Vernalis (83)), Sacramento River from Shasta Dam to Colusa Basin Drain (13) and the Sacramento River from the Colusa Basin Drain to I Street Bridge (30). Feather River from Fish Barrier Dam to Sacramento River (40).
Diazinon	0.16 µ g/L ; 1-hour average (acute) 0.10 µ g/L ; 4-day average (chronic) Not to be exceeded more than once in a three year period.	San Joaquin River from Mendota Dam to Vernalis (Reaches include Mendota Dam to Sack Dam (70), Sack Dam to Mouth of Merced River (71), Mouth of Merced River to Vernalis (83)), Sacramento River from Shasta Dam to Colusa Basin

		Drain (13) and the Sacramento River from the Colusa Basin Drain to I Street Bridge (30). Feather River from Fish Barrier Dam to Sacramento River (40).
~~Diazinon~~	~~0.080 µg/L ; 1-hour average 0.050 µg/L ; 4-day average Not to be exceeded more than once every three years on average.~~	~~Sacramento River from Shasta Dam to Colusa Basin Drain (13) and the Sacramento River from the Colusa Basin Drain to I Street Bridge (30). Feather River from Fish Barrier Dam to Sacramento River (40).~~

3.2 Changes to Chapter IV, Implementation

3.2.1 Changes to the "Regional Water Board Prohibitions" Section

To the "Regional Water Board Prohibitions" Section, modify section 7. Diazinon Discharges into the Sacramento and Feather Rivers as follows:

7. *Diazinon and Chlorpyrifos Discharges into the Sacramento and Feather Rivers*

   Beginning ~~July 1, 2008~~[*U.S. EPA Approval Date*], ~~(i)~~ the direct or indirect discharge of diazinon or chlorpyrifos into the Sacramento and Feather Rivers is prohibited if, in the previous year (July-June), any exceedance of the diazinon or chlorpyrifos water quality objectives, or diazinon and chlorpyrifos loading capacity occurred., ~~and (ii) the direct or indirect discharge of diazinon into any sub-watershed (identified in Table IV-7) is prohibited if, in the previous year (July-June), the load allocation was not met in that subwatershed. Prohibition (i) applies only to diazinon discharges that are tributary to or upstream from the location where the water quality objective was exceeded.~~

   These prohibitions do not apply if the discharge of diazinon or chlorpyrifos is subject to a waiver of waste discharge requirements implementing the diazinon and chlorpyrifos water quality objectives and load allocations for diazinon and chlorpyrifos for the Sacramento and Feather Rivers, or governed by individual or general waste discharge requirements.

   These prohibitions apply only to dischargers causing or contributing to the exceedance of the water quality objective or loading capacity.

3.2.2 Changes to the "Pesticide Discharges from Nonpoint Sources" Section

Modify the Pesticide Discharges from Nonpoint Sources, as follows:

~~Orchard Pesticide Runoff and Diazinon Runoff into the Sacramento and Feather Rivers~~ Diazinon and Chlorpyrifos Runoff into the Sacramento and Feather Rivers

1. The ~~orchard~~ Sacramento and Feather River pesticide runoff ~~and diazinon runoff~~ control program shall:

   a. ensure compliance with water quality objectives applicable to ~~the~~ diazinon and chlorpyrifos ~~water quality objectives~~ in the Sacramento and Feather Rivers through the implementation of ~~necessary~~ management practices;

   b. ensure that measures that are implemented to reduce discharges of diazinon and chlorpyrifos ~~discharges~~ do not lead to an increase in the discharge of other pesticides to levels that ~~violate~~ cause or contribute to violations of applicable water quality objectives and Regional and State Water Board policies; and

   c. ensure that ~~pesticide~~ discharges ~~from orchards~~ of pesticides to surface waters are controlled so that the pesticide ~~discharges~~ concentrations are at the lowest levels that ~~is~~ are technically and economically achievable.

2. ~~Orchard d~~Dischargers must consider whether a proposed alternative to diazinon or chlorpyrifos has the potential to degrade ground or surface water. If the alternative to diazinon or chlorpyrifos has the potential to degrade ground water, alternative pest control methods must be considered. If the alternative to diazinon or chlorpyrifos has the potential to degrade surface water, control measures must be implemented to ensure that applicable water quality objectives and Regional and State Water Board policies are not violated, including State Water Resources Control Board Resolution 68-16.

3. Compliance with water quality objectives, waste load allocations, and load allocations for diazinon and chlorpyrifos in the Sacramento and Feather Rivers is required by ~~June 30, 2008~~ *[U.S. EPA Approval Date].*

   The water quality objectives and allocations will be implemented through ~~one or a combination of the following:~~ the adoption or modification of ~~one or more~~ waivers of waste discharge requirements, and general or individual waste discharge requirements where provisions necessary for implementation are not already in place. ~~To the extent not already in place, the Regional Water Board expects to adopt or revise the appropriate waiver(s) or waste discharge requirements by December 31, 2007.~~

~~4. The waste load allocations for all NPDES permitted discharges are the diazinon water quality objectives.~~

~~5.~~4. The Regional Water Board will review the diazinon and chlorpyrifos allocations and the implementation provisions in the Basin Plan ~~at least once every five years, beginning~~ no later than ~~June 30, 2007~~ 30 June 2013.

~~6.~~5. Regional Water Board staff will meet at least annually with staff from the Department of Pesticide Regulation and representatives from the California Agricultural Commissioners and Sealers Association to review pesticide use and instream pesticide concentrations during the dormant spray and irrigation application seasons and to consider the effectiveness of management measures in meeting water quality objectives and load allocations.

~~7. The Loading Capacity (LC) for diazinon is determined by:~~

~~LC=C x Q x a Unit Conversion Factor; where C= the maximum concentration established by the diazinon water quality objectives and Q= the flow (the daily average flow is used in conjunction with the 0.080 µg/L diazinon objective and the four-day average flow is used in conjunction with the 0.050 µg/L diazinon objective). The LC will be calculated for the Sacramento River at I Street; the Sacramento River at Verona; the Sacramento River at Colusa; and the Feather River near its mouth. The value for Q (flow) in the Loading Capacity calculations for the Sacramento River sites will be increased to account for any flood control diversions into the Yolo Bypass or Butte Sink. The best available estimates of such diversions will be used.~~

~~8. The Load Allocation for discharges into the Sacramento River between Verona and I Street is determined by the following: [LC(Sacramento River at I Street) minus LC(Sacramento River at Verona)] multiplied by 0.70.~~

~~The Load Allocations required to meet the Loading Capacity in the Sacramento River at Verona are determined by multiplying the LC calculated for the Sacramento River at Verona by the Load Allocation factors in Table IV-7. If the calculated Load Allocation for the Feather River or Sacramento River at Colusa is greater than the Loading Capacity for that site, then the Loading Capacity for that site applies.~~

~~The Load Allocations establish the allowable diazinon load from nonpoint source dischargers.~~

~~Note: If the Sacramento River at Verona mean daily flow were 15,000 cubic feet per second or cfs, the loading capacity would equal approximately 2,900 grams/day for the 0.080 µg/L diazinon water quality objective. The Unit Conversion Factor would be 2.446.~~

~~The load allocations would be approximately 493 grams/day for the Colusa Basin Drain; 348 grams/day for the Feather River; 783 grams/day for the Sacramento River at Colusa; and 957 grams/day for Sutter/Butte.~~

~~If the mean daily flow in the Feather River were 5,000 cubic feet per second or cfs, the loading capacity would be approximately 978 grams/day for the 0.080 µg/L diazinon water quality objective. The Unit Conversion Factor would be 2.446.~~

~~If the load allocation for the Feather River for that day were 348 grams/day, the load allocation would apply.~~

6. The Waste Load Allocations (WLA) for all NPDES-permitted dischargers, Load Allocations (LA) for nonpoint source discharges, and the Loading Capacity of the Sacramento and Feather Rivers shall not exceed the sum (S) of one (1) as defined below.

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

where

C_D = diazinon concentration in µg/L of point source discharge for the WLA; nonpoint source discharge for the LA; or the Sacramento or Feather Rivers for the LC.

C_C = chlorpyrifos concentration in µg/L of point source discharge for the WLA; nonpoint source discharge for the LA; or the Sacramento or Feather Rivers for the LC.

WQO_D = acute or chronic diazinon water quality objective in µg/L.

WQO_C = acute or chronic chlorpyrifos water quality objective in µg/L.

Available samples collected within the applicable averaging period for the water quality objective will be used to determine compliance with the allocations and loading capacity. Prior to performing any averaging calculations, only chlorpyrifos and diazinon results from the same sample will be used in calculating the sum (S). For purposes of calculating the sum (S) above, analytical results that are reported as "nondetectable" concentrations are considered to be zero.

Compliance with the load allocations will be determined where the nonpoint source discharges into the Sacramento or Feather Rivers.

~~9.~~7. The established waste load and load allocations for diazinon and chlorpyrifos, and the water quality objectives for diazinon and chlorpyrifos ~~water quality objectives~~ in the Sacramento and Feather Rivers represent a maximum allowable level. The Regional Water Board shall require any additional reductions in diazinon or chlorpyrifos levels necessary to account for additive or synergistic toxicity effects or to protect beneficial uses in tributary waters.

~~10.~~8. Pursuant to CWC §13267, the Executive Officer will require dischargers ~~of diazinon must~~ to submit a management plan that describes the actions that the discharger will take to reduce diazinon and chlorpyrifos discharges and meet the applicable allocations ~~by the required compliance date~~.

The management plan may include actions required by State and federal pesticide regulations. The Executive Officer will require the discharger ~~must~~ to document the relationship between the actions to be taken and the expected reductions in diazinon and chlorpyrifos discharge(s). The Executive Officer will allow individual ~~Individual~~ dischargers or a discharger group or coalition ~~may~~ to submit management plans.

The management plan must comply with the provisions of any applicable waiver of waste discharge requirements or waste discharge requirements ~~and must be submitted no later than June 30, 2005~~. The ~~Regional Water Board~~ Executive Officer may require revisions to the management plan if compliance with applicable allocations is not attained or the management plan is not reasonably likely to attain compliance. When requiring any revisions to the management plan, the Executive Officer may consider the relative contributions of diazinon and chlorpyrifos to the lack of compliance with the allocations.

~~11.~~9. Any waiver of waste discharge requirements or waste discharge requirements that govern the control of ~~orchard~~ pesticide runoff ~~or diazinon runoff~~ that is discharged directly or indirectly into the Sacramento or Feather Rivers must be consistent with the policies and actions described in paragraphs 1-~~10~~ 8.

~~12.~~10. In determining compliance with the waste load allocations, the Regional Water Board will consider any data or information submitted by the discharger regarding diazinon and chlorpyrifos inputs from sources outside of the jurisdiction of the permitted discharge, including any diazinon and chlorpyrifos present in precipitation; and any applicable provisions in the discharger's NPDES permit requiring the discharger to reduce the discharge of pollutants to the maximum extent practicable.

11. The above provisions for control of diazinon and chlorpyrifos discharges apply to the Sacramento and Feather Rivers as described in Table III-2A.

~~Table IV-7~~
~~Load Allocation Factors for Diazinon in the Sacramento River Watershed~~

~~Sub-Watershed~~	~~Load Allocation Factor~~

~~Colusa Basin Drain~~	~~17%~~
~~Feather River~~	~~12%~~
~~Sacramento River at Colusa~~	~~27%~~
~~Sutter/Butte~~	~~33%~~

~~*Location Descriptions*~~

~~Colusa Basin Drain - is the Colusa Basin Drain at the confluence with the Sacramento River. The Colusa Basin Drain sub-watershed includes all land that drains into the Colusa Basin Drain.~~

~~Feather River - is the Feather River near the confluence with the Sacramento River. The Feather River sub-watershed includes all land that drains into the Feather River below the Oroville Dam, but does not include flow from the Sutter Bypass.~~

~~Sacramento River at Colusa – is the Sacramento River at the River Road bridge in the town of Colusa. (United States Geological Survey gauging Station 11389500) The Sacramento River at Colusa subwatershed includes all land below Shasta Dam that drains to the Sacramento River at Colusa.~~

~~Sutter/Butte - is Sacramento Slough near the confluence with the Sacramento River or the sum of the Sutter Bypass near the confluence with the Feather River and Reclamation Slough near the confluence with the Sutter Bypass depending on flow conditions (minus diazinon loading resulting from Sacramento River water being bypassed into tributaries of Sacramento Slough or the Sutter Bypass). The Sutter/Butte sub-watershed includes all land that drains to Sacramento Slough, the Sutter Bypass, and Reclamation Slough.~~

~~Sacramento River at I Street – is the Sacramento River at the I Street Bridge in the city of Sacramento.~~

~~Sacramento River at Verona – is the Sacramento River at the United States Geological Survey gauging station at Verona (Station Number 11425500).~~

3.2.3 Changes to the "Estimated Costs of Agricultural Water Quality Control Programs and Potential Sources of Financing" section

Sacramento and Feather Rivers ~~Orchard~~ Diazinon and Chlorpyrifos ~~Runoff~~ Runoff Control Program

The total estimated costs for management practices to meet the diazinon and chlorpyrifos objectives for the Sacramento and Feather Rivers ~~are~~ range from ~~a~~ ~~$0.3~~ ~~million/ year cost savings to a $3.8~~ $0 to $6.2 million/year ~~cost~~ (~~2001~~ 2007 dollars). The estimated costs for discharger monitoring, planning, and evaluation ~~are~~ range from ~~$0.5 to $9.3~~ $0.3 to $1.5 million/year (~~2003~~ 2007 dollars).

Potential funding sources include:
1. Those identified in the San Joaquin River Subsurface Agricultural Drainage Control Program and the Pesticide Control Program.

3.3 Changes to Chapter 5, Surveillance and Monitoring

~~Orchard Pesticide Runoff and~~ Diazinon and Chlorpyrifos Runoff into the Sacramento and Feather Rivers

The Regional Water Board requires a focused monitoring effort of agricultural pesticide runoff ~~from orchards in the Sacramento Valley~~ into the Sacramento and Feather Rivers.

The monitoring and reporting program for any waste discharge requirements or waiver of waste discharge requirements that addresses agricultural pesticide runoff ~~from orchards in the Sacramento Valley~~ into the Sacramento or Feather Rivers must be designed to collect the information necessary to:

1. determine compliance with established water quality objectives and the loading capacity applicable to ~~for~~ diazinon and chlorpyrifos in the Sacramento and Feather Rivers;
2. determine compliance with ~~established waste load allocations and~~ load allocations for diazinon and chlorpyrifos;
3. determine the degree of implementation of management practices to reduce off-site migration of diazinon and chlorpyrifos;
4. determine the effectiveness of management practices and strategies to reduce off-site migration of diazinon and chlorpyrifos;
5. determine whether alternatives to diazinon or chlorpyrifos are causing surface water quality impacts;
6. determine whether the discharge causes or contributes to a toxicity impairment due to additive or synergistic effects of multiple pollutants; and

7. demonstrate that management practices are achieving the lowest pesticide levels technically and economically achievable.

Dischargers are responsible for providing the necessary information. The information may come from the dischargers' monitoring efforts; monitoring programs conducted by State or federal agencies or collaborative watershed efforts; or from special studies that evaluate the effectiveness of management practices.

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4.0 BENEFICIAL USES

Porter-Cologne requires that the "Past, present, and probable future beneficial uses of water" be considered in establishing water quality objectives. The Basin Plan defines 21 categories of uses that could be applied to surface waters in the Central Valley. Existing designated beneficial uses were evaluated in the 2003 Staff Report and found to be appropriate in regards to regulation of pesticides. Specifically, the 2003 report concluded that the use most sensitive to pesticides, aquatic life uses (WARM and COLD), had already been designated. Therefore, no changes to existing beneficial use designations are proposed for this Basin Plan. Current beneficial uses are as follows:

- Beneficial uses for the Sacramento River from the Shasta Dam to the Colusa Basin Drain include: domestic supply (MUN); agriculture irrigation and stock watering (AGR); industry service supply (IND); power (PWR); contact recreation (REC-1); non-contact recreation (REC-2); warm and cold freshwater habitat (WARM and COLD); warm and cold migration and spawning (MIGR and SPWN); wildlife habitat (WILD); and navigation (NAV).

- The Sacramento River from the Colusa Basin Drain to the "I" Street Bridge has the same designated uses, except for stock watering, IND, and PWR. The Feather River from the Fish Barrier Dam to the confluence with the Sacramento River has the same designated uses as the Sacramento River from the Colusa Basin Drain to the "I" Street Bridge, except it does not have the NAV use designated (CVRWQCB, 2006a).

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5.0 WATER QUALITY OBJECTIVES FOR DIAZINON AND CHLORPYRIFOS

Section 303(c) of the Federal Clean Water Act requires States to adopt water quality standards to protect public health and enhance water quality. Water quality standards consist of the beneficial uses of a water body and the water quality criteria designed to protect those uses. Individual states are responsible for reviewing, establishing, and revising water quality standards, and these water quality standards are then submitted to the U.S. EPA for approval. In California, the State Water Board and the Regional Water Quality Control Boards are responsible for developing these standards. Upon approval by the Central Valley Water Board, State Water Board, State Office of Administrative Law and U.S. EPA, these criteria are included in the appropriate Water Quality Control Plan (Basin Plan) as water quality objectives.

Water quality objectives can be either numeric or narrative. The Basin Plan currently includes specific numeric water quality objectives for diazinon in portions of the Sacramento and Feather Rivers. These objectives include the following maximum concentrations and averaging periods.

- 0.080 µg/L; 1-hour average, not to be exceeded more than once every three years on average.
- 0.050 µg/L; 4-day average, not to be exceeded more than once every three years on average.

These numeric objectives are applicable to Sacramento River from Shasta Dam to Colusa Basin Drain, the Sacramento River from the Colusa Basin Drain to I Street Bridge, and the Feather River from Fish Barrier Dam to Sacramento River.

In addition to numeric objectives, the Basin Plan also contains the following narrative water quality objectives for pesticides and for toxicity:

- No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses.
- Discharges shall not result in pesticide concentrations in bottom sediments or aquatic life that adversely affect beneficial uses.
- Pesticide concentrations shall not exceed those allowable by applicable antidegradation policies.
- Pesticide concentrations shall not exceed the lowest levels technically and economically achievable.

The Basin Plan defines pesticides as: "…any substance, or mixture of substances which is intended to be used for defoliating plants, regulating plant growth, or for preventing, destroying, repelling, or mitigating any pest…or, any spray adjuvant; or, any breakdown products of these materials that threaten beneficial uses. Note that discharges of 'inert' ingredients included in pesticide formulations must comply with all applicable water quality objectives."

The Basin Plan's narrative water quality objective for toxicity specifies, "all waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life. This objective applies regardless of whether the toxicity is caused by a single substance or the interactive effect of multiple substances. Compliance with this objective will be determined by analyses of indicator organisms, species diversity, population density, growth anomalies, and biotoxicity tests of appropriate duration or other methods as specified by the Central Valley Water Board." This narrative objective applies to toxicity caused by pesticides.

The Implementation chapter of the Basin Plan includes the following policies for evaluating pesticides relative to narrative water quality objectives:

> *"For most pesticides, numerical water quality objectives have not been adopted. U.S. EPA criteria and other guidance are also extremely limited. Since this situation is not likely to change in the near future, the Board will use the best available technical information to evaluate compliance with the narrative objectives. Where valid testing has developed 96 hour LC50 values for aquatic organisms (the concentration that kills one half of the test organisms in 96 hours), the Board will consider one tenth of this value for the most sensitive species tested as the upper limit (daily maximum) for the protection of aquatic life. Other available technical information on the pesticide (such as Lowest Observed Effect Concentrations and No Observed Effect Levels), the water bodies and the organisms involved will be evaluated to determine if lower concentrations are required to meet the narrative objectives."*

The Basin Plan also includes a policy for considering the additive toxicity of pesticides:

"In conducting a review of pesticide monitoring data, the Board will consider the cumulative impact if more than one pesticide is present in the water body. This will be done by initially assuming that the toxicities of pesticides are additive. This will be evaluated separately for each beneficial use, using the following formula:

$$\frac{C_1}{O_1} + \frac{C_2}{O_2} + \ldots + \frac{C_i}{O_i} = S \qquad \textbf{Eq. 5.1}$$

Where:

C = The concentration of each pesticide.

O = The water quality objective or criterion for the specific beneficial use for each pesticide present, based on the best available information. Note that the numbers must be acceptable to the Board and performance goals are not to be used in this equation.

S = The sum. A sum exceeding one (1.0) indicates that the beneficial use may be impacted."

The Basin Plan also includes a more general policy for considering the additive toxicity of pollutants that is consistent with the pesticide-specific policy (see pages IV-17.00 & IV-18.00 of the Basin Plan).

In addition to the Basin Plan's narrative water quality objectives for pesticides and toxicity and associated policies for implementing those objectives, the State Water Board's policy for maintaining high quality waters (Resolution 68-16) requires the maintenance of existing water quality, unless a change in water quality would provide maximum benefit to the people of the state and will not adversely affect beneficial uses.

5.1 Alternate Methods for Deriving Water Quality Objectives

This section examines and evaluates alternatives for establishing numeric water quality objectives and describes the basis for the recommended alternative. The alternative water quality standards methodologies reviewed for the Delta and San Joaquin Rivers in McClure et al., 2006 and Beaulaurier et al., 2005 are reviewed in this report for the Sacramento and Feather Rivers. The detailed description of those methodologies that was provided previously (Karkoski, et al., 2003) is not repeated.

The Probabilistic Ecological Risk Assessment (PERA) approach conducted by Novartis (1997) is not evaluated in this report. The evaluation for the Sacramento and Feather Rivers (Karkoski, et al., 2003) found that the PERA methodology applied by Novartis is

inconsistent with the Clean Water Act and would allow toxic conditions to exist. Since the Central Valley Water Board is not required to evaluate alternatives that are clearly contrary to State and federal clean water laws, the PERA method as applied by Novartis will not be included as an alternative.

Two additional methodologies from Canada and Australia were considered in the Delta Staff Report (McClure et al., 2006). However, both methods were determined infeasible due to lack of developed diazinon guidelines and other technical issues. As a result, these methods will not be considered in this report.

The Central Valley Water Board staff is working with researchers at the University of California, Davis to develop a new method to derive water quality criteria (Tenbrook and Tjeerdema 2006). As part of the development of the criteria, the researchers developed chlorpyrifos criteria as a test case. However, the methodology is still undergoing review and the chlorpyrifos criteria derived from the method should be considered only preliminary. Therefore, they will not be considered further in this Staff Report.

Tables 5.1 and **5.2** present diazinon and chlorpyrifos water quality criteria currently used in the United States. Criteria for other beneficial uses are not included since available criteria show that the freshwater habitat beneficial uses are the most sensitive to diazinon and chlorpyrifos in the Sacramento and Feather Rivers.
Water quality objectives adopted by the Central Valley Water Board must protect the beneficial uses designated for the applicable water bodies, be consistent with State and Federal regulations, and be approved by the State Water Board, the U.S. EPA, and the Office of Administrative Law. Alternate methods for deriving water quality objectives are discussed below, followed by an evaluation of the methods and their suitability for use in deriving a water quality objective.

Invertebrates are specifically mentioned in the definition of freshwater habitat uses contained in the Basin Plan (page II-2.00): "Uses of water that support warm (cold) water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates." Therefore, any methodology used to derive water quality objectives must protect the beneficial uses (40 CFR §131.11(a)), which for this use specifically includes invertebrates.

Table 5.1. Water Quality Criteria for Diazinon

Aquatic Life Criteria For Surface Water	**ng/L**
Current Basin Plan Water Quality Objective – 4-hour maximum concentration	50
Current Basin Plan Water Quality Objective – 4-day average concentration	80
CDFG Aquatic Life Criteria for freshwater – 4 day average concentration	50
CDFG Aquatic Life Criteria for freshwater – 1 hour maximum concentration	80
Recalculated CDFG Aquatic Life Criteria for freshwater – 4 day average concentration	100
Recalculated CDFG Aquatic Life Criteria for freshwater – 1 hour maximum concentration	160
EPA Aquatic Life Criteria for freshwater – 4 day average concentration	170
EPA Aquatic Life Criteria for freshwater – 1 hour maximum concentration	170
1/10th Most sensitive species mean average value (Ceriodaphnia dubia)[8] (Basin Plan)	44
Human Health Criteria For Drinking Water	
U.S. EPA Suggested No Adverse Response Levels (SNARL) for non-cancer toxicity	600
California Department of Health Services State Action Level for Toxicity	6,000

Table 5.2. Water Quality Criteria for Chlorpyrifos

Aquatic Life Criteria For Surface Water	**ng/L**
CDFG Aquatic Life Criteria for freshwater – 4 day average concentration	14
CDFG Aquatic Life Criteria for freshwater – 1 hour maximum concentration	20
Recalculated CDFG Aquatic Life Criteria for freshwater – 4 day average concentration	15
Recalculated CDFG Aquatic Life Criteria for freshwater – 1 hour maximum concentration	25
EPA Aquatic Life Criteria for freshwater – 4 day average concentration	41
EPA Aquatic Life Criteria for freshwater – 1 hour maximum concentration	83
1/10th most sensitive species mean average value (Ceriodaphnia dubia)[9] (Basin Plan)	6
Human Health Criteria For Drinking Water	
U.S. EPA Suggested No Adverse Response Levels (SNARL) for non-cancer toxicity	20,000
Agriculture-Livestock	

Sources: Marshack 2003; U.S. EPA 2006; U.S. EPA 1986; Siepmann and Finlayson, 2000; Finlayson, 2004a;

[8] The species mean average value reported by Siepmann and Finlayson 2000 is 440 ng/L for diazinon acute toxicity tests accepted by CDFG. *Ceriodaphnia dubia* is the most sensitive species when the reported results for *Gammarus fasciatus* are not considered (see discussion in **Sections 5.1.1** and **5.1.3** below).

[9] The species mean average value reported by Siepmann and Finlayson 2000 is 60 ng/L for chlorpyrifos acute toxicity tests. Of the freshwater species tested, *Ceriodaphnia dubia* is the most sensitive to chlorpyrifos.

The alternatives considered for deriving water quality objectives for diazinon and chlorpyrifos are:

- No change in water quality objectives
- No detectable levels of diazinon or chlorpyrifos
- U.S. EPA Water Quality Criteria methodology

After each methodology is described, a preliminary evaluation is made. The evaluation is based on the scientific merits of the method, and policy and data considerations. If no significant issues are associated with the methodology after the preliminary evaluation, a more detailed evaluation is performed relative to Porter-Cologne considerations and other applicable laws and policies in **Section 5.2**.

5.1.1 No Change in Water Quality Objectives

The Basin Plan currently contains the numeric water quality objectives for diazinon in the Sacramento and Feather Rivers of 0.080 µg/L as a 1-hour average and 0.050 µ/L as a 4-day average. This objective was established in 2003 based on CDFG application of the U.S. EPA criteria derivation method. The U.S. EPA criteria derivation method is discussed in detail in **Section 5.1.3**.

Since that time, the manufacturer of diazinon (Makhteshim Agan of North America, Inc. or MANA) has provided new information showing that the results from one of the toxicity tests used to derive the CDFG diazinon criteria were reported incorrectly (Weinberg, 2004a, b). The toxicity test in question used the species *Gammarus fasciatus,* which had the lowest acceptable acute toxicity test result identified by CDFG or U.S. EPA. The toxicity test data sheets MANA provided came from the microfiche archives of the USGS laboratory that conducted the toxicity tests. The USGS researcher who obtained the data sheets concluded that the toxicity value for *Gammarus fasciatus* was an order of magnitude higher than originally reported (Ingersoll, 2004). Central Valley Water Board staff concluded that the toxicity test data sheets were inconsistent in how test results were reported, and the toxicity test results reported in the literature could neither be definitively confirmed nor changed to a value an order of magnitude higher, as suggested by MANA (CVRWQCB, 2004). CDFG also concluded it was impossible to discern the correct toxicity test results for the questionable *Gammarus fasciatus* study from the toxicity test data sheets (Finlayson 2004a).

Despite the question over the incorrect data point, the Central Valley Water Board could choose to continue to use these diazinon objectives for a number of reasons. First, the Board is required to set a water quality objective for the reasonable protection of beneficial uses (Porter Cologne §13241). The current basin plan objective has been determined to be protective and the revised criteria calculation continues to support that

the existing objective is protective. Secondly, the Board is not required to maximize the amount of allowable pollution. Specifically, Porter Cologne Section 13263 explicitly states that the Central Valley Water Board, in setting discharge requirements, need not authorize the utilization of the full waste assimilation capacities of the receiving waters.

Finally, the States antidegradation policy (State Water Resources Control Board Resolution 68-16) requires that:

"1. Whenever the existing quality of the water is better than the quality established in policies… such existing high quality will be maintained…

2. Any activity which produces or may produce a waste or increased volume or concentration of waste… will be required to meet discharge requirements which will result …in the control of discharge necessary to ensure that the highest water quality consistent with the maximum benefit to the people of the state will be maintained."

While the area has not yet achieved compliance with the existing diazinon water quality objectives and loading capacity in all years, significant progress has been made and it appears feasible that with minimal additional effort, the water quality objectives could be attained within a short period of time. As a result, it is reasonable within the context of the setting water quality objectives to consider the current objectives as the level that must be maintained consistent with the anti-degradation policy. In addition, the Central Valley Water Board could determine that, while the presence of some diazinon or chlorpyrifos is consistent with the maximum benefit to the people of the state, the level that is consistent with maximum benefit is less than the highest level that would still be protective of beneficial uses.

In contrast to diazinon, there currently are no numeric objectives for chlorpyrifos in the Sacramento and Feather Rivers, though objectives have been proposed for the San Joaquin River (Beaulaurier et al., 2005) and the Sacramento/San Joaquin Delta (McClure et al., 2006). As discussed above, the Basin Plan currently contains narrative water quality objectives regarding pesticides and toxicity that would apply to chlorpyrifos. The Central Valley Water Board uses available guidelines and criteria to interpret existing narrative water quality objectives. Since 2000, the Central Valley Water Board has been using the California Department of Fish and Game (CDFG) criteria for chlorpyrifos (Siepmann and Finlayson, 2000) to interpret compliance with its narrative toxicity and pesticide water quality objectives.

Alternatively, the Basin Plan states that the Central Valley Water Board will consider $1/10^{th}$ of the 96-hour LC50 of the most sensitive organism as the daily maximum for

protection of aquatic life. Other available information, such as the Lowest Observed Effect Concentrations and No Observed Effect Levels, is to be evaluated to determine whether lower concentrations are required to interpret narrative objectives when numeric water quality objectives or appropriate criteria are not available. However, since diazinon and chlorpyrifos criteria have been calculated based on the CDFG dataset, it would not be necessary to interpret narrative objectives using $1/10^{th}$ of the 96-hour LC50 of the most sensitive organism.

The "no change" alternative will be considered for both diazinon and chlorpyrifos, since it would apply if new water quality objectives were not established. Under the No Change alternative, the diazinon water quality objectives would remain as currently listed in the current basin plan. For the "no change" alternative for chlorpyrifos, the Central Valley Water Board's recalculation of the CDFG chlorpyrifos criteria would be used to interpret compliance with narrative objectives[10]. The majority of the most sensitive invertebrates used in the development of the CDFG criteria were freshwater zooplankton, which are typically abundant in healthy freshwater ecosystems. When additive toxicity is considered in determining compliance, the existing Basin Plan diazinon objective, along with the recalculated CDFG chlorpyrifos criteria, would be used.

5.1.2 Numeric Water Quality Objectives Based on No Diazinon or Chlorpyrifos

The Central Valley Water Board could adopt water quality objectives that would maintain "natural" water quality conditions. Water quality objectives based on these conditions would mean no detected concentrations of diazinon or chlorpyrifos. State and federal anti-degradation policies would allow for the presence of diazinon and chlorpyrifos if the presence of those pollutants were consistent with maximum benefit to the people of the State, would not unreasonably affect present and anticipated beneficial uses, and would not result in water quality less than that prescribed in existing policies. (See State Water Board Resolution 68-16 and 40 CFR 131.12.)

The Central Valley Water Board could make a determination that the presence of any diazinon or chlorpyrifos in surface waters is not to the maximum benefit of the people of the State, which would serve as the basis for a no diazinon or chlorpyrifos objective. Alternatively, the Central Valley Water Board could determine that the presence of some diazinon or chlorpyrifos is consistent with the maximum benefit to the people of the State, but the level that is consistent with the maximum benefit is less than the highest level that would still be protective of beneficial uses.

[10] The Central Valley Water Board used the suggested significant figures for criteria calculations found in the U.S. EPA (1985) guidelines, which resulted in slightly higher acute and chronic chlorpyrifos criteria.

The no diazinon or chlorpyrifos alternative will be further considered, since anti-degradation policies suggest that the Central Valley Water Board could determine that the presence of any diazinon or chlorpyrifos in the Sacramento and Feather Rivers is not to the maximum benefit of the people of the State.

5.1.3 Numeric Water Quality Objectives Based on the U.S. EPA Method for Deriving Numeric Water Quality Criteria

Most states and the U.S. EPA use the U.S. EPA methodology to establish aquatic life water quality criteria and standards. U.S. EPA guidelines (U.S. EPA, 1985) for deriving numeric water quality criteria (WQC) for aquatic organisms provide a method to review available toxicity data for a water quality constituent and to derive two values-the criterion maximum concentration (CMC), an acute criterion, and the criterion continuous concentration (CCC), a chronic criterion. According to the guidelines, restricting concentrations to levels at or below these criteria should provide aquatic organisms with a "reasonable level" of protection and prevent "unacceptable" impacts.

U.S. EPA WQC are intended to protect all species for which acceptable toxicity data exist, and species for which those in the data set serve as surrogates. The criteria are met if the one-hour average concentration of the constituent does not exceed the acute criterion (CMC) and the four-day average concentration does not exceed the chronic criterion (CCC) more than once every three years, on average, at a given location.

The U.S. EPA guidelines also suggest that data that may not have been used in the standard criteria derivation method should be used "…if the data were obtained with an important species, the test concentrations were measured, and the endpoint was biologically important." In cases in which such data show that a lower value than that suggested by the Final Chronic Value, the Final Plant Value, or the Final Residue Value should be used, that lower value should be applied as the Criterion Continuous Concentration (CCC) or chronic criterion (U.S. EPA, 1985).

5.1.3.1 U.S. EPA Final Criteria for Diazinon and Chlorpyrifos

For diazinon, U.S. EPA recently published final aquatic life ambient water quality criteria (U.S. EPA, 2005). These criteria were derived using the U.S. EPA methodology described above. Acceptable freshwater acute toxicity data for thirteen invertebrate, ten fish, and one amphibian species were used in calculating the U.S. EPA criteria. In response to the concerns about the questionable toxicity values reported for *Gammarus fasciatus* discussed above, the data set used by U.S. EPA included *Gammarus fasciatus* acute toxicity values that were changed to a value an order of magnitude higher than originally reported, as suggested by MANA (U.S. EPA, 2006)(MANA, 2004 a,b,c). Also in response to the concerns about the questionable *Gammarus fasciatus* toxicity values discussed above, the toxicity value for a less sensitive *Gammarus* species, *Gammarus pseudolimnaeus*, was added to the U.S. EPA data set, as

suggested by MANA (U.S. EPA, 2006)(MANA, 2004 a,b,c). The acute freshwater criterion was calculated to be 170 ng/L. Chronic toxicity values for two species were used in calculating the U.S. EPA chronic criteria. The chronic freshwater criterion was also calculated to be 170 ng/L, or equivalent to the acute criterion. In Appendix G of the Delta Basin Plan Amendment (McClure et al., 2006), Central Valley Water Board staff calculated the acute and chronic freshwater diazinon criteria using the U.S. EPA data set, both with and without the changed *Gammarus fasciatus* acute toxicity values. These calculations are reproduced in **Appendix D**. The results of the Central Valley Water Board calculations using the U.S. EPA data set were the same as the U.S. EPA criteria. The inclusion of the changed *Gammarus fasciatus* acute toxicity values did not affect the final freshwater diazinon criteria.

The U.S. EPA published national water quality criteria for chlorpyrifos in 1986 (U.S. EPA, 1986). Acceptable freshwater acute toxicity data were available for seven fish species and eleven invertebrate species. Acceptable saltwater acute toxicity data were available for ten species of fish and five species of invertebrates. Acceptable chronic toxicity data were available for one freshwater and seven saltwater species. The calculated freshwater acute criterion was 83 ng/L and the chronic criterion was 41 ng/L.

5.1.3.2 CDFG Criteria for Diazinon and Chlorpyrifos

In 2000 CDFG published freshwater WQC for diazinon and chlorpyrifos (Siepmann and Finlayson, 2000), using the U.S. EPA methodology described above (U.S. EPA, 1985). Forty acceptable acute toxicity values were available to calculate freshwater criteria for diazinon. Acceptable acute toxicity tests were available for nine invertebrate and nine fish species. Five acute to chronic ratios for four species were available to calculate a chronic criterion for diazinon. CDFG calculated an acute criterion for diazinon of 80 ng/L and a chronic criterion of 50 ng/L.

The CDFG diazinon criteria in Siepmann and Finlayson (2000) were calculated using the questionable *Gammarus fasciatus* toxicity test results discussed above. CDFG has recalculated the diazinon criteria to exclude the questionable toxicity test values for *Gammarus fasciatus*, but has also noted that the recalculation assumes no new information has been collected that would affect the criteria (Finlayson, 2004a). CDFG believed that it was impossible to discern the correct toxicity test results for the questionable *Gammarus fasciatus* study (Finlayson 2004a). The data set that CDFG used in recalculating the diazinon criteria also did not include the toxicity values for *Gammarus pseudolimnaeus* test that U.S. EPA used in their criteria. CDFG found the *Gammarus pseudolimnaeus* study used by U.S. EPA unacceptable for use in calculating water quality criteria because it did not meet American Society for Testing and Materials (ASTM) standards for acute toxicity tests (Finlayson, 2004b). The recalculated CDFG values are an acute criterion for diazinon of 160 ng/L and a chronic

criterion of 100 ng/L. Central Valley Water Board staff confirmed these recalculated values. The Central Valley Water Board's diazinon criteria calculations are contained in **Appendix D**.

For the chlorpyrifos section of the CDFG criteria derivation (Siepmann and Finlayson, 2000) forty-three acceptable acute toxicity values were available to calculate freshwater criteria. Acceptable acute toxicity tests were available for thirteen invertebrate and seven fish species. Eight acute to chronic ratios for seven species (both freshwater and saltwater) were available to calculate a chronic criterion for chlorpyrifos. CDFG calculated an acute criterion for chlorpyrifos of 20 ng/L and a chronic freshwater criterion of 14 ng/L. The calculations that are part of the U.S. EPA methodology (1985) can include interim calculations before the final criterion is calculated. The methodology states that interim calculations should be rounded to four significant figures and the final criterion should be rounded to two significant figures. When the freshwater chlorpyrifos criteria are rounded to two significant figures using the data set that CDFG found acceptable, the acute criterion is 25 ng/L, rather than 20 ng/L, and the chronic criterion is 15 ng/L, rather than 14ng/L. The Central Valley Water Board's chlorpyrifos criteria calculations are contained in **Appendix D**.

5.1.3.3 Comparison of Diazinon and Chlorpyrifos Criteria Derived Using the U.S. EPA Methodology

For the freshwater diazinon criteria, the use of different data sets resulted in a small (6%) difference between the recalculated CDFG acute criterion and the U.S. EPA acute criterion, 160 vs. 170 ng/L, respectively. The U.S. EPA methodology uses only toxicity data from the four most sensitive genera directly in the criteria derivation. If the toxicity values for the four lowest genera are not changed, adding data for additional genera makes the criteria higher by lowering the percentile rankings of the four lowest genera. The four lowest toxicity values used by U.S. EPA and CDFG were very similar. The associated percentile ranks were different because US EPA's data set included additional, less sensitive genera. The inclusion of data for a greater number of genera in the U.S. EPA data set resulted in US EPA's acute criterion being slightly higher than CDFG's recalculated acute criterion.

The difference between the recalculated CDFG and the U.S. EPA chronic freshwater diazinon criterion (100 vs. 170 ng/L, respectively) is due to the use of different acute to chronic ratios (ACRs) – an ACR of 2 was used by U.S. EPA and an ACR of 3 was used by CDFG. The ACR calculated by CDFG appears to be more appropriate, since CDFG included three sensitive species in their calculation of the ACR (versus two by U.S. EPA) and CDFG calculated ACRs based on toxicity test results from the same studies or at least the same laboratory. Because the CDFG criteria calculations used a more appropriate ACR and did not use the results from the two questionable *Gammarus* studies discussed above, the recalculated CDFG criteria presented by Finlayson

(2004a) and confirmed by Central Valley Water Board staff calculations, are used to represent the application of the U.S. EPA methodology for deriving freshwater diazinon criteria (see **Appendix D**).

For chlorpyrifos, the criteria derived by CDFG (Siepmann and Finlayson, 2000), and recalculated by Central Valley Water Board staff to correct the number of significant figures, as described in **Appendix D**, are more appropriate than the criteria derived by U.S. EPA (1986). The CDFG data set included toxicity studies for a greater number of sensitive organisms and included more recent toxicity study results.

5.1.4 Summary of Potential Water Quality Objectives Derived by Alternate Methods

The alternative potential water quality objectives are summarized in **Table 5.3**. The three alternatives for diazinon and chlorpyrifos are evaluated below with respect to Porter-Cologne requirements and other applicable laws and policies. Water quality objectives for diazinon and chlorpyrifos do not necessarily have to be selected from the same alternative.

Table 5.3. Summary of Potential Freshwater Water Quality Objectives Derived by Alternative Methods

	DIAZINON		CHLORPYRIFOS	
ALTERNATIVE	**Acute (ng/L)**	**Chronic (ng/L)**	**Acute (ng/L)**	**Chronic (ng/L)**
1. No Change	80	50	25 [(2)]	15 [(2)]
2. No diazinon or chlorpyrifos	0 or non detect	0 or non detect	0 or non detect	0 or non detect
3. CDFG/U.S. EPA Method	160 [(1)]	100 [(1)]	25 [(2)]	15 [(2)]

[(1)] Central Valley Water Board staff calculations based on the CDFG data set, using the U.S. EPA method. The acute criterion is a one-hour average and the chronic criterion is a four-day average– neither to be exceeded more than once every three years on the average.

[(2)] CDFG (Siepmann and Finlayson, 2000) acute criterion recalculated by Central Valley Water Board staff to two significant figures per the U.S. EPA methodology (1985).

The "No change" alternative would maintain the current numeric water quality objectives for diazinon. The current narrative pesticide and toxicity objectives would be used to control chlorpyrifos discharges. The criteria developed from the CDFG data set would likely be used to interpret the narrative objectives.

The "No diazinon or chlorpyrifos" alternative would establish no detectable concentrations of either pesticide as water quality objectives.

The "CDFG/U.S. EPA method" alternative would establish water quality objectives for diazinon and chlorpyrifos based upon criteria calculated using the revised CDFG data set and the U.S. EPA methodology.

5.1.5 Additive Toxicity

Diazinon and chlorpyrifos have the same mechanism of toxic action, and have been shown to exhibit additive toxicity to aquatic invertebrates when they co-occur (Bailey et al., 1997; Siepmann and Finlayson, 2000). Studies of mixtures of compounds acting through the same mechanism suggest there is no concentration below which a compound will no longer contribute to the overall toxicity of the mixture (Deneer et al., 1988). Therefore, the total potential toxicity of co-occurring diazinon and chlorpyrifos needs to be assessed, even when one or both of their individual concentrations would otherwise be below thresholds of concern. As discussed above, existing Central Valley Water Board water quality objectives require that additive toxicity effects be considered when evaluating compliance with the applicable narrative objectives. The Basin Plan (in Chapter IV, "Pesticide Discharges from Nonpoint Sources) provides an additivity formula that applies to diazinon and chlorpyrifos when they co-occur.

$$\frac{C_D}{O_D} + \frac{C_C}{O_C} \leq 1.0 \qquad \textit{Eq. 5.2}$$

Where:

C_D = *Diazinon concentration in the receiving water.*

C_C = *Chlorpyrifos concentration in the receiving water.*

O_D = *Acute or chronic diazinon water quality objective or criterion.*

O_C = *Acute or chronic chlorpyrifos water quality objective or criterion.*

The diazinon and chlorpyrifos water quality objectives adopted by the Central Valley Water Board would be applied to the above formula when both diazinon and chlorpyrifos are present. In the absence of an established water quality objective for either diazinon or chlorpyrifos, the best available information would be used to identify an appropriate criterion for the formula.

It should be noted that when applying the additive toxicity formula, care must be taken in choosing the criteria to ensure that the additive effects being assessed are comparable. For example, if one criterion was driven by fish toxicity test results and the

other by aquatic invertebrate test results, it may not be appropriate to use those criteria together to determine whether there is an additive effect.

The Delta Diazinon and Chlorpyrifos Basin Plan Amendment (McClure et al., 2006) reviewed another method recommended by one of the scientific peer reviewers (Felsot 2005) that could be used to evaluate the additive toxicity of similar toxicants. The Toxic Equivalents (TEQ) method suggested by Felsot (2005) was used by U.S. EPA to calculate the cumulative human health risk of OP pesticides (U.S. EPA, 2002). The Delta Basin Plan Amendment demonstrated that the TEQ method is mathematically equivalent to the Basin Plan formula for additive toxic effects of pesticides. This demonstration has been reproduced in **Appendix D**. Given that the two methods are mathematically equivalent, the TEQ method will not be discussed further.

5.1.6 Comparison of Water Quality Data to Alternative Objectives

Tables 5.4 and **5.5** compare historical data to the alternate water quality objectives. The studies evaluated used different sampling frequencies (either event-based or a

Table 5.4. Comparison of Recent Available Data (2000 - 2006) to Alternate Diazinon Acute Water Quality Objectives

Location	# Samples	% Detected	%>80	Reduction Needed to Meet 80 ng/L During Exceedance		%>160	Reduction Needed to Meet 160 ng/L During Exceedance	
				Average	Maximum		Average	Maximum
Feather R at Yuba City	30	27%	7%	15%	18%	0%	---	---
Feather R nr outlet	106	70%	2%	33%	38%	0%	---	---
Sac R at Hamilton City	35	3%	0%	---	---	0%	---	---
Sac R at Colusa	107	39%	2%	47%	50%	0%	---	---
Sac R at Alamar	215	36%	1%	54%	64%	<1%	27%	27%
Sac R at Freeport	154	23%	1%	11%	11%	0%	---	---
Sac R at Sacramento	85	87%	1%	17%	17%	0%	---	---

Table 5.5. Comparison of Recent Available Data (2000 – 2006) to Proposed Chlorpyrifos Acute Water Quality Objectives

Location	# Samples	% Detected	% >25	Reduction Needed to Meet 25 ng/L During Exceedance	
				Average	Maximum
Feather R at Yuba City	14	0%	0%	---	---
Feather R nr outlet	103	26%	1%	51%	51%
Sac R at Hamilton City	30	3%	3%	14%	14%
Sac R at Colusa	97	3%	0%	---	---
Sac R at Alamar	210	8%	<1%	29%	29%
Sac R at Sacramento	85	14%	1%	17%	17%

specified frequency) and different analytical methods, which had different detection limits. For the "no diazinon" and "no chlorpyrifos" method, any detection of diazinon or chlorpyrifos would be counted as an exceedance.

5.2 Evaluation of Alternate Methods for Deriving Water Quality Objectives

This section evaluates the alternate methods for deriving water quality objectives presented above, with respect to Porter-Cologne and other applicable state and federal laws and policies. Section 13241 of Porter-Cologne specifies the following considerations in establishing water quality objectives:

- Past, present, and probable future beneficial uses of water.
- Environmental characteristics of hydrographic unit, including quality of water available to it.
- Water quality conditions reasonably achievable through coordinated control of all factors that affect water quality in the area.
- Economic considerations.
- The need for developing housing within the region.
- The need to develop and use recycled water.

Tables 5.6 and **5.7** present qualitative assessments of the alternate methods for their consistency with Porter-Cologne and other state and federal requirements. The rationale for the assessment of each method follows the tables.

5.2.1 Beneficial Uses

This section evaluates each potential objective with the requirement to protect beneficial uses. Federal law requires that states adopt criteria that protect the beneficial uses and that the most sensitive use is protected (40 CFR § 131.11(a)). State law requires the reasonable protection of beneficial uses and that those beneficial uses of water be considered in establishing water quality objectives (CWC § 13241, et seq.).

5.2.1.1 No Change in Water Quality Objectives

With no change in the water quality objectives, the existing numeric diazinon water quality objective would apply. As discussed above, the diazinon numeric objectives were derived using the best information available at the time. Since the establishment of numeric diazinon water quality objectives, the new information provided by MANA and the recalculation of the CDFG/EPA criteria indicates that this limit is more protective than initially believed.

Table 5.6. Assessment of Diazinon Alternatives for Consistency with Porter Cologne and other State and Federal Requirements

Porter Cologne Requirement	**No Change**	**No Diazinon**	**Revised CDFG/ U.S. EPA**
Beneficial Uses	++	++	++
Environmental Characteristics	0	0	0
Conditions Reasonably Achievable	+	-	+ +
Economic Considerations	+	-	+ +
Need for Housing	0	0	0
Need to Recycle Water	0	0	0
State and Federal Laws and Policies	**No Change**	**No Diazinon**	**Revised CDFG/ U.S. EPA**
Anti-degradation	C	C	C
Clean Water Act	C	C	C
ESA	C	C	C
Other Requirements	**No Change**	**No Diazinon**	**Revised CDFG/ U.S. EPA**
Consistent with TMDL Development	-	+	+

Table 5.7. Assessment of Chlorpyrifos Alternatives for Consistency with Porter Cologne and other State and Federal Requirements

Porter Cologne Requirement	**No Change**	**No Diazinon**	**CDFG/ U.S. EPA**
Beneficial Uses	++	++	++
Environmental Characteristics	0	0	0
Conditions Reasonably Achievable	+	-	+
Economic Considerations	+	-	+
Need for Housing	0	0	0
Need to Recycle Water	0	0	0
State and Federal Laws and Policies	**No Change**	**No Diazinon**	**CDFG/U.S. EPA**
Anti-degradation	C	C	C
Clean Water Act	C	C	C
ESA	C	C	C
Other Requirements	**No Change**	**No Diazinon**	**CDFG/U.S. EPA**
Consistent with TMDL Development	-	+	+

Scores indicate relative degree of protection; attainability; achievability; impact or consistency with policy, as applicable, with 0 indicating neutral. Repeated scores (e.g. "++") indicate a higher score relative to other options.

Key to Tables: - - — - — 0 — + — + + ➤

Beneficial uses:	Not Protective of beneficial uses	Fully Protective
Environmental Characteristics:	Not Attainable	Fully Attainable
Achievability:	Difficult to Achieve	Readily Achievable
Economic Considerations:	Potentially significant impact	Modest or no negative impact
Housing:	Significant housing impact	Little or no impact
Recycling Water:	Significant impact on Recycling Water	Little or no impact

C = Consistent

The No Change alternative would continue to rely on the narrative pesticide objective for the regulation of chlorpyrifos discharges. The Basin Plan's narrative water quality objectives for pesticides and toxicity provide direction in terms of protecting beneficial uses, i.e., toxicity is not allowed. However, the practical application of the narratives is problematic in that toxicity has to be demonstrated by actually testing surface water samples with living organisms, or by using available numeric criteria to determine whether beneficial uses are impacted. In addition, a narrative objective cannot be used directly to establish total maximum daily loads (TMDLs) or for other quantitative applications that require numeric criteria.

Existing numeric criteria, such as the CDFG water quality criteria, have been used for specific water bodies to determine if beneficial uses are being protected. The CDFG criteria have been used to determine if waters should be identified as not attaining standards as required by Section 303(d) of the Clean Water Act. Criteria calculations applying the U.S. EPA methodology to the CDFG datasets were considered the most appropriate. The datasets were evaluated by a California state agency charged with protecting fish and wildlife and the U.S. EPA methodology is used specifically to derive numeric criteria that should protect aquatic life beneficial uses.

The recalculated CDFG criteria for chlorpyrifos are at a level that should be protective of freshwater habitat uses. Other beneficial uses are less sensitive to chlorpyrifos than the freshwater habitat uses. With no change in the water quality objectives, the recalculated CDFG criteria for chlorpyrifos would be used.

5.2.1.2 Numeric Water Quality Objectives Based on No Diazinon or No Chlorpyrifos

Water quality objectives based on no diazinon or no chlorpyrifos would be highly protective of beneficial uses, since there would be no potential risk to beneficial uses from these chemicals.

5.2.1.3 Numeric Water Quality Objectives Based on the U.S. EPA Method

The U.S. EPA criteria method, as applied by CDFG (and recalculated by the Central Valley Water Board), uses acute and chronic toxicity data for a wide range of species. The criteria are designed to be protective of the most sensitive aquatic organisms and the acute and chronic criteria are designed to avoid detrimental physiologic responses. The method has been used by the U.S. EPA for almost twenty years to establish water quality criteria, and has been used by the CDFG since the late 1980s to assess hazards to aquatic organisms in the Sacramento-San Joaquin Rivers and Sacramento and Feather Rivers. All available information indicates that the recalculated CDFG diazinon criteria and the recalculated CDFG chlorpyrifos criteria (both recalculated by Central Valley Water Board staff using the U.S. EPA method of calculating significant figures- see **Appendix D**) should be protective of all freshwater habitat uses in the Sacramento and Feather Rivers.

5.2.2 Environmental Characteristics and Quality of Water Available

Diazinon and chlorpyrifos enter the Sacramento River primarily from applications to a variety of crops in the Sacramento and Feather Rivers watersheds. While urban runoff has also been a historically large contributor to diazinon and chlorpyrifos in the watershed, the recent changes in allowable uses will cause urban runoff to be a decreasingly minor contributor in the future. None of the alternate methods of deriving water quality objectives are dependent on any natural environmental characteristic. Diazinon and chlorpyrifos are not natural pollutants, so background levels of these pesticides would not be expected in absence of their use. All of the potential criteria are, therefore, equally consistent with the environmental characteristics of the watershed.

5.2.3 Water Quality Conditions Reasonably Achievable

Diazinon and chlorpyrifos concentrations detected in the Sacramento and Feather Rivers are the result of current-year applications of these pesticides. Unlike DDT or certain other chlorinated pesticides, diazinon and chlorpyrifos break down relatively rapidly in the aqueous environment, and are not sequestered in sediments to an appreciable extent. Unlike some naturally occurring compounds such as selenium, there are no natural sources of diazinon or chlorpyrifos, and there are no natural, or "background" concentrations. If these pesticides were prevented from entering surface waters, then concentrations of diazinon and chlorpyrifos in the Sacramento and Feather Rivers system would decline rapidly. **Tables 5.4** and **5.5** compare historical data to the alternate water quality objectives evaluated in this section.

The difficulty and cost of preventing diazinon and chlorpyrifos from entering surface waters is the key element in achieving the water quality objectives for these pesticides. Options for reducing the amount of pesticides entering the Sacramento and Feather Rivers are discussed in Beaulaurier et al., (2005) and Reyes and Menconi (2002). It is reasonable to assume that the lower the water quality objective, the more difficult it will be to achieve, and the more cost and effort will be required to meet it. Some options discussed in **Section 6.5** and by Reyes and Menconi (2002) are more likely to be effective than others, and it is currently unknown which options will deliver the greatest reductions for the least cost and effort. Given the suite of options available to agricultural dischargers, as well as the recent declines in use and concentrations in Central Valley waterways, the numeric criteria developed using the U.S. EPA methodology appear to be reasonably achievable. More significant changes would likely be needed to meet the no detectable levels of diazinon or chlorpyrifos alternative (e.g. additional controls to completely prevent diazinon and chlorpyrifos runoff).

5.2.4 Economic Considerations

The existing diazinon water quality objective requires the implementation of best management practices. In addition, as described in **Section 9.1.1** of this report, new federal label requirements on the use of diazinon (MANA, 2004d) and DPR Dormant Spray Regulations (DPR, 2006b) have recently been issued. In addition, existing data suggests that the Sacramento and Feather Rivers are meeting the proposed objectives and loading capacity or will be by the time this Basin Plan Amendment is implemented. Additional reductions in diazinon loading are anticipated as a result of the new diazinon label and dormant spray regulations. As a result no additional management practices should be needed in either the dormant or irrigation seasons. Under the recalculated CDFG/EPA alternative, the diazinon objective would increase. Best management practice implemented to meet the lower No Change alternative objective would be sufficient to meet the higher objective. Therefore, the economic costs are expected to be largely limited to monitoring activities with some possible irrigation season management costs. Additional information about costs is provided in **Section 9.0**

For the No Diazinon/Chlorpyrifos alternative, all growers would either need to use a different pesticide product or implement measures to prevent surface water runoff. Using an alternative to diazinon or chlorpyrifos would not necessarily lead to a significant increase in cost to the grower, since the cost of the actual pesticides is not a significant part of overall production costs (see **Section 9.0**), but in some cases it could increase potential pest damage by limiting pest control options available to address insecticide resistance in pests. Preventing all off-site movement of diazinon or chlorpyrifos into the Sacramento and Feather Rivers would be more costly since both runoff and aerial drift would need to be controlled.

NPDES dischargers would likely be able to meet the criteria with no additional cost, given enough time for the ban on the sale of non-agricultural uses of diazinon and chlorpyrifos to take full effect, including the depletion of existing homeowner supplies. So there should be no economic impact to NPDES dischargers based on either of the proposed objectives.

5.2.5 The Need to Develop Housing

The discharge of diazinon and chlorpyrifos is not necessary for the development of new housing or to maintain existing housing supply or values. Therefore, none of the alternate methods for establishing water quality objectives for diazinon or chlorpyrifos in the Sacramento and Feather Rivers is expected to affect housing.

5.2.6 The Need To Develop And Use Recycled Water

Neither diazinon nor chlorpyrifos is known to be a limiting factor for the development or use of recycled water. Therefore, none of the alternate methods for establishing water

quality objectives in the Sacramento and Feather Rivers is expected to affect the development or use of recycled water.

5.2.7 Consistency of Alternate Methods with State and Federal Laws and Policies

5.2.7.1 Water Quality Objectives for the Sacramento and San Joaquin River Delta

As has been discussed previously, a Basin Plan Amendment to control diazinon and chlorpyrifos in the Delta was approved by the Central Valley Water Board in 2006. This Basin Plan Amendment established Water Quality objectives, loading capacity, and load and waste load allocations for surface waters in the Delta. To be consistent with this policy, discharges from the Sacramento River into the Delta should not exceed the Delta water quality objectives of 100 ng/L (4-day) and 160 ng/L (1-hour) for diazinon, or 15 ng/L (4-day) and 25 ng/L (1-hour) for chlorpyrifos.

The no diazinon/chlorpyrifos would be consistent since discharges into the Delta would not contain any diazinon or chlorpyrifos. Chlorpyrifos and diazinon water quality objectives based on the U.S. EPA methodology would be consistent since the objectives would be established at the same level as the Delta objectives. The No Change alternative would most likely be consistent with the Delta, since the diazinon levels in discharges from the Sacramento River to the Delta would be less than the Delta objectives. Chlorpyrifos discharges would be covered by the narrative objective, which would most likely be interpreted for chlorpyrifos as the CDFG criteria. This would result in chlorpyrifos levels that are consistent with the Delta Objectives. However, because the narrative objective does not provide a clear numeric limit, it is possible that the narrative objective could be interpreted another way that might not be consistent with the Delta Objectives.

5.2.7.2 Anti-degradation Policy

Establishing a water quality objective based on "no diazinon/chlorpyrifos" would be consistent with the anti-degradation policy, since water quality would improve in the absence of diazinon and chlorpyrifos.

The "no change" alternative is protective of beneficial uses, since the existing diazinon numeric objectives and narrative objectives are consistent with the anti-degradation policy.

Chlorpyrifos and diazinon water quality objectives based on the U.S. EPA methodology should be protective of beneficial uses and would not cause degradation of the existing quality of the Sacramento and Feather Rivers. A complete discussion of the consistency of the proposed Basin Plan Amendment with the antidegradation policy is provided in **Section 7.1.3**.

5.2.7.3 Clean Water Act

The Clean Water Act requires that numerical criteria be based on "…(i) 304(a) Guidance; or (ii) 304(a) Guidance modified to reflect site-specific conditions; or (iii) other scientifically defensible methods" (40 CFR § 131.11 (b) et seq.).

Making no change in the current numeric diazinon and narrative water quality objectives would be consistent with the Clean Water Act. The Central Valley Water Board would continue to apply the numeric diazinon objective. For chlorpyrifos, the Board would need to interpret the existing narrative objectives to adopt TMDLs. Numeric water quality objectives based on the no diazinon or chlorpyrifos alternative would be consistent with the Clean Water Act, since States may adopt water quality standards that are more stringent than those necessary to protect beneficial uses. Criteria based on the U.S. EPA methodology would be consistent with the Clean Water Act, since the methodology is part of the 304(a) Guidance.

5.2.7.4 Endangered Species Act

Karkoski et al., 2003, identified several species of special concern that occur in the Sacramento and San Joaquin Rivers and Delta, including the federally threatened Sacramento splittail (Pogonichthys macrolepidotus) and the state- and federally-endangered winter-run Chinook salmon (Oncorhynchus tshawytscha). The report identified that the critical life stages for many of these fish occurs during January through March, when diazinon concentrations tend to be highest. Karkoski et al., 2003 and McClure et al., 2006 also included information about studies conducted on Chinook Salmon (Scholz, et al., 2000) that found that diazinon significantly inhibited olfactory-mediated avoidance response to predators at concentrations as low as 1,000 ng/L (1 µg/L). This avoidance response was linked to survival and reproduction. An effect was also found at 100 ng/L; however the result was not statistically significant and is not suitable for use in deriving the criteria. The statistically significant level of 1,000 ng/L is higher than the any of the proposed diazinon objectives. Therefore all three alternatives should be protective of threatened or endangered species.

Tenbrook and Tjeerdema (2006) recently reviewed literature related to chlorpyrifos affects on endangered species. This report identified two species of interest with chlorpyrifos toxicity data. The species Oncorhynchus mykiss (steelhead) is listed as federally threatened throughout California. Oncorhynchus tshawytscha (Chinook salmon) is listed as federally threatened or endangered, depending on season and location. The reported acute toxicities for steelhead and Chinook salmon are 8.0 µg/L and 15.96 µg/L respectively. No other chlorpyrifos acute or chronic data was found for any of the other state or federal listed animals or plants. However, there was toxicity data for species in the same family or genus as some of the listed species. Tenbrook and Tjeerdema (2006) used the U.S. EPA interspecies correlation estimation (ICE)

software to estimate toxicity values for the listed species based on toxicity tests for the surrogate species. This information is provided as **Table 5.8**. All of the predicted acute toxicity values are above 4.0 µg/L (400 ng/L).

Table 5.8. Predicted Chlorpyrifos LC_{50} Values for Threatened or Endangered Species

Species	Common Name	Family	LC_{50} (µg/L)	Surrogate
Oncorhynchus tshawytscha	Chinook Salmon	Salmonidae	9.2	*Oncorhynchus Mykiss*
Oncorhynchus kisutch	Coho Salmon	Salmonidae	7.3	*Oncorhynchus mykiss*
Oncorhynchus clarki henshawi	Lahontan cutthroat trout	Salmonidae	4.0	*Oncorhynchus mykiss*
Gila elegans	Bonytail chub	Cyprinidae	186	*Pimephales promelas*
Ptychocheilus lucius	Colorado squawfish	Cyprinidae	171	*Pimephales promelas*

Source: Tenbrook and Tjeerdema 2006.

Tenbrook and Tjeerdema (2006) provided the caveat for the above assessment that while cladocerans and insects are the most sensitive species in the data set used for their report, no data were found for effects of chlorpyrifos on federally endangered cladocerans or insects, or acceptable surrogates (i.e., in the same family). However, with the data available, this analysis suggests that any of the alternate chlorpyrifos criteria should be protective of threatened or endangered species.

5.2.8 Recommended Alternative for Diazinon Water Quality Objectives in the Sacramento and Feather Rivers

The recalculated CDFG criteria using the U.S. EPA methodology (Finlayson, 2004a) are the recommended water quality objectives. The recommended diazinon water quality objectives are 160 ng/L as a 1-hour average (acute) maximum concentration and 100 ng/L as a 4-day average (chronic) maximum concentration, not to be exceeded more than once in three years. The CDFG criteria are driven by toxicity studies for aquatic invertebrates. The criteria would, therefore, be appropriate to use when assessing the additive toxicity of diazinon and chlorpyrifos. The Scholz (2000) study indicated that effects on salmon behavior from short-term exposure to diazinon begin to occur at a concentration somewhere between 100 ng/L and 1000 ng/L; however, additional study is needed in order to determine a concentration that would be appropriate to apply as a water quality criterion. If the proposed diazinon criteria are adopted as and new information suggested the numeric objectives were not protective enough, the Central Valley Water Board could still apply the narrative objectives to ensure protection of beneficial uses while it went through the process of amending the numeric objective. Existing data indicate that the Sacramento and Feather Rivers appear to be meeting the recommended objectives. The new diazinon label and DPR dormant spray regulations

should ensure that the Sacramento and Feather Rivers continue to achieve the proposed objectives. The recommended alternative is consistent with all applicable policies including supporting achievement of the Delta water quality objectives.

The "No Diazinon" alternative is not recommended at this time. It may not be feasible to completely prevent off-site movement of diazinon given current allowed uses, seasons of use, and application methods.

The "No Change" alternative is not recommended. The initial diazinon objective was based on data that has since been shown to be questionable. The recalculated CDFG criteria show that the existing diazinon criteria are needlessly conservative.

5.2.9 Recommended Alternative for Chlorpyrifos Water Quality Objectives in the Sacramento and Feather Rivers

The recalculated CDFG criteria for chlorpyrifos are the recommended water quality objectives. The recommended chlorpyrifos water quality objectives are 25 ng/L as a 1-hour average (acute) maximum concentration and 15 ng/L as a 4-day average (chronic) maximum concentration, not to be exceeded more than once in three years. A number of alternative management practices are available to reduce the amount of chlorpyrifos introduced into the Sacramento and Feather Rivers. Available data indicate that the Sacramento and Feather River appear to be meeting the proposed objectives. The proposed alternative is consistent with all applicable laws and policies, including supporting achievement of the Delta water quality objectives.

The "No Chlorpyrifos" alternative is not recommended at this time. It may not be feasible to completely prevent off-site movement of chlorpyrifos given current allowed uses, seasons of use, and application methods.

The "No Change" alternative is not recommended. There is sufficient information available to establish a chlorpyrifos objective, which will provide a clear goal for dischargers of chlorpyrifos.

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6.0 PROGRAM OF IMPLEMENTATION

Porter-Cologne (§ 13242) requires the identification of a program of implementation for achieving water quality objectives "…that shall include, but not be limited to:

a) A description of the nature of actions that are necessary to achieve the objectives, including recommendations for appropriate action by any entity, public or private.
b) A time schedule for actions to be taken.
c) A description of the surveillance to be undertaken to determine compliance with objectives."

This section proposes options for how the Central Valley Water Board can ensure compliance with the proposed water quality objectives and TMDLs for diazinon and chlorpyrifos in the Sacramento and Feather Rivers. The first part of this section proposes definitions for the loading capacity and allocations that make up the TMDL, including consideration of the additive toxicity of the two pesticides. The rest of this section contains a discussion of the alternative regulatory tools available to control discharge of diazinon and chlorpyrifos runoff, and proposes a time schedule for specific actions to ensure compliance with the water quality objectives.

6.1 TMDL Loading Capacity and Allocations

Section 303(d)(1)(C) of the Clean Water Act requires the establishment of a Total Maximum Daily Load (TMDL) for waters identified on the 303(d) list, if the U.S. EPA Administrator has determined that the pollutant is suitable for a TMDL calculation. The TMDL must be "…established at a level necessary to implement the applicable water quality standards with seasonal variations and a margin of safety which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality."

Federal regulations provide further definition of the structure and content of TMDLs. TMDLs shall "… take into account critical conditions for stream flow, loading, and water quality parameters" (40 CFR § 130.7(c)(1)).

TMDLs are defined as the sum of the individual waste load allocations (WLAs) and load allocations (LAs). TMDLs can be expressed in terms of "… mass per time, toxicity, or other appropriate measure" (40 CFR 130.2(i)). WLAs are the portion of the receiving water's loading capacity allocated to existing or future point sources (40 CFR 130.2(h)) and LAs are the portion of the receiving water's loading capacity allocated to existing or future nonpoint sources of pollution or to natural background sources (40 CFR

130.2(g)). The loading capacity is the greatest amount of a pollutant a water can receive without violating water quality standards (40 CFR 130.2 (f)). Although the term "load" often refers to "mass", the federal regulations do not restrict the expression of a TMDL to units of mass. In this section, the discussion of load allocations, waste load allocations, and loading capacity include consideration of mass per time or other appropriate measures (e.g. concentration or toxic unit calculations).

This section provides an overview of the alternatives considered, the factors considered in selecting a recommended alternative, and a description of the recommended alternatives for defining the loading capacity, the waste load allocations, and the load allocations for diazinon and chlorpyrifos in the Sacramento and Feather Rivers.

6.1.1 Factors Considered in Selecting the Recommended Alternative

The following factors were considered in selecting the recommended method for determining the loading capacity and allocation method:

1. The ability of the method to adequately assess the loading capacity.
2. The availability of adequate data to apply to the method.
3. The ability of the method to account for seasonal variations.
4. The degree of uncertainty associated with the method.
5. The ease of determining compliance.
6. Equity of the methodology.

6.1.2 Loading Capacity

The loading capacity of the Sacramento and Feather Rivers for diazinon and chlorpyrifos is the amount of diazinon and chlorpyrifos that can be assimilated by the rivers without exceeding the proposed water quality objectives. Since diazinon and chlorpyrifos can both be present at levels of concern in both rivers, additive toxicity must also be considered in determining the loading capacity.

6.1.3 Concentration-Based Loading Capacity

The loading capacity for the Sacramento and Feather Rivers could be defined in terms of maximum allowable concentrations. Under this scenario, to meet the TMDL, diazinon or chlorpyrifos concentrations would be required to be equal to or below the water quality objectives. Since diazinon and chlorpyrifos can and do co-occur in the Sacramento River, the joint toxicity of these chemicals must also be considered (in accordance with Basin Plan; pages IV-18.00 and IV-35.00). To address the joint toxicity of these chemicals, the loading capacity can be expressed using either of the equations for additive toxicity discussed in **Section 5.1.5**.

6.1.4 Mass-Based Loading Capacity

A Mass-based loading capacity would be defined in terms of a mass per unit time, such as grams per day. Determination of a mass-based loading capacity for a river or stream requires an estimate of the volume of water or the amount of flow available to assimilate the pollutant load. For a pollutant in a typical stream or river site, where flow is only in one direction, the loading capacity, or allowable loading over a given time interval, can be determined by calculating the product of flow rate and the water quality objective concentration.

There are two methods for calculating mass-based loading capacity: variable loading capacity and fixed loading capacity. A fixed loading capacity would be a constant maximum allowable load based on design flows from historical data. Fixed loading capacities were considered in previous Central Valley Water Board staff reports for the Sacramento and San Joaquin Rivers (Karkoski et al., 2003, Beaulaurier et al., 2005). This approach was rejected because it does not adequately assess the loading capacity under critical conditions.

The existing basin plan includes loading capacities for diazinon in the Sacramento and Feather Rivers. A variable loading capacity is defined as a maximum allowable load that varies with the flow within, and/or into a waterbody. Variable loading capacities directly assess the actual available assimilative capacities. Since a variable loading capacity varies with flow, seasonal variations are explicitly considered. There is no uncertainty in the calculation of the loading capacity. There is uncertainty associated with the measurement of flow under this option, which would need to be taken into consideration in determining the Margin of Safety under this scenario.

The joint toxicity of diazinon and chlorpyrifos must also be considered when determining a mass-based loading capacity. The mass-based loading capacities are found by converting the equation for combined toxicity from **Section 5.1.5** to express the loading capacity in terms of mass loads instead of concentrations and becomes:

$$\frac{L_{Diaz}}{LC_{Diaz}} + \frac{L_{Chlor}}{LC_{Chlor}} \leq 1 \qquad \textbf{\textit{Eq. 6.1}}$$

where

L_{Diaz} = *Diazinon Load (g/day)*

LC_{Diaz} = *Diazinon Loading Capacity (g/day)*

L_{Chlor} = *Chlorpyrifos Load (g/day)*

LC_{Chlor} = *Chlorpyrifos Loading Capacity (g/day)*

There are a number of potential ways to split the total allowable mass load between diazinon and chlorpyrifos to determine the allowable mass loads for the individual pesticides. The allowable loads of each pesticide could be based on a reduction of the existing loads of each pesticide. This would require either assuming that the existing loads are currently well characterized, or implementing extensive monitoring to characterize the current loads. Such an approach could penalize those who are already implementing effective runoff control by requiring them to reduce loads that are already being controlled at a lower level than surrounding dischargers.

The allowable loads of each pesticide could be set according to the acreage in the watershed directly tributary to the Sacramento and Feather Rivers that is planted in crops for which each pesticide is registered or commonly used. This could be difficult to define, since not all growers of the commodities for which diazinon or chlorpyrifos are registered use diazinon or chlorpyrifos on those crops. This alternative would also be somewhat complicated and cumbersome to implement, since it would require frequent, extensive land-use data collection since crops planted, especially field crops, can vary extensively from year to year. This alternative would also create a moving target for the regulated community since the loading capacity and required management practices to meet that loading capacity could change each year as crop mixes change.

Another method of splitting the total allowable mass load between diazinon and chlorpyrifos would be to make the allowable load of each pesticide proportional to the use of each pesticide in the watersheds directly tributary to the Sacramento and Feather Rivers. This alternative would be complicated and cumbersome to implement, however, due to the temporal and spatial variability of the use patterns in the Sacramento and Feather Rivers, and the delay in the availability of the pesticide use data (e.g. compliance could not be evaluated for up to a year after any violations occurred, pesticide use data typically takes from 1 to 2 years after use is reported to become available). As with the previous alternative, this alternative would also create a moving target for the regulated community since the loading capacity and required management practices to meet that loading capacity could change each year as pesticide uses change.

6.1.5 Recommended Loading Capacities

The recommended loading capacity is a concentration-based loading capacity that addresses the additive toxicity of diazinon and chlorpyrifos. The equation used in the Basin Plan to assess the additive toxicity is recommended. The recommended loading capacity is therefore based on **Equation 6.2**:

$$\frac{C_{Diaz}}{O_{Diaz}} + \frac{C_{Chlor}}{O_{Chlor}} = S; S \leq 1 \qquad \textit{Eq. 6.2}$$

Where:

S = The sum. A sum exceeding one (1.0) indicates that beneficial uses may be impacted

C = The concentration of a pesticide in the receiving water.

O = The water quality objective or criterion (acute or chronic) for the specific beneficial use for each pesticide present, based on the best available information. The numbers must be acceptable to the Board and performance goals are not to be used in this equation.

The recommended loading capacity is consistent with the narrative toxicity water quality objective which states, in part "…This objective applies regardless of whether the toxicity is caused by a single substance or the interactive effect of multiple substances…" The recommended loading capacity is also consistent with the narrative pesticide objective that states, in part "No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses" (see Basin Plan; pages III-6.00 and III-8.00). Finally, the recommended loading capacity changes the way the existing loading capacity is stated to be consistent in form with the loading capacities of the San Joaquin River and the Delta, providing overall administrative consistency across the basin.

The recommendation for this method of defining the loading capacity was made after considering all the factors listed in **Section 6.1.1**. The recommended method of defining the loading capacity is more straightforward than any of the mass-based methods in terms of defining and assessing compliance with the allowable amounts of diazinon and chlorpyrifos in the Sacramento and Feather Rivers. Since the recommended loading capacity is not dependant on a particular flow regime, it would not be changed by changes in flows, withdrawals, or flow routing within either the Sacramento River or the Feather River. Because the recommended method of determining the loading capacity is so straightforward, there is no error involved in applying this method to adequately assess the loading capacity. Similarly there are no data gaps that need to be filled in order to use the recommended method. Since the loading capacity is based on an hourly and 4-day basis, all seasonal variations are taken into account. For these reasons, there is minimal uncertainty associated with this method of defining the loading capacity. Determining the loading capacity is relatively straightforward, since it only requires measuring concentrations in the rivers and does not require the extensive discharge measurements and loading calculations involved in the other scenarios.

6.2 Allocations

This section of the report identifies scenarios for defining the load allocations for nonpoint sources, and waste load allocations for point sources of the diazinon and chlorpyrifos in the Sacramento and Feather Rivers. These allocations are defined so that when the allocations are combined, along with a margin of safety, they will be equal to the Sacramento and Feather Rivers loading capacity.

6.2.1 Wasteload Allocations

The point sources with potential to discharge diazinon and chlorpyrifos into the Sacramento and Feather Rivers are the municipal wastewater treatment plants and the municipal stormwater discharges in the Sacramento and Feather Rivers and their watersheds. Since sales of all non-agricultural uses of diazinon have been banned since December 31, 2004 (U.S. EPA, 2001), diazinon levels in municipal wastewater treatment plant discharges and stormwater discharges are expected to decline rapidly. Since the majority of the non-agricultural uses of chlorpyrifos were banned after December 2001 by U.S. EPA, a significant reduction in the concentrations of chlorpyrifos in urban runoff and wastewater treatment plant effluent is also expected.

Infrequent outdoor applications of diazinon may occur for several years after the phase-out and some fraction of the diazinon applied may be discharged in storm water. A few minor non-agricultural uses of chlorpyrifos will still be allowed. Some fraction of these chlorpyrifos applications may be discharged in storm water or wastewater treatment plant effluent. For these reasons a waste load allocation should be established for chlorpyrifos and diazinon in urban stormwater discharges and wastewater treatment plant discharges. The proposed diazinon and chlorpyrifos waste load allocations for these point sources are equivalent to the Sacramento and Feather Rivers loading capacity defined above. Since the proposed Wasteload Allocations are not dependant on a particular flow regime, they would not be changed by changes in flows within the Sacramento and Feather Rivers and their tributaries. Since chlorpyrifos and diazinon from agricultural sources may still be present in rainfall in urban areas, these "background" concentrations may need to be considered in assessing compliance with the waste load allocations. Based on the phase out of urban uses of diazinon and the ban in 2001 of the majority of non-agricultural chlorpyrifos uses, the presence of diazinon and chlorpyrifos in urban runoff is expected to be infrequent and below the waste load allocations.

6.2.2 Load Allocations

The existing method to determine load allocations for diazinon within the Sacramento and Feather Rivers Watersheds is to divide up the loading capacity for the Sacramento and Feather Rivers among the subwatersheds defined in **Figure 2.1**. For each of the

major monitoring points, the available loading capacity is allocated among the subwatersheds upstream of that point based on land use. Specifically, the load allocation is based on the relative proportion of land that is used for the crops (almonds, peach and plums dried and fresh) that receive significant diazinon applications during the dormant spray season.

There are several alternative load allocation scenarios that could be used to allocate the available diazinon and chlorpyrifos loading capacity to agricultural sources. These allocation scenarios are discussed in detail in Azimi-Gaylon et al., (2003). Methods used to allocate loads could be based upon a geographic split, crop or land-use patterns, pesticide use patterns, present loading rates, concentration or a mix of these methods. Possible alternatives include the following:

1. Allocation among the subwatersheds based on current or historic loading rates
2. Allocation among the subwatersheds based on the current or historic amount of pesticide use.
3. Continue with the current allocation based on the amount of land that is used for the crops that receive significant diazinon applications during the dormant spray season.
4. Allocation among the subwatersheds based in proportion of the amount of land that is used for the crops that receive significant diazinon and chlorpyrifos applications throughout the year (modification of the existing method to include chlorpyrifos).
5. Allocation based on the loading capacity for the Sacramento and Feather Rivers.

Alternatives such as Alternatives 1 and 2, which are based on current or historical loading or usage rates, are not considered appropriate because these would disadvantage dischargers and areas that have already effectively minimized offsite movement of pesticides through implementation of management practices or reduced pesticide use. In addition, insufficient information is available to characterize current loading rates from all areas.

Under Alternative 3, no change would be made to the existing load allocations, but the ratios would be applied to diazinon and chlorpyrifos. This scenario could be chosen, because diazinon and combined diazinon/chlorpyrifos pesticide levels in the Sacramento and Feather Rivers tend to be highest during the winter wet period, which also corresponds to the diazinon dominated dormant spray season. However, this alternative would not account for the seasonal variation in pesticide use, especially chlorpyrifos use in the irrigation season.

Under Alternative 4, allocation would be based on in proportion to the amount of land used for crops that receive significant diazinon and chlorpyrifos applications throughout the year. This scenario could account for seasonal variation by altering the loading capacity based on the major pesticide use. However, such a scheme would be difficult to implement and enforce, would suffer from significant information lags related to the availability of use information and would suffer from the same inherent disadvantage to responsible dischargers as with alternatives based upon pesticide use or loading.

Load allocation scenarios without a geographic component are not considered feasible because of the difficulty in measuring compliance with such scenarios. Scenarios based on current loading rates are not considered appropriate because this would disadvantage dischargers and areas that have already effectively minimized offsite movement of pesticides through implementation of management practices. In addition, insufficient information is available to characterize current loading rates from all areas. Scenarios based on pesticide use rates were also not considered since this may disadvantage areas and dischargers that try to minimize offsite movement of pesticide through reduced use.

Alternative 5 would set the load allocations for each subwatershed at the proposed loading capacity for the Sacramento and Feather Rivers. Under this scenario, the concentrations of diazinon and chlorpyrifos coming into the Sacramento and Feather River from each subwatershed would be required to be no greater than the concentrations which would be allowable in the Sacramento and Feather Rivers, as defined by the proposed loading capacity.

The latter scenario for defining the load allocations is the proposed methodology for determining the allowable nonpoint source loads. The recommendation for this method of defining the load allocations was made after considering all the factors listed in **Section 6.1.1**. This proposed allocation methodology would provide a very straightforward definition of the load allocations, with no inherent error involved in the methodology, and no data gaps that would have to be filled. The load allocations would not change with changes in crops grown in the subwatersheds, and therefore load allocations would not need to be re-defined with each new growing season. Since the load allocations would be defined on an hourly and 4-day basis, seasonal variations are taken into account. For these reasons, there is minimal uncertainty associated with this method of defining the load allocations. Assessment of compliance for each subwatershed would be relatively straightforward; the flow monitoring and load calculations that would be needed in other scenarios would likely not be required to assess compliance under the proposed load allocations. The only data that would be necessary to assess compliance with the proposed load allocations would be diazinon and chlorpyrifos concentration data at the points of discharge to the Sacramento and

Feather Rivers. Finally, this alternative would not penalize discharger who are already minimizing offsite movement of pesticides through implementation of management practices and/or reduced pesticide use.

6.3 Margin of Safety and Seasonal Variations

The recommended alternative load allocations and wasteload allocations have an implicit margin of safety, as described below, and therefore no explicit margin of safety is required. Since all the load allocations are set at the Sacramento and Feather Rivers loading capacity, no dilution is assumed; all tributaries and the Sacramento and Feather Rivers are assumed to be discharging at concentrations approaching the loading capacity. Since all tributaries and Sacramento and Feather Rivers are not expected to be discharging diazinon and chlorpyrifos at concentrations approaching the loading capacity, there will be extra dilution in the Sacramento and Feather Rivers to provide a sufficient margin of safety.

The recommended methodology for allocating the Sacramento and Feather Rivers loading capacity also assumes no significant reductions in diazinon or chlorpyrifos loading due to removal from the water column by degradation and adsorption to sediment particles and subsequent sediment deposition. Since these processes are likely to take place, this assumption further contributes to the implicit margin of safety in the recommended allocation alternative. Since the load allocations and loading capacity are all defined using hourly and 4-day concentrations, all seasonal variations and critical conditions are explicitly considered in the recommended method for determining of the Sacramento and Feather Rivers loading capacity and Allocations.

6.4 Comparison of Proposed Load Allocations to Current Concentrations

A review of recent diazinon and chlorpyrifos concentrations gives an indication of the additional effort that will be required to consistently meet the proposed Sacramento and Feather Rivers loading capacity, and the load allocations for tributaries to Sacramento and Feather Rivers. **Tables 2.5 through 2.8** provide summaries of recent (2000 to 2005) diazinon, chlorpyrifos and combined diazinon and chlorpyrifos concentrations relative to those that would be allowable under the proposed Sacramento and Feather Rivers loading capacity and load allocations. Additional information showing all years and all Sacramento Valley sampling stations is provided as **Appendix B**.

In making these comparisons, it is important to consider both the overall change in total use of these pesticides in recent years and recent change in labeling and use regulations. These changes make the concentrations in recent years more representative of current conditions However, the variability of precipitation and flow

patterns from year to year makes it necessary to consider multiple years to fully characterize current and potential near future conditions.

Diazinon and chlorpyrifos concentration data for the Sacramento and Feather Rivers, obtained since 2000 indicate that the Sacramento and Feather Rivers loading capacity and the Allocations for their tributaries have been occasionally exceeded. However, the most recent exceedances were nearly all in February 2004, prior to implementation of the new label (MANA, 2004d) and the dormant spray regulations (DPR, 2006b). Management practices required by the label and regulations would be expected to reduce the number of exceedances, and in fact in 2005 and 2006, there were no exceedances of the loading capacity.

The recent loading data suggest the objectives and loading capacity are being met. However if exceedances continue to occur, one or a combination of three general approaches could be used to address those exceedances. : (1) reduce diazinon and chlorpyrifos use further, (2) reduce the runoff of diazinon and chlorpyrifos, (3) delay the runoff of diazinon and chlorpyrifos.

As discussed in **Section 6.5** of this report there are a number of alternative management practices available to growers that would result in reduction in the amount of diazinon and chlorpyrifos present in the Sacramento and Feather Rivers and their tributaries. An approach focused solely on reduction of diazinon and chlorpyrifos use could be applied incrementally until the loading capacity is no longer exceeded. The amount of use reduction necessary would depend on the focus of the effort. If the effort was focused on areas that are likely to result in greater diazinon and/or chlorpyrifos runoff (e.g. based on slope, soil type, crop type, and proximity to waterways), diazinon and chlorpyrifos use could be maximized. Simple adjustments in timing of application (e.g. applying dormant sprays in December when soils are not saturated or avoiding applications before storms) may require little or no reduction in overall use to provide further reductions of diazinon and chlorpyrifos concentrations.

The reduction in the amount of diazinon and chlorpyrifos that runs off fields and orchards would also result in reductions in peak concentrations. As discussed in previous Central Valley Water Board reports (Reyes and Menconi 2002; Karkoski et al 2003), substantial reductions of pesticide runoff can occur when buffer strips or cover crops are used. Another approach, that has not been thoroughly evaluated, is to detain diazinon and/or chlorpyrifos storm or irrigation runoff, so that peaks are attenuated. In many cases, if a portion of the diazinon and/or chlorpyrifos loading could be shifted to at least a day or two after the peak, the Sacramento and Feather Rivers loading capacity would not be exceeded. Techniques used in rice farming and to flood irrigate orchards during the irrigation season could possibly be employed to temporarily retain some

pesticide-bearing runoff during rainfall events and to allow that runoff to be discharged over a period of days. Irrigation and drainage management practices could also be employed to reduce or eliminate pesticide-bearing tail water runoff in the irrigation season.

6.5 Available Practices and Technology

The information in this section is a summary of information described in greater detail by Reyes and Menconi (2002) and Azimi-Gaylon et al., (2002), and is similar to the discussion of available practices and technology for the reduction of concentrations of diazinon and chlorpyrifos in the San Joaquin River (Beaulaurier et al., 2005). Many viable agricultural management practices exist that are likely to be effective in reducing offsite movement of diazinon and chlorpyrifos into surface water.

However, while information is available on trends in pesticide use through the pesticide use reporting system, and the Board is working with coalition and other groups to encourage and fund management efforts, information on the extent of implementation of runoff mitigation practices is not currently available. The major types of management practices available for reducing diazinon and chlorpyrifos agricultural discharges are:

- Pest management practices.
- Pesticide application practices.
- Vegetation management practices.
- Water management practices.

As discussed in Beaulaurier et al., (2005) and Reyes and Menconi (2002), viable pest control alternatives to diazinon and chlorpyrifos are available. Changes in application practices could include improved sprayer technologies, more frequent calibration of sprayer equipment, use of aerial drift retardants, improved mixing and loading procedures, and other practices that would result in reduced application rates or mitigation of off-site pesticide movement.

Vegetation management practices could be used to increase infiltration and/or decrease runoff. Examples of these types of practices include planting cover crops, buffer strips or allowing native vegetation to grow where they would reduce runoff rates. In addition to reducing runoff, vegetative cover would also reduce runoff of sediment and excess nutrients, as well as recharge groundwater through increased infiltration.

Water management practices that could include improvements in water infiltration and runoff control include better irrigation efficiency and distribution uniformity, increased

use of soil moisture monitoring tools, increased use of tailwater return systems, and vegetated drainage ditches.

The appropriate actions for individual growers to take will vary, depending on the specific crops grown, field conditions and pest pressures. The Central Valley Water Board will not require implementation of specific practices or technologies, but may review proposed actions based upon the likelihood that the growers' collective actions will be protective of water quality in the Sacramento and Feather Rivers.

In summary, growers have available a variety of management practices to control pests and to control diazinon and chlorpyrifos runoff. In addition, some growers have already implemented these practices in order to come into compliance with the existing diazinon objectives. Specifically, since the approval of the existing diazinon water quality objectives the following activities have occurred:

- A Supplemental label requiring additional management practices has been prepared by Makhteshim Agan and approved by the EPA. Management practices include:
  - the use of Buffer Strips and Set Backs
  - awareness of Weather Conditions
  - demonstration of need prior to application of diazinon
  - operational requirements to prevent discharge during and after pesticide application
  - Worker awareness training
- Management plans have been submitted for both urban and agricultural diazinon uses.
- $3.6 M in grant funding has been provided to assist Sacramento Valley growers in reducing pesticide runoff from their orchards. These grants provide funding to:
  - Conduct orchard site assessments
  - Identify, demonstrate, communicate and evaluate Best Management Practices (BMP's)
  - Install cover crops, filter strips or vegetated ditches, sediment basins
  - Calibrate sprayers and retrofit with Smart Sprayer technology

Based on the variety of management practices available to growers, it is technically and economically feasible to meet the proposed diazinon and chlorpyrifos water quality objectives, loading capacity and load allocations.

6.6 Implementation Framework Alternatives

An existing framework for addressing diazinon discharges to the Sacramento and Feather River has already been adopted (Karkoski et al., 2003). In addition, the Central Valley Water Board adopted frameworks for addressing diazinon and chlorpyrifos discharges to the San Joaquin River (Beaulaurier et al., 2005) and the Delta (McClure et al., 2006). These frameworks are similar and are generally recommended for addressing diazinon and chlorpyrifos discharges to the Sacramento and Feather Rivers. Portions of the following discussion are, therefore, very similar to the implementation framework discussions included in those Basin Plan Amendment Staff Reports.

Porter-Cologne provides four basic tools for the regulation of discharges of waste (including runoff) into surface waters:

1. Not allowing discharge of waste in certain areas or under certain conditions (i.e. a prohibition under Water Code Section 13243).
2. Issuing Waste Discharge Requirements (WDR) -Water Code Section 13263.
3. Conditionally waiving WDRs - Water Code Section 13269.
4. Issuing cleanup and abatement orders - Water Code Section 13304.

Cleanup and abatement orders are generally applied to localized pollution problems and not to watershed-wide issues addressed in the Basin Plan, so they are not reviewed any further. For point sources of diazinon and chlorpyrifos, the implementation mechanism is defined by federal law. Those sources are regulated through the NPDES permit program[11]. Therefore implementation of point sources will not be reviewed further.

Any alternative that is selected to implement this Basin Plan Amendment must clearly address the attainment of the water quality objectives, and must be protective of the aquatic life beneficial use. The primary factors considered in evaluating the alternatives include flexibility, certainty in meeting water quality objectives, and consistency with State and Federal laws and policies. Alternatives considered include:

1. no change to the existing flexible implementation framework,
2. modifications of the existing flexible implementation framework to include chlorpyrifos,
3. modification of the existing flexible implementation framework to include chlorpyrifos but remove conditional prohibition language.
4. specific definition of the implementation framework or mechanism (e.g. WDR; waivers of WDR; or a prohibition of discharge).

[11] The permits issued for point sources in California are both NPDES permits and Waste Discharge Requirements.

Previous Basin Plan Amendment Staff Reports have also identified a No Specific Implementation Framework or Mechanism option. Because a specific framework has already been established in the basin plan, and because such a lack of a framework has been found to conflict with the State Water Board's Nonpoint Source Pollution Control Program (McClure et al., 2006), it will not be considered further.

6.6.1 Alternative 1. No Change to Existing Flexible Implementation Framework

The basin plan currently includes a flexible implementation framework for addressing diazinon discharges to the Sacramento and Feather Rivers. This framework utilizes a conditional prohibition of discharge. Specifically, either WDRs, or waivers of WDRs can be used to control nonpoint source discharges of diazinon to the Sacramento and Feather Rivers. If neither is used to control these discharges from nonpoint sources, then a prohibition automatically becomes in effect to ensure that objectives and allocations are met within the required time frame. The prohibition does not apply to those areas that are attaining the applicable objectives and allocations. The prohibition also does not apply to point source discharges regulated under NPDES permits.

The existing flexible implementation framework was established at a time when the regulatory framework covering discharges from irrigated agricultural lands was a short-term waiver of waste discharge requirements, and the future status of that program was uncertain. Since that time, the waiver has been renewed and the Irrigated Lands Program is an established Central Valley Water Board program. As discussed in **Section 2.0**, future urban use is expected to be minor, and in any case would be covered by a Municipal Stormwater NPDES Permit.

Under the No Change alternative the existing Basin Plan language would be left unchanged. Under this alternative, discharges of diazinon and chlorpyrifos would be regulated differently. Diazinon discharges would continue to be covered under the flexible framework with WDR, waiver of WDR and conditional prohibition of discharge being the primary regulatory tools. Dischargers would continue to be explicitly required to develop and submit management plans. In contrast, no particular implementation mechanism would be defined for chlorpyrifos. As applicable waste discharge requirements or waivers of waste discharge requirements are renewed, it would be assumed that the provisions for chlorpyrifos in this Basin Plan Amendment would be incorporated. There would be no explicit requirement for dischargers to prepare management plans for discharges of chlorpyrifos; however, there would still be the requirement to ensure that pesticides used as alternatives to diazinon (i.e. chlorpyrifos) do not degrade surface waters.

This alternative would provide maximum flexibility in regards to chlorpyrifos, since no particular implementation mechanism would be defined. However, there would be less certainty that water quality objectives would be met, since there would be no description as to how the Central Valley Water Board plans to implement the provisions of this Basin Plan Amendment in regards to chlorpyrifos. In addition, this alternative would not be consistent with the Enforcement of the Nonpoint Source Control Program (Nonpoint Source Policy – SWRCB 2004). The Nonpoint Source Policy states that the Central Valley Water Board will address nonpoint source discharges through waivers of waste discharge requirements, waste discharge requirements or prohibitions.

6.6.2 Alternative 2. Inclusion of Chlorpyrifos into Existing Framework

Under this alternative, the existing Basin Plan implementation framework would be amended to explicitly include chlorpyrifos. Either WDRs or waivers of WDRs could be effectively used to control nonpoint source discharges of diazinon and chlorpyrifos into the Sacramento and Feather Rivers.

Under this alternative, discharges of both diazinon and chlorpyrifos would be subject to the conditional prohibition of discharge if water quality objectives were exceeded. Application of the conditional prohibition to diazinon and chlorpyrifos would be similar to the existing application to diazinon. However, as with Alternative 1, the prohibition would not apply to those areas that are attaining the applicable objectives and allocations. The prohibition also would not apply to point source discharges regulated under NPDES permits, or nonpoint source discharges regulated under WDR or waivers of WDR.

This alternative maintains the high degree of flexibility to the Central Valley Water Board as provided under the existing framework. The Central Valley Water Board can continue to use waivers of WDRs or individual or general WDRs for different categories of nonpoint source dischargers. There would be a high degree of certainty of attaining the water quality objectives, since any waiver or WDR would explicitly include limits on either pesticide individually, or both pesticides together. Additionally, retaining the prohibition keeps in place an important regulatory backstop for the Irrigated Lands Conditional Waiver program. This is because the prohibition provides the Central Valley Water Board a more direct enforcement path for unauthorized discharges – prohibition violations can be directly enforced against under Porter Cologne section 13350. Additional steps would need to be taken by the Central Valley Water Board before it could enforce against unauthorized discharges not covered by waivers or WDRs under other sections of Porter Cologne. Identification of an implementation framework that includes WDRs, waivers of WDRs, and a prohibition of discharges would be consistent with the Nonpoint Source Policy.

6.6.3 Alternative 3. Inclusion of Chlorpyrifos into Existing Framework with removal of conditional prohibition.

Under this alternative, the existing Basin Plan implementation framework would be amended to explicitly include chlorpyrifos. Water quality objectives and allocations would continue to be implemented through one or a combination of wavers of waste discharge, or individual or general waste discharge requirements. The conditional prohibition of waste discharge would be removed. The Central Valley Water Board can continue to use waivers of WDRs or individual or general WDRs for different categories of nonpoint source dischargers. There would be a high degree of certainty of attaining the water quality objectives, since waiver or WDR would address either pesticide individually, or both pesticides together. Identification of an implementation framework that includes WDRs or waivers of WDRs, would be consistent with the Nonpoint Source Policy.

However, removing the prohibition reduces the flexibility provided in Alternative 2. Absence of a prohibition removes the Central Valley Water Board's ability to directly enforce against unauthorized discharges not covered under a waiver or WDRs under Porter Cologne section 13350.

6.6.4 Alternative 4. Specific Definition of the Implementation Framework or Mechanism

The Basin Plan Amendment could define a specific implementation framework or mechanism. For nonpoint source discharge of pesticides, a variety of approaches could be identified through the use of waivers of waste discharge requirements, waste discharge requirements or prohibitions of discharge (see Karkoski, et al., 2003 for a detailed description of these options).

This alternative would limit the flexibility of the Central Valley Water Board, since it would identify a specific regulatory mechanism for nonpoint source pesticide discharges. The degree of certainty in attaining water quality objectives would depend on which mechanism was chosen. If the WDRs or waivers of WDRs depend to some extent on the actions of a third party not directly regulated by the Central Valley Water Board (e.g. another agency or association of dischargers), there would be less certainty that objectives would be met. Identifying a specific implementation framework would be consistent with the Nonpoint Source Policy.

6.6.5 Recommended Alternative

Alternative 2 is recommended. At this time, it provides the greatest flexibility, a high degree of certainty of attaining objectives and allocations, and is consistent with applicable laws and policies. Either WDRs or a conditional waiver of WDRs could be used to control diazinon and chlorpyrifos discharges. A conditional prohibition provides a regulatory backstop and encourages participation in the Irrigated Lands Waiver

program. Continued implementation of the program to control agricultural discharges should provide the flexibility to take advantage of DPR, EPA or County Agricultural Commissioner regulatory activities, and any efficiencies offered by coalition groups in representing the dischargers.

6.7 Other Implementation Provisions

6.7.1 Submission of Management Plans

The Nonpoint Source Policy requires nonpoint source dischargers to describe the management practices that will be implemented to attain water quality objectives. The Central Valley Water Board will require the submission of a management plan by a coalition of dischargers or by individual dischargers. Where, dischargers have already submitted management plans to control diazinon, these plans will need to be modified to incorporate control of chlorpyrifos. By identifying the actions that the discharger will take to reduce diazinon and chlorpyrifos discharges, the Central Valley Water Board and the dischargers will be able to determine which practices are most effective at reducing pesticide runoff. The Central Valley Water Board will also be able to determine whether adequate effort is being made to reduce diazinon and chlorpyrifos discharges to the Sacramento and Feather Rivers.

6.7.2 Time Schedule for Actions to be Taken

Porter-Cologne requires the Central Valley Water Board to include a time schedule for actions to be taken as part of the program of implementation. Timelines are identified for Central Valley Water Board issuance or revision of WDRs or waivers of WDRs to address diazinon and chlorpyrifos runoff. A timeline for the expected establishment of diazinon water quality objectives is identified, as well as the frequency for review of the implementation program.

6.7.3 Time Schedule for Compliance

This section will discuss the alternative time schedules for compliance with water quality objectives and the TMDL. The primary considerations were:

- feasibility of complying in the specified time frame,
- minimizing the time period in which potential beneficial use impacts could occur,
- cost,
- clarity for the regulated community, and
- potential impact on achieving water quality objectives within the Delta due to discharges from the Sacramento River.

Note that much of the discussion from the Sacramento and Feather River diazinon Staff Report (Karkoski, et al., 2003) and the San Joaquin River diazinon and chlorpyrifos

Staff Report (Beaulaurier et al., 2005) is also applicable to this Basin Plan Amendment. Short term (by 2008-2010), medium term (by 2011-2012), and long term (by 2013-2016) time frames for compliance were evaluated. It is assumed that establishing requirements for chlorpyrifos in less than two years would not be feasible, since State Water Board, U.S. EPA and Office of Administrative Law approval of the water quality objectives and the Basin Plan Amendment may take 18 months or more after Central Valley Water Board action. Since the concentrations of diazinon and chlorpyrifos in the Sacramento and Feather Rivers appear to be meeting objectives, the time schedule discussion will focus largely on the time required to achieve the loading capacity.

Factors that may make compliance more difficult and require more time to achieve compliance include, (1) increased diazinon or chlorpyrifos use, (2) unfavorable weather conditions, and (3) difficulty in reducing peak concentrations. Diazinon and chlorpyrifos use may increase if pests develop resistance to alternatives being used. Diazinon and chlorpyrifos use may also increase if commodity prices increase and growers are more willing to increase production costs to ensure yields are maximized. If heavy rainfall were to occur soon after applications were made, receiving water concentrations may increase, even if total yearly use does not. Careful management of the timing of pesticide application (i.e. so that applications are not made immediately prior to storm or irrigation events) may be required to make significant reductions in peak concentrations. More specific discussion of factors affecting the compliance schedule is provided below.

6.7.3.1 Short-Term (2008-2010) Time Schedule for Compliance

A short-term compliance schedule would likely provide the greatest benefit to the environment, since exposure of aquatic life to diazinon and chlorpyrifos would be quickly reduced.

Compliance with the proposed objectives and loading capacity is feasible in the short term. There have been several exceedances of the proposed loading capacity. However, the magnitudes of these exceedances have been relatively minor (generally with S values less than 2). Additionally, nearly all of the exceedances occurred during the 2004 dormant spray season. There have been no exceedances since that time. This is significant because, since that time, the supplemental label for diazinon and the DPR's dormant spray regulations (DPR, 2006b) have been issued. Also, the implementation of management practices in response to the 2003 Basin Plan Amendment is continuing. These factors should result in a continued reduction of dormant spray season diazinon and chlorpyrifos concentrations and a corresponding reduction the number of exceedances of the proposed loading capacity. Given the Sacramento and Feather Rivers are meeting objectives, and the loading capacity has been met for the last two years, it is likely that objectives and loading capacity will continue to be met in the future. It is possible that additional management practices

may still be required to address the occasional exceedances in the irrigation season, but historical data suggests that exceedances during this time frame are infrequent. Therefore a short-term deadline is justified.

A short time frame would support achieving compliance in the Delta by ensuring that diazinon and chlorpyrifos inputs to the Delta from the Sacramento River would not exceed the Delta water quality objectives, which have compliances dates in 2012.

A short-term compliance schedule should be readily attainable by NPDES dischargers. It is expected that the majority of the diazinon and chlorpyrifos stock held by non-agricultural users will have been applied within a short-term timeframe. This should result in very few detections of diazinon or chlorpyrifos in NPDES effluent that originates within the jurisdiction of NPDES permittees.

6.7.3.2 Medium-Term (2011-2012) Time Schedule for Compliance

A medium term compliance schedule would potentially result in aquatic life being exposed to elevated diazinon and chlorpyrifos levels for a longer period of time. If growers implement practices to reduce overall pesticide runoff, the exposure of aquatic life to all potentially toxic pesticides would be reduced.

Compliance with the proposed objectives and loading capacity is feasible to obtain in the medium term (see Short-Term discussion). A medium-term time schedule would accommodate any additional time that might be needed to address pesticide discharges in the irrigation season and would provide growers with greater flexibility to adopt those management practices that are most cost effective at minimizing pesticide runoff. A medium-term compliance schedule should be readily attained by NPDES dischargers for the same reasons described above for a short-term compliance schedule.

As with a short time frame, a medium time frame would also support achieving compliance in the Delta by ensuring that diazinon and chlorpyrifos inputs to the Delta from the Sacramento River would not exceed the Delta water quality objectives.

6.7.3.3 Long-Term (2013-2016) Time Schedule for Compliance

Compliance with the proposed objectives is feasible to obtain in the long term (see Short Term discussion). A long-term compliance time schedule would have similar benefits to a medium term time schedule. A longer compliance schedule would provide growers with greater flexibility to adopt those management practices that are most cost effective at minimizing pesticide runoff. There are not likely to be any NPDES permitted sources of diazinon or chlorpyrifos, since the sale of non-agricultural diazinon products would have been banned for over ten years and most non-agricultural chlorpyrifos products would have been banned for thirteen years.

A long-term time frame might not support achieving compliance within the Delta. The lack of a clear numeric objective for chlorpyrifos and irrigation season diazinon could create the unlikely, yet possible situation where the Sacramento River would be held to less stringent requirements than the Delta that it discharges into

6.7.3.4 Evaluation of Single or Separate Compliance Deadlines.

Diazinon and chlorpyrifos compliance deadlines could be harmonized to take effect at the same time. Establishing a single compliance date for both diazinon and chlorpyrifos would be the most straightforward and easily understood alternative. This alternative would either require delaying compliance with the dormant season diazinon objective, or establishing a short-term deadline for complying with the chlorpyrifos and irrigation season diazinon objectives. Were compliance with the diazinon objective to be delayed, aquatic life could potentially be exposed to elevated diazinon and chlorpyrifos levels for a longer period of time.

Alternatively, separate compliance deadlines could be set for each pesticide and season. Establishing separate compliance dates would allow the implementation of dormant season diazinon objectives, loading capacity and allocations to continue to take effect in the short term, but would provide additional time for implementation of the chlorpyrifos and irrigation season diazinon. Under this alternative, aquatic life could potentially be exposed to elevated diazinon and chlorpyrifos levels for a longer period of time. If needed to reduce chlorpyrifos discharges, growers would have the flexibility to adopt management practices that are most cost effective at minimizing pesticide runoff

6.7.3.5 Recommendation for Time Schedule for Compliance

A short-term schedule, requiring compliance with the proposed water quality objectives, Allocations and loading capacity upon approval by the EPA is recommended. The Sacramento and Feather Rivers already appear to be meeting water quality objectives. Also, there is significant evidence to suggest that, given the recent changes to diazinon labeling and dormant spray regulations, compliance with the loading capacity will be achieved prior to approval of this Basin Plan Amendment. The proposed change to the diazinon objectives will only facilitate this compliance. Therefore the short-term schedule is feasible. Having a single deadline provides clear guidance for dischargers. A short-term schedule will provide maximum benefit to aquatic life and will support meeting objectives in the downstream Delta. Because the current data suggests that the Sacramento and Feather Rivers are already meeting the proposed objectives, no management measures should be required. To the extent that any additional management measures are determined to be necessary, the short term schedule may not provide the flexibility that the longer term options provide, but any associated cost is expected to be minor.

7.0 POLICIES

Both the State Water Board and the Central Valley Central Valley Water Board have a number of existing policies and Management Agency Agreements (MAAs) that are potentially applicable to the control of diazinon and chlorpyrifos in the Sacramento and Feather Rivers. The Basin Plan Amendment should be consistent with those policies. In addition, the Basin Plan Amendment will need to include new policies specific to the control of diazinon and chlorpyrifos in the Sacramento and Feather Rivers. The new policies will either address the mitigation of a potential impact or will specify how the program of implementation will be carried out. This section summarizes existing State and Central Valley Water Board policies and MAAs that are relevant to the changes proposed in this Basin Plan Amendment , and describes the needed policies specific to the control of diazinon and chlorpyrifos discharges to the Sacramento and Feather Rivers. In the sections below, the language from the State and Central Valley Water Board policies or MAAs are shown in italics within quotes.

7.1 Existing Policies

7.1.1 Central Valley Water Board's Water Quality Limited Segments Policy

> *"Additional treatment beyond minimum federal requirements will be imposed on dischargers to Water Quality Limited Segments. Dischargers will be assigned or allocated a maximum allowable load of pollutant so that water quality objectives can be met in the segment"* (CVRWQCB, 2006a, pp. IV-7.00).

The proposed Basin Plan Amendment establishes a TMDL for the Sacramento and Feather Rivers, which are included in the CWA section 303(d) list of Water Quality Limited Segments, and allocates the allowable loads to nonpoint source dischargers and to NPDES dischargers. Therefore, the proposed Basin Plan Amendment is consistent with the implementation of this policy.

7.1.2 Central Valley Water Board's Controllable Factors Policy

> *"Controllable water quality factors are not allowed to cause further degradation of water quality in instances where other factors have already resulted in water quality objectives being exceeded. Controllable water quality factors are those actions, conditions, or circumstances resulting from human activities that may influence the quality of waters of the State, that are subject to the authority of the State Water Board or Central Valley Water Board, and that may be reasonably controlled"* (CVRWQCB, 2006a, pp. IV-15.00).

The evaluation of management practices in **Section 6.5** shows that a variety of methods to control the runoff of diazinon and chlorpyrifos are available. Implementation of these control measures is expected to result in attainment of the proposed water quality objectives within a reasonable period of time. There are no other factors that would cause these water quality objectives to be exceeded.

7.1.3 State Water Board and Central Valley Water Board Antidegradation Policies

The State Water Board's Statement of Policy with Respect to Maintaining High Quality of Water in California (Anti-degradation Policy) (State Water Board Resolution No. 68-16)[12] includes the following statements:

> *"1. Whenever the existing quality of water is better than the quality established in policies as of the date on which such policies become effective, such existing high quality will be maintained until it has been demonstrated to the State that any change will be consistent with maximum benefit to the people of the State, will not unreasonably affect present and anticipated beneficial use of such water and will not result in water quality less than that prescribed in the policies."*
>
> *"2. Any activity which produces or may produce a waste or increase volume or concentration of waste and which discharges or proposes to discharge to existing high quality waters will be required to meet waste discharge requirements which will result in the best practicable treatment or control of the discharge necessary to assure that (a) a pollution or nuisance will not occur and (b) the highest water quality consistent with maximum benefit to the people of the State will be maintained."*

In addition, the Central Valley Water Board's Anti-degradation Implementation Policy states:

> *"…Implementation of this policy [State Water Board Resolution No. 68-16] to prevent or minimize surface and ground water degradation is a high priority for the Board.…The prevention of degradation is, therefore, an important strategy to meet the policy's objectives"* (CVRWQCB, 2006a, pp. IV-15.01).
>
> *"The Central Valley Water Board will apply 68-16 in considering whether to allow a certain degree of degradation to occur or remain. In conducting this type of analysis, the Central Valley Water Board will evaluate the nature of any proposed discharge, existing discharge, or material change therein, that could affect the quality of waters within the region. Any discharge of waste to high quality waters must apply best*

[12] Resolution No. 68-16 incorporates the federal anti-degradation standards for surface waters. (see 40 CFR § 131.12)

> *practicable treatment or control not only to prevent a condition of pollution or nuisance from occurring, but also to maintain the highest water quality possible consistent with the maximum benefit to the people of the State"* (CVRWQCB, 2006a, pp. IV-16.00).

The change to the proposed diazinon objective is consistent with the antidegradation policy for a number of reasons. As discussed in Section 5.1.1, the existing objective was based on scientific data that has since been called into question. The new objective simply corrects this calculation error. While the proposed objective is higher than the existing one, it is still designed to provide protection to the most sensitive present or future beneficial use. Changing the proposed objective allows for protection of beneficial uses, and prevention of pollution or nuisance without requiring the discharger to incur the additional costs that might be required to meet the existing objective. This could be considered by the Board to be consistent with the maximum benefit to the people of the State.

Finally, several factors supported or implemented by this Basin Plan Amendment will result in an improvement in water quality in the Sacramento and Feather Rivers. These factors include:

- establishment of chlorpyrifos water quality objectives with changes to the implementation program to include consideration of cumulative impacts,
- implementation of management measures required by the diazinon supplemental labels; and
- implementation of the DPR's dormant Spray Regulations.

These factors will prevent degradation of the existing quality of the Sacramento and Feather Rivers.

The Anti-degradation policies discussed above also apply to potential degradation of ground water, and potential degradation of the ground or surface water due to the use and introduction of new chemicals. As discussed in **Section 6.5**, there are a number of alternative practices available to growers that could lead to further reduction of diazinon and chlorpyrifos levels in the Sacramento and Feather Rivers. Some of these alternatives could result in increased infiltration of water, changes in timing of application of diazinon and/or chlorpyrifos, or the increased use of other chemicals that could degrade ground or surface water.

The proposed Basin Plan Amendment, therefore, includes new policies requiring that dischargers using an alternative to diazinon or chlorpyrifos prevent groundwater contamination and ensure compliance with existing Central Valley Water Board water quality objectives and policies. In addition, any monitoring and reporting program will require the discharger to demonstrate that the lowest pesticide levels in surface water

that are technically and economically achievable are being attained. Also, practices that result in increased infiltration of surface runoff are not expected to degrade ground water due to the relatively short half-life of diazinon and chlorpyrifos in soil (see **Section 2.0**). The proposed Basin Plan Amendment is, therefore, consistent with the State Water Board and Central Valley Water Board's Anti-degradation Policy and Central Valley Water Board's Anti-degradation Implementation Policy.

7.1.4 Central Valley Water Board's Watershed Policy

> *"The Central Valley Water Board supports implementing a watershed based approach to addressing water quality problems. The benefits to implementing a watershed based approach would include gaining participation of stakeholders and focusing efforts on the most important problems and those sources contributing most significantly to those problems."* (CVRWQCB, 2006a, pp. IV-21.00)

The Central Valley Water Board conducted outreach to the stakeholders in the area covered by this Basin Plan Amendment, as discussed in the Executive Summary. These outreach activities were conducted to gain participation of stakeholders as part of implementation of the watershed policy. This Report also focuses on identifying and addressing the uses of diazinon and chlorpyrifos that are likely contributing most significantly to their presence in the Sacramento and Feather Rivers. For these reasons, the proposed Basin Plan Amendment is consistent with the watershed policy.

7.1.5 Central Valley Water Board's Policy for Application of Water Quality Objectives

Excerpts from this policy are presented below. The full text can be found on page IV-16.00 of the Basin Plan.

> *"Water quality objectives are defined as 'the limits or levels of water quality constituents or characteristics which are established for the reasonable protection of beneficial uses of water, or the prevention of nuisance within a specific area.' Water quality objectives may be stated in either numerical or narrative form. Water quality objectives apply to all waters within a surface or ground water resource for which beneficial uses have been designated. The numerical and narrative water quality objectives define the least stringent standards that the Central Valley Water Boards will apply to regional waters in order to protect beneficial uses. Where compliance with narrative objectives is required, the Central Valley Water Board will, on a case-by-case basis, adopt numerical limitations in orders which will implement the narrative objectives."*

> *"Where multiple toxic pollutants exist together in water, the potential for toxicological interactions exists. On a case-by-case basis, the Central Valley Water Board will evaluate data to determine whether there is a reasonable potential for interactive*

toxicity. Pollutants which are carcinogenic or which manifest their toxic effects on the same organ systems or through similar mechanisms will generally be considered to have potentially additive toxicity. The following formula will be used to assist the Central Valley Water Board in making determinations:"

$$\sum_{i=1}^{n} \frac{[\textbf{Concentration of Toxic Substance}]_i}{[\textbf{Toxicologic Limit for Substance in Water}]_i} < 1.0 \qquad \textbf{Eq. 7.1}$$

"The concentration of each toxic substance is divided by its toxicologic limit. The resulting ratios are added for substances having similar toxicologic effects. If such a sum of ratios is less than one, an additive toxicity problem is assumed not to exist. If the summation is equal to or greater than one, the combination of chemicals is assumed to present an unacceptable level of toxicologic risk."

This Basin Plan Amendment proposes the establishment of acute and chronic numeric objectives for diazinon and chlorpyrifos in the Sacramento and Feather Rivers. Since diazinon and chlorpyrifos have the same toxicological effect, this Basin Plan Amendment also requires compliance based upon the additive toxicity of these two pesticides when present together. The loading capacity and allocations for diazinon and chlorpyrifos explicitly account for the additive effects of these pesticides. Therefore, this Basin Plan Amendment is consistent with the Policy for Application of Water Quality Objectives.

7.1.6 Pesticide Discharges from Nonpoint Sources

The Central Valley Water Board's policy on Pesticide Discharges from Nonpoint Sources (Pesticide Policy) was adopted to implement the water quality objectives for Pesticides. The Pesticide Policy includes a number of provisions that should be evaluated with respect to this Basin Plan Amendment.

"The control of pesticide discharges to surface waters from nonpoint sources will be achieved primarily by the development and implementation of management practices that minimize or eliminate the amount discharged" (CVRWQCB, 2006a, pp. IV-33.04)

The evaluation of available practices for the control of diazinon and chlorpyrifos (**Section 6.5**) includes both management practices that should minimize the off-site movement of diazinon and chlorpyrifos, as well as practices (i.e. use of other pest control methods) that would eliminate the amount discharged. The proposed Basin Plan Amendment requires dischargers to submit a management plan to describe the actions they will take to meet the applicable allocations. The Basin Plan Amendment

has, therefore, been prepared in a manner consistent with this provision of the Pesticide Policy.

> *"The Board will use water quality monitoring results to evaluate the effectiveness of control efforts and to help prioritize control efforts"* (CVRWQCB, 2006a, pp. IV-33.04)

The proposed Basin Plan Amendment includes provisions that address the evaluation of water quality monitoring results to evaluate the effectiveness of control efforts (see **Sections 3.0** and **8.0**). Prioritization of which control efforts to pursue will be conducted primarily by growers or their representatives and will be identified in the management plan submitted. The Basin Plan Amendment has, therefore, been prepared in a manner consistent with this provision of the Pesticide Policy.

> *"Central Valley Water Board monitoring will consist primarily of chemical analysis and biotoxicity testing of major water bodies receiving irrigation return flows. The focus will be on pesticides with use patterns and chemical characteristics that indicate a high probability of entering surface waters at levels that may impact beneficial uses. Board staff will advise other agencies that conduct water quality and aquatic biota monitoring of high priority chemicals, and will review monitoring data developed by these agencies. Review of the impacts of "inert" ingredients contained in pesticide formulations will be integrated into the Board's pesticide monitoring program.* (CVRWQCB, 2006a, pp. IV-34.00)

> *"When a pesticide is detected more than once in surface waters, investigations will be conducted to identify sources. Priority for investigation will be determined through consideration of the following factors: toxicity of the compound, use patterns and the number of detections. These investigations may be limited to specific watersheds where the pesticide is heavily used or local practices result in unusually high discharges. Special studies will also be conducted to determine pesticide content of sediment and aquatic life when conditions warrant. Other agencies will be consulted regarding prioritization of monitoring projects, protocol, and interpretation of results."*

These provisions focus on the general approach the Central Valley Water Board will use in determining whether a water quality problem related to pesticides exist. This procedure was generally followed in the investigation of water quality problems related to diazinon and chlorpyrifos. The Central Valley Water Board will need to continue following this procedure to determine if shifts in pesticides use patterns or use of alternatives to diazinon or chlorpyrifos require investigation or special studies. The proposed Basin Plan Amendment includes provisions that address continued sampling

and evaluation of pesticides in the major waterbodies (see **Sections 3.0** and **8.0**). The Basin Plan Amendment has, therefore, been prepared in a manner consistent with this provision of the Pesticide Policy.

> *"To ensure that new pesticides do not create a threat to water quality, the Board, either directly or through the State Water Resources Control Board, will review the pesticides that are processed through the Department of Food and Agriculture's (DFA) registration program. Where use of the pesticide may result in a discharge to surface waters, the Board staff will make efforts to ensure that label instructions or use restrictions require management practices that will result in compliance with water quality objectives. When the Board determines that despite any actions taken by DFA, use of the pesticide may result in discharge to surface waters in violation of the objectives, the Board will take regulatory action, such as adoption of a prohibition of discharge or issuance of waste discharge requirements to control discharges of the pesticide. Monitoring may be required to verify that management practices are effective in protecting water quality"* (CVRWQCB, 2006a, pp. IV-34.00)

This provision of the Pesticide Policy describes a procedure to be applied during the registration process for new pesticides, and is, therefore, not directly related to the control of diazinon or chlorpyrifos runoff and does not apply to this Basin Plan Amendment.

> *"The Board will notify pesticide dischargers through public notices, educational programs and the Department of Food and Agriculture's pesticide regulatory program of the water quality objectives related to pesticide discharges. Dischargers will be advised to implement management practices that result in full compliance with these objectives by 1 January 1993, unless required to do so earlier. (Dischargers of carbofuran, malathion, methyl parathion, molinate and thiobencarb must meet the requirements detailed in the Prohibitions section.) During this time period, dischargers will remain legally responsible for the impacts caused by their discharges."* (CVRWQCB, 2006a, pp. IV-34.00)

This provision of the Pesticide Policy refers to the pesticide water quality objectives adopted at the time of the policy. The provision, therefore, does not apply to the establishment of site-specific water quality objectives for diazinon contained in this Basin Plan Amendment.

> *"The Board will conduct reviews of the management practices being followed to verify that they produce discharges that comply with water quality objectives. It is anticipated that practices associated with one or two pesticides can be reviewed each year. Since objective, control methods and other factors are subject to*

change, it is also anticipated that allowable management practices will change over time, and control practices for individual pesticides will have to be reevaluated periodically." (CVRWQCB, 2006a, pp. IV-34.00)

The proposed Basin Plan Amendment (see **Section 3.0**) describes a role for the Central Valley Water Board in reviewing management practices and provides for periodic review of those practices. Dischargers of diazinon and chlorpyrifos will be responsible for providing that information to the Central Valley Water Board. The Basin Plan Amendment has, therefore, been prepared in a manner consistent with this provision of the Pesticide Policy.

"Public hearings will be held at least once every two years to review the progress of the pesticide control program. At these hearings, the Board will

- review monitoring results and identify pesticides of greatest concern,
- review changes or trends in pesticide use that may impact water quality,
- consider approval of proposed management practices for the control of pesticide discharges,
- set the schedule for reviewing management practices for specific pesticides; and
- consider enforcement action.

"After reviewing the testimony, the Board will place the pesticides into one of the following three classifications. When compliance with water quality objectives and performance goals is not obtained within the timeframes allowed, the Board will consider alternate control options, such as prohibition of discharge or issuance of waste discharge requirements."

"1. Where the Board finds that pesticide discharges pose a significant threat to drinking water supplies or other beneficial uses, it will request DFA to act to prevent further impacts. If DFA does not proceed with such action(s) within six months of the Board's request, the Board will act within a reasonable time period to place restrictions on the discharges."

"2. Where the Board finds that currently used discharge management practices are resulting in violations of water quality objectives, but the impacts of the discharge are not so severe as to require immediate changes, dischargers will be given three years, with a possibility of three one year time extensions depending on the circumstances involved, to develop and implement practices that will meet the objectives. During this period of time, dischargers may be required to take interim steps, such as meeting Board established performance goals to reduce impacts of the discharges.

Monitoring will be required to show that the interim steps and proposed management practices are effective."

"3. The Board may approve the management practices as adequate to meet water quality objectives. After the Board has approved specific management practices for the use and discharge of a pesticide, no other management practice may be used until it has been reviewed by the Board and found to be equivalent to or better than previously approved practices. Waste discharge requirements will be waived for irrigation return water per Resolution No. 82-036 if the Board determines that the management practices are adequate to meet water quality objectives and meet the conditions of the waiver policy. Enforcement action may be taken against those who do not follow management practices approved by the Board" (CVRWQCB, 2006a, pp. IV-34.00)

The Central Valley Water Board, through the Clean Water Act Section 303(d) listing process, has reviewed available monitoring results for pesticides and has identified diazinon and chlorpyrifos as two of the pesticides of greatest concern, which is consistent with this provision of the Pesticide Policy.

In preparing this Basin Plan Amendment, Central Valley Water Board staff has reviewed changes and trends in use of diazinon and chlorpyrifos and potential replacement products, which is consistent with this provision of the Pesticide Policy.

As part of the review procedure identified in this Basin Plan Amendment (see **Section 3.0**), the Central Valley Water Board will consider enforcement action, which is consistent with this provision of the Pesticide Policy.

By adopting this Basin Plan Amendment, the Central Valley Water Board is effectively considering diazinon and chlorpyrifos to fall within classification three (3). Current data indicate that the Sacramento and Feather Rivers appear to be meeting the proposed water quality objectives. With the management practices being implemented as a result of the new label and the DPR dormant spray regulations, the loading capacity is already being met or is expected to be met by the time this Basin Plan Amendment is approved. Discharges of diazinon and chlorpyrifos will be regulated through implementation of an enforceable waiver of waste discharge requirements (the Irrigated Lands Program). This Basin Plan Amendment requires monitoring to demonstrate that proposed management practices are effective. The Basin Plan Amendment is, therefore, consistent with this provision of the Pesticide Policy.

> *"To ensure the best possible program, the Board will coordinate its pesticide control efforts with other agencies and organizations. Wherever possible, the burdens on pesticide dischargers will be reduced by working through the DFA or other appropriate regulatory processes. The Board may also designate another agency or organization as the responsible party for the development and/or implementation of management practices, but it will retain overall review and control authority. The Board will work with water agencies and others whose activities may influence pesticide levels to minimize concentrations in surface waters"* (CVRWQCB, 2006a, pp. IV-35.00).

The Central Valley Water Board has been working with DPR[13] to identify possible ways of reducing the burden on pesticide dischargers. Management practices for controlling diazinon have been added to the diazinon use label requirements (MANA, 2004d), which are implemented by the County Agricultural Commissioners under DPR's supervision. Management practices for controlling diazinon and chlorpyrifos are also expected to be incorporated into upcoming revisions to the chlorpyrifos use labels requirements (DPR, 2004), as well as DPR's dormant spray regulations (DPR, 2006b). The proposed Basin Plan Amendment contains provisions for continuing to work with DPR and the County Agricultural Commissioners to assess the success of the management practices being implemented. The program of implementation established by this Basin Plan Amendment also still retains the Central Valley Water Board's role in reviewing management practices and monitoring data, as well as determining what further control actions might be required. The Basin Plan Amendment has, therefore, been prepared in a manner consistent with this provision of the Pesticide Policy.

> *"Since the discharge of pesticides into surface waters will be allowed under certain conditions, the Board will take steps to ensure that this control program is conducted in compliance with the federal and state antidegradation policies. This will primarily be done as pesticide discharges are evaluated on a case by case basis"* (CVRWQCB, 2006a, pp. IV-36.00)

Anti-degradation policies have been explicitly considered in a number of sections of this staff report. The Basin Plan Amendment has, therefore, been prepared in a manner consistent with this provision of the Pesticide Policy.

[13] DPR was part of the California Department of Food and Agriculture at the time the Pesticide Policy was adopted.

7.1.7 State Water Board's Water Quality Control Policy for Addressing Impaired Waters

The State Water Board adopted the Water Quality Control Policy for Addressing Impaired Waters (SWRCB 2005) to describe the requirements for how the State and Central Valley Water Boards must correct impairments to the waters of the State.

> *"A. If the water body is neither impaired nor threatened, the appropriate regulatory response is to delist the water body."*

As discussed in the Background section of this staff report, diazinon and chlorpyrifos are still found at levels exceeding the existing water quality standards in the Sacramento and Feather Rivers, therefore this impairment still needs to be corrected through a Central Valley Water Board action.

> *"B. If the failure to attain standards is due to the fact that the applicable standards are not appropriate to natural conditions, an appropriate regulatory response is to correct the standards."*

The existing diazinon objective was established based on data that has since been shown to be questionable and the existing objective could be considered inappropriate . Therefore, this report recommends revising the diazinon standard.

> *"C. The State Board and Regional Boards are responsible for the quality of all waters of the state, irrespective of the cause of the impairment. In addition, a TMDL must be calculated for impairments caused by certain EPA designated pollutants."*

Pesticides fit under the definition of pollutants, and diazinon and chlorpyrifos are technically suitable for TMDL calculation in the Sacramento and Feather Rivers. Therefore a TMDL must be calculated. The proposed Basin Plan Amendment contains all of the necessary elements of a TMDL; the loading capacity, allocations, and consideration of seasonal variations and a margin of safety.

> *"D. Whether or not a TMDL calculation is required as described above, impaired waters will be corrected (and implementation plans crafted) using existing regulatory tools"*

The proposed Basin Plan Amendment uses existing regulatory tools, including prohibitions of discharge, waste discharge requirements and, possibly, waivers of waste discharge requirements, to correct the diazinon and chlorpyrifos impairment in the Sacramento and Feather Rivers.

"D1. If the solution to an impairment will require multiple actions of the Regional Board that affect multiple persons, the solution must be implemented through a Basin Plan Amendment or other regulation."

Correcting the diazinon and chlorpyrifos impairment in the Sacramento and Feather Rivers will likely require multiple actions of the Central Valley Water Board to gain compliance from all of the dischargers to the Sacramento and Feather Rivers, therefore a Basin Plan Amendment or other regulation is necessary in this case.

"D2. If the solution to an impairment can be implemented with a single vote of the Regional Board, it may be implemented by that vote."

As discussed under D1, the solution to this impairment will likely require multiple votes of the Central Valley Water Board, therefore a regulation, such as a Basin Plan Amendment, is required.

"D3. If a solution to an impairment is being implemented by a regulatory action of another state, regional, local, or federal agency, and the Regional Board finds that the solution will actually correct the impairment, the Regional Board may certify that the regulatory action will correct the impairment and if applicable, implement the assumptions of the TMDL, in lieu of adopting a redundant program."

Recent and anticipated changes in pesticide use requirements by regulatory agencies such as DPR and U.S. EPA are expected to reduce diazinon and chlorpyrifos discharges. However, some of those changes have not yet been implemented, so there is no guarantee that these actions will result in attainment of water quality objectives. Therefore the adoption of a Basin Plan Amendment is appropriate. In addition, this provision of the Policy provides an option for the Central Valley Water Boards and not a requirement to certify a regulatory action by another agency.

"D 4. If a solution to an impairment is being implemented by a non-regulatory action of another entity, and the Regional Board finds that the solution will actually correct the impairment, the Regional Board may certify that the non-regulatory action will correct the impairment and if applicable, implement the assumptions of the TMDL, in lieu of adopting a redundant program."

A solution to the impairment is not being implemented through a non-regulatory action by another entity, so this provision could not be applied.

For the reasons stated above, a Basin Plan Amendment is the appropriate means for the adoption of a TMDL for diazinon and chlorpyrifos in the Sacramento and Feather Rivers. The adoption of this TMDL will follow the process outlined in this policy

The proposed Basin Plan Amendment contains all the necessary elements of a TMDL, and an implementation plan that uses existing regulatory tools, prohibitions, waivers and WDRs to correct the impairment caused by diazinon and chlorpyrifos in the Sacramento and Feather Rivers. This Basin Plan Amendment has, therefore, been prepared in a manner consistent with this provision of the State Water Board's Water Quality Control Policy for Addressing Impaired Waters.

7.1.8 State Water Board's Policy for Implementation and Enforcement of the Nonpoint Source Pollution Program

The Nonpoint Source Pollution Program Policy (Policy) (SWRCB, 2004) clarifies the applicability of Porter-Cologne to nonpoint sources. The Policy also describes the key elements that must be included in a nonpoint source implementation program.

The Policy makes it clear that all nonpoint source (NPS) discharges must be regulated under waste discharge requirements, waivers of waste discharge requirements, a Basin Plan prohibition, or some combination of those administrative tools. An implementation program developed by the Central Valley Water Board, State Water Board, discharger, or third party must include the following key elements:

KEY ELEMENT 1: An NPS control implementation program's ultimate purpose shall be explicitly stated. Implementation programs must, at a minimum, address NPS pollution in a manner that achieves and maintains water quality objectives and beneficial uses, including any applicable anti-degradation requirements.

KEY ELEMENT 2: An NPS control implementation program shall include a description of the management practices and other program elements that are expected to be implemented to ensure attainment of the implementation program's stated purpose(s), the process to be used to select or develop management practices, and the process to be used to ensure and verify proper management practice implementation.

KEY ELEMENT 3: Where a Regional Water Quality Control Board determines it is necessary to allow time to achieve water quality requirements, the NPS control implementation program shall include a specific time schedule, and corresponding quantifiable milestones, designed to measure progress toward reaching the specified requirements.

KEY ELEMENT 4: An NPS control implementation program shall include sufficient feedback mechanisms so that the Regional Water Quality Control Board, dischargers, and the public can determine whether the program is achieving its stated purpose(s), or whether additional or different management practices or other actions are required.

KEY ELEMENT 5: Each Central Valley Water Board shall make clear, in advance, the potential consequences for failure to achieve an NPS control implementation program's stated purposes.

The proposed Basin Plan Amendment is consistent with the NPS Program Policy. WDRs or Waiver of WDRs can be effectively used to address nonpoint sources of diazinon and chlorpyrifos. The proposed Basin Plan Amendment includes requirements to: meet water quality objectives (Key Element 1); submit management plans and evaluate management practices (Key Element 2); comply with objectives and allocations within a specified time frame (Key Element 3); and conduct monitoring on the success of management practices (Key Element 4). The Basin Plan Amendment includes provisions for requiring modification to management plans in the event of failure to achieve objectives (Key Element 5).

7.1.9 Management Agency Agreement (MAA) with the California Department of Pesticide Regulation (DPR)

The State Water Board and DPR have a Management Agency Agreement (MAA) (SWRCB and DPR 1997) to ensure that pesticides registered for use in California are used in a manner that protects water quality and the beneficial uses of water, while recognizing the need for pest control. The State and Central Valley Water Boards are responsible for protecting the beneficial uses of water in California, and for controlling all discharges of waste into waters of the State. DPR is the lead agency for pesticide regulation in California.

The MAA describes a four-stage process for DPR and the Central Valley Water Boards to address potential water quality problems related to pesticides. Stage one is general outreach and education to prevent surface water contamination. Stage two is a self-regulating response based on sponsors leading implementation efforts. Stage three is a regulatory approach based on the authorities of DPR and the Agricultural Commissioners. Stage four is a regulatory approach based on Central Valley Water Board authorities.

Stage two and stage three include the development of numerical values (referred to as "Quantitative Response Limits"-QRLs) to assess success of mitigation efforts when no numerical water quality objectives are available. DPR is to develop QRLs after repeated valid detections of pesticides in surface water. The stage four process under

the MAA, regulation by the Central Valley Water Board, is to be considered when there is an actual or threatened violation of water quality standards; when the Regional or State Water Board finds that the stage two or three efforts are not protecting water quality; or when the Central Valley Water Board believes it is necessary to take action to protect water quality and meet its statutory obligations.

A stage two process described in the MAA has not been put into effect for diazinon or chlorpyrifos in the Sacramento or Feather Rivers. A QRL or QRLs for diazinon or chlorpyrifos have not been developed and no sponsor has been identified. DPR began the stage 3 process in February 2003 (DPR, 2003) by placing diazinon into the reevaluation process, and later placed chlorpyrifos into reevaluation (DPR, 2004). In 2006, the DPR released dormant spray regulations. The regulations restrict ground and aerial applications of dormant season insecticides to areas 100 feet or more from any irrigation or drainage ditch, canal, or any other body of water in which the presence of dormant season insecticides could adversely impact any of the beneficial uses of the waters of the state. The regulations also specify wind speeds in which dormant insecticides may be applied. The regulations allow aerial application only if soil conditions do not allow field entry or approaching bloom conditions require aerial applications. The regulations prohibit all dormant insecticide applications when soil moisture is at field capacity and a storm event is forecast to occur within 48 hours following application, or when a storm event that is likely to produce runoff from the treated area is forecast to occur within 48 hours following application.

Since the diazinon and chlorpyrifos concentrations in the Sacramento and Feather Rivers have been found to exceed existing water quality objectives, the Central Valley Water Board is obligated by both Federal and State law to develop a program to address the discharge of diazinon and chlorpyrifos, so the stage four process applies. This Basin Plan Amendment allows DPR requirements to be taken into account as a component of management plans that are submitted by dischargers. DPR's regulatory authorities can still be used in conjunction with this Basin Plan Amendment to address the control of diazinon and chlorpyrifos discharges.

7.2 Need For New Policies

7.2.1 Compliance Policy

The Central Valley Water Board's compliance policy for control of diazinon and chlorpyrifos in the Sacramento and Feather Rivers requires compliance with both the allocations and the water quality objectives. The allocations are established to assign responsibility for meeting the water quality objectives. If all allocations are met, the water quality objectives should be met.

Although the Basin Plan Amendment establishes diazinon and chlorpyrifos water quality objectives and allocations, the Basin Plan's general pesticide objectives and policies still apply to diazinon and chlorpyrifos discharges. Based on current information, reduction of diazinon and chlorpyrifos levels to meet the allocations and water quality objectives should be sufficient to protect the Sacramento and Feather Rivers from diazinon and chlorpyrifos discharges. If it is later found that diazinon and chlorpyrifos discharges are contributing to a violation of other Basin Plan water quality objectives (e.g. due to additive or synergistic toxicity impacts), additional Central Valley Water Board action to reduce diazinon and chlorpyrifos discharges may be necessary.

Given the potential for the need for further reductions of diazinon and chlorpyrifos in the Sacramento and Feather Rivers, either due to toxicity issues (discussed above) or to protect tributary waters, the Basin Plan Amendment clarifies that the diazinon and chlorpyrifos objectives and allocations are maximum allowable levels. In addition, the Basin Plan Amendment states that the Central Valley Water Board shall require any necessary reductions in diazinon and chlorpyrifos levels to account for additive or synergistic effects or protect beneficial uses in tributary waters. Depending on the nature of the needed reductions, the Central Valley Water Board may further regulate diazinon and chlorpyrifos through waste discharge requirements, waiver of waste discharge requirements, or by additional Basin Plan Amendments.

7.2.2 Pesticide Runoff Management Policy

The Central Valley Water Board must follow federal, State, and Central Valley Water Board anti-degradation policies when taking specific actions (see discussion in **Section 7.0**). In the case of the control of diazinon and chlorpyrifos, potential responses by growers could result in the use of other products that may runoff and degrade water quality. In addition, the Central Valley Water Board has an existing pesticide water quality objective that states "[p]esticide concentrations shall not exceed the lowest levels technically and economically achievable."

Based on the existing anti-degradation policy and the current pesticide water quality objective, the Central Valley Water Board should encourage the adoption of practices to control pesticide runoff to surface waters. In addition, the Central Valley Water Board recognizes that practices that retain surface runoff may in some instances increase infiltration. It is, therefore, important that the solution for one problem (surface water contamination) does not create another problem (groundwater contamination). The Department of Pesticide Regulation and the County Agricultural Commissioners currently have programs to address groundwater contamination and are familiar with those pesticides that are most likely to cause groundwater contamination problems.

It is ultimately the responsibility of the dischargers to ensure that their pest control practices are not contaminating ground water and not causing violations of applicable Central Valley Water Board policies and water quality objectives. The proposed Basin Plan Amendment includes a policy that requires dischargers to consider potential impacts to ground or surface waters of alternatives to diazinon and chlorpyrifos.

7.2.3 Review and Planning Policies

The Central Valley Water Board will review the provisions that have been included in this Basin Plan Amendment. New scientific or technical information may be developed that could suggest revisions to the water quality objectives, TMDL, or implementation policies. The Central Valley Water Board will also determine whether the implementation framework established by this Basin Plan Amendment is effective. The Central Valley Water Board may act on new information at any time, but a comprehensive, review of the overall control program will help ensure that water quality objectives are being attained. The proposed Basin Plan Amendment includes a policy to review the implementation program.

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8.0 SURVEILLANCE AND MONITORING

Porter-Cologne requires that the Basin Plan Amendment describe the type of surveillance and monitoring that will be required to determine compliance with the water quality objectives, loading capacity and load allocations. In general, responsibility for monitoring and surveillance will fall to three main groups: the Central Valley Water Board, the entity or entities and individuals directly overseeing the implementation program (i.e. watershed coalition groups representing agricultural dischargers and/or individual agricultural dischargers), and those responsible for adopting new management practices. Monitoring requirements are intended to apply to agricultural discharges. Because non-agricultural uses of diazinon and chlorpyrifos have largely been phased out, there is no apparent need to apply surveillance and monitoring requirements to urban discharges, beyond the existing requirements for NPDES dischargers.

Three main alternatives for surveillance and monitoring were considered:

1. No change in the existing surveillance and monitoring requirements,
2. Modify the existing surveillance and monitoring program to include chlorpyrifos, but otherwise continue to provide only general direction on the required monitoring and surveillance, and
3. Identify specific monitoring requirements, including methods, sites, and constituents.

Under the no changes alternative, the existing surveillance and monitoring program would be maintained. This program requires that any waste discharge requirements or waivers of waste discharge requirements include a monitoring and reporting program to evaluate compliance of discharges of diazinon and other pesticides with the requirements of the Basin Plan. The Basin Plan currently includes 7 discrete requirements that must be fulfilled by a monitoring and reporting program. Monitoring of chlorpyrifos discharges is not specifically enumerated, but would be included in the sixth monitoring and reporting program evaluation criteria. That evaluation criteria states that monitoring must be sufficient to determine whether the discharge causes or contributes to a toxicity impairment due to additive or synergistic effects of multiple pollutants.

Currently, the Sacramento Valley Water Quality Coalition is the only group that has had approved and is implementing a monitoring and reporting program required by the Board. The Central Valley Water Board is currently conducting some monitoring of diazinon and chlorpyrifos in the Sacramento and Feather Rivers and their tributaries. However, the Central Valley Water Board's funding for monitoring in the Sacramento and Feather Rivers is not certain for the long term and does not include tracking and

evaluating management practices. In addition, while all the programs report diazinon using appropriate methods, many of the methods used for chlorpyrifos use methods having method detection limits that exceed the proposed water quality objective. Under the current monitoring program, there is no incentive to switch to methods that have lower method detection limits.

Alternative 2 would continue to provide general requirements for the monitoring and surveillance to be conducted, but allow flexibility in terms of the precise requirements and who would conduct the monitoring. However, the surveillance and monitoring goals would be modified to explicitly include chlorpyrifos monitoring. The general requirements would be structured to provide enough data to allow evaluation of compliance with this Basin Plan Amendment. By explicitly including chlorpyrifos as a monitoring requirement, it would ensure that all programs are utilizing methods with sufficiently low method detection limits.

Alternative 3 would identify specific requirements for monitoring and surveillance, including specific sites to be monitored, the frequency of monitoring, and constituents to be monitored. This alternative would provide the greatest certainty as to expectations of the monitoring effort, but would provide the least flexibility.

Alternative 2 is recommended. Specific expectations with respect to the information to be collected are needed to ensure the Central Valley Water Board can determine progress in implementing this Basin Plan Amendment. The specific methods and number of monitoring sites required to meet those expectations should remain flexible to take advantage of the efforts of different groups and agencies conducting monitoring and evaluating management practices. The use of monitoring and reporting programs (e.g. through a waiver of waste discharge requirements or waste discharge requirements) should provide the assurance that the necessary information is collected and submitted to the Central Valley Water Board. Alternative 2 would only apply to agricultural discharge, since diazinon and chlorpyrifos discharge from NPDES sources is not expected and any monitoring required as part of the NPDES permit process should be sufficient. The general monitoring and surveillance needs are described below.

The surveillance and monitoring program should be designed to collect the information necessary to:

1. Determine compliance with established water quality objectives and Loading Capacities applicable to diazinon and chlorpyrifos in the Sacramento and Feather Rivers.

2. Determine compliance with the load allocations applicable to discharges of diazinon and chlorpyrifos into the Sacramento and Feather Rivers
3. Determine the degree of implementation of management practices to reduce off-site movement of diazinon and chlorpyrifos
4. Determine the effectiveness of management practices and strategies to reduce off-site migration of diazinon and chlorpyrifos
5. Determine whether alternatives to diazinon and chlorpyrifos are causing surface water quality impacts
6. Determine whether the discharge causes or contributes to a toxicity impairment due to additive or synergistic effects of multiple pollutants
7. Demonstrate that management practices are achieving the lowest pesticide levels technically and economically achievable.

The types of activities required to meet the monitoring goals are described in more detail below. The descriptions below assume that a collective monitoring effort would continue to be implemented by the agricultural dischargers. As discussed above, current coalitions have already submitted and/or implement monitoring plans that are expected to be consistent with the following recommendations, however plans may need to be adjusted to incorporate enhanced chlorpyrifos monitoring. If individual agricultural dischargers choose to implement their own monitoring, the requirements would consist of monitoring their own discharges to meet the goals stated above.

1: Determine compliance with established water quality objectives and Loading Capacities applicable to diazinon and chlorpyrifos in the Sacramento and Feather Rivers.

To determine compliance with water quality objectives and Loading Capacities, monitoring will need to occur at a number of sites within the Sacramento and Feather Rivers. A number of sites along the Sacramento and Feather Rivers would need to be monitored to track the presence and transport of diazinon and chlorpyrifos in the river. Monitoring locations should be chosen to provide information about direct and indirect discharges of diazinon and chlorpyrifos from the various subwatersheds and tributaries to the Sacramento and Feather Rivers.

The frequency of monitoring should be based on the primary processes leading to diazinon and chlorpyrifos runoff. During the dormant season, storm water runoff will account for most diazinon and chlorpyrifos found in the Sacramento and Feather Rivers. Monitoring should, therefore, take place concurrent with and for a number of days after storms of sufficient magnitude to produce runoff in the Sacramento and Feather Rivers Watersheds. Storm water runoff during March should also be monitored, since this is the period of intense chlorpyrifos applications on alfalfa.

During the irrigation season, interval sampling should be implemented to monitor diazinon and chlorpyrifos transported into the Sacramento and Feather Rivers via irrigation runoff and possibly aerial drift. Since irrigation and pesticide use will take place at different times, monitoring at the sites discussed above can take place at a frequency that depends on use patterns and frequency of irrigation.

Laboratory detection limits must be low enough to detect exceedances of the water quality objectives or criteria.

2: Determine compliance with the load allocations applicable to discharges of diazinon and chlorpyrifos into the Sacramento and Feather Rivers

To determine compliance with load allocations, water quality monitoring will need to be conducted where tributary waters discharge into the Sacramento and Feather Rivers. Monitoring could be done to cover discharges from each tributary water. This would provide the greatest level of assurance that loading capacities were being met. However this level of monitoring would be expensive. Alternatively, monitoring could be designed so that the samples collected would be representative of the areas with the greatest potential to discharge diazinon or chlorpyrifos. Study design could be based on land use, sampling more frequently in areas where diazinon or chlorpyrifos is used more heavily. Study design could also be based on historical data, focusing greater monitoring effort on those areas that have historically contributed higher pesticide levels. Finally, a monitoring program could include a mixture of all of these elements.

3: Determine the degree of implementation of management practices to reduce off-site movement of diazinon and chlorpyrifos.

Information must be collected from growers on the types of practices being used and how those practices are being applied, while considering the following factors:

- Minimize the paperwork burden on growers.
- Use existing reporting systems.
- Create a repository for the data that will allow for ease of data entry and analysis.

Data should be collected in the four broad areas:

- Pesticide application, mixing, and loading practices.
- Pest management practices.
- Water management practices.
- Cultural practices.

Experts in each of those broad fields should be consulted in designing the survey or reporting requirements to ensure relevant data is collected.

A focused effort should be made to receive complete reporting from growers whose lands drain to the monitoring sites. This should allow the Central Valley Water Board to relate the implementation of specific diazinon and chlorpyrifos runoff mitigation approaches to changes in diazinon and chlorpyrifos loading.

4: Determine the effectiveness of management practices and strategies to reduce off-site migration of diazinon and chlorpyrifos.

To assess the effectiveness of specific management practices or strategies, field level evaluations will need to be conducted. The field evaluations should quantify the amount of load reduction, or reduction in off-site migration of diazinon and chlorpyrifos (in the case of practices to reduce aerial drift) that could be expected with implementation of a new management practice or strategy.

5: Determine whether alternatives to diazinon and chlorpyrifos are causing surface water quality impacts.

Replacement of diazinon and chlorpyrifos with other OP insecticides, carbamate insecticides or pyrethroids may result in water column or sediment toxicity. First, an evaluation of pesticide use patterns would need to be performed in order to determine whether any alternative pesticides pose a threat to water quality. Monitoring of the water column and sediment would need to include analyses for these insecticides to ensure that aquatic toxicity does not continue, or does not simply move from the water column to sediment.

The monitoring locations should generally be the same as those used to monitor diazinon and chlorpyrifos levels and the monitoring could be done concurrently. Sediment monitoring should be done at sites where sediments are likely to be deposited. Sediment sampling could be performed concurrently with surface water monitoring, but may not need to be performed as frequently (e.g. monthly during the dormant season rather then daily storm event sampling).

6: Determine whether the discharge causes or contributes to a toxicity impairment due to additive or synergistic effects of multiple pollutants.

The toxicity and pesticide water quality objectives that apply to diazinon and chlorpyrifos include provisions for considering additive or synergistic effects. The Basin Plan Amendment is based on the current understanding of the additive effects of diazinon and chlorpyrifos. Diazinon and chlorpyrifos may also have additive, synergistic or antagonistic effects in combination with other pollutants. To determine if such effects are occurring, monitoring for toxicity and monitoring for pollutants suspected of acting in

an additive or synergistic manner with diazinon and chlorpyrifos will be required. When toxicity is detected, toxicity identification evaluations will be required to determine the compounds contributing to the toxicity. Such monitoring can be conducted in conjunction with monitoring for diazinon and chlorpyrifos.

7: Demonstrate that management practices are achieving the lowest pesticide levels technically and economically achievable.

Goal 7 can be met by assessing the information collected to meet goals 3 and 4. Evaluation of the effectiveness of management practices should help identify which ones (or combinations) achieve the lowest pesticide levels in discharge and are economically achievable. Tracking the degree of implementation of these practices should help the Central Valley Water Board determine whether the practices are wide spread enough to achieve the lowest pesticide levels possible in the Sacramento and Feather Rivers.

9.0 ESTIMATED COSTS AND POTENTIAL SOURCES OF FINANCING

The Porter-Cologne Water Quality Control Act requires consideration of economics when water quality objectives are established, and requires that "prior to implementation of any agricultural water quality control program, an estimate of the total cost of such a program, together with an identification of potential sources of financing, shall be indicated in any regional water quality control plan." This section presents the information needed to meet those requirements. The costs to meet the proposed water quality objectives and Allocations are estimated below.

It should be noted that without the proposed Basin Plan Amendment, the discharges of diazinon and chlorpyrifos would still need to be addressed under existing laws and regulations. These include the existing water quality objectives for toxicity and pesticides discussed in the water quality objectives section of this report and the State Water Board's Nonpoint Source Pollution Program Policy (SWRCB, 2004), Bay Protection, In addition, in 2004, supplemental Federal label requirements for diazinon were issued by the manufacturer of diazinon to reduce impacts of diazinon used for dormant sprays in the Sacramento and San Joaquin Valleys (MANA, 2004d).

In 2006, DPR issued dormant spray regulations (DPR, 2006b) to address the impacts of the use of diazinon and chlorpyrifos as dormant spray pesticides in the Central Valley. It is likely that by meeting the existing federal label requirements for diazinon dormant season applications and implementing the DPR dormant spray regulations that growers will not need to implement additional management practices in the dormant season to meet the requirements of this proposed Basin Plan Amendment. Therefore, no additional costs are assumed to control dormant spray discharges. Also, existing data suggests that exceedances during the irrigation season are infrequent. Diazinon and Chlorpyrifos objectives appear to be met, though some additional controls may be required to meet load allocations. Therefore, the costs to agriculture for implementing management practices to meet the water quality objectives and Allocations proposed in this Basin Plan Amendment, should be considered high-end cost estimates, since reductions in diazinon and chlorpyrifos discharges to the Sacramento and Feather Rivers are required by current laws and regulations.

9.1 Estimated Costs for Agricultural Management Practices

Previous Central Valley Water Board Staff Reports (Karkoski et al., 2003), (Beaulaurier et al., 2005[14]) have examined the costs to agriculture of implementing management

[14] With cost corrections as described in Landau, 2006.

practices to reduce or eliminate agricultural discharges of diazinon and chlorpyrifos. The results of the most recent analyses are used in this report to estimate the costs to agriculture of implementing practices to reduce or eliminate diazinon and chlorpyrifos discharges to meet the proposed load allocations. Beaulaurier et al., (2005) and McClure et al. (2006) examined the costs of management practices for irrigation season discharges from alfalfa and almonds. A base case scenario for each crop, was compared with alternative scenarios that reduced risk to water quality while still providing adequate pest control. The management practices for the irrigation season included water management, since irrigation runoff is the main mechanism of transport of chlorpyrifos and diazinon from agricultural lands into surface waters during the irrigation season. The resulting cost estimates are summarized in **Table 9.1**.

Table 9.1. Ag Practice Cost Estimates from Beaulaurier et al., 2005 [15]

CROP	COST OF IMPLEMENTING PRACTICES ($/ACRE)	CHANGE IN PER-ACRE PRODUCTION COST (PERCENT)
Alfalfa	$60 to $100	6% to 10%
Almonds	$90 to $196	3% to 4%

From a review of the Staff Reports discussed above, it is evident that management practices are available that will result in the reduction or elimination of diazinon and chlorpyrifos in agricultural discharges. The range of overall costs for implementing dormant season or irrigation season practices did not vary greatly between commodities during either the dormant or irrigation season. For all of the commodities examined, alternative products are available that are effective in controlling pests. The price of the pesticide is a small fraction of overall production costs. Therefore, the use of alternative pesticides generally did not represent a significant cost increase, unless the use of alternative pesticides made it more likely that multiple applications would be necessary to adequately control pests (Karkoski et al., 2003). Some or all of the water management practices examined in Beaulaurier et al., (2005) for alfalfa and almonds are applicable to the other orchard and field/row crops grown in the Sacramento and Feather Rivers Watersheds. Therefore, the other orchard and field/row crops upon which diazinon and chlorpyrifos are used in the Sacramento and Feather River watersheds are expected to have similar costs to implement practices to meet the proposed load allocations.

To estimate the costs of implementing management practices to agricultural dischargers in the Sacramento and Feather Rivers Watersheds, the high- and low-end per-acre cost estimates for orchard crops and field/row crops from Beaulaurier et al., (2005)[11] are multiplied by the number of acres treated (using 2003 pesticide use data [DPR, 2006a])

[15] With cost corrections as described in Landau, 2006.

for the major irrigation season uses in the Sacramento and Feather Rivers Watersheds. Cost information has been updated to reflect 2007 costs[16]. Where specific updated cost information (i.e., federal mileage reimbursement rate) is available, it has been used. Otherwise, costs were adjusted for inflation using the U.S. Department of Labor. Bureau of Labor Statistics' Consumer Price Index Inflation Calculator (U.S. Department of Labor, 2007).

Since the new diazinon label requirements and dormant spray regulations described below are expected to adequately control dormant season discharges, costs of management practices during the dormant season were not included in these calculations. Also, because irrigation season exceedances are infrequent it is reasonable to expect that the elimination of dormant season exceedances result in compliance with water quality objectives by the time that this Basin Plan Amendment is approved. Under these circumstances, costs to irrigation season growers will be 0. To the extent that additional mitigation measures are required, these costs are reflected in the high-end estimate. Finally, the per-acre cost of implementation did not include any cost savings from reduced water use or reduced soil loss.

Table C-2 in **Appendix C** summarize the estimates of the cost of implementing agricultural management practices for the irrigation seasons. The crops included in these calculations constitute 99% of the irrigation season agricultural use of diazinon and chlorpyrifos. Uses in the Sacramento and Feather Rivers Watersheds are described in **Section 2.3** of this report. The estimated total costs of implementing irrigation season practices throughout the Sacramento and Feather Rivers Watersheds range $0 to $6.2 million.

9.2 Estimated Monitoring, Planning, and Evaluation Costs

Monitoring and planning costs were estimated for two different approaches that growers could take in responding to this Basin Plan Amendment. There are currently two watershed groups that monitor the Sacramento and Feather River Basins. Growers could continue to participate in these groups watershed group to meet the Basin Plan Amendment requirements, or growers could work individually with the Central Valley Water Board to meet the Basin Plan Amendment requirements.

Approximately 736 growers reported 2,700 applications of diazinon or chlorpyrifos in the Sacramento and Feather Rivers Watersheds in 2004 (DPR 2006a). For the purposes of this analysis, it is assumed that all of those growers would need to respond to this Basin

[16] The CPI inflation calculator uses the average Consumer Price Index for a given calendar year. This data represents changes in prices of all goods and services purchased for consumption by urban households. For 2007, the latest monthly index value is used (US Department of Labor, 2007).

Plan Amendment. The total cost for monitoring, planning, and evaluation would be approximately $0.3 to $1.5 million for a waiver-based program, depending on whether growers used a watershed approach or an individual approach, respectively. The cost calculations are detailed in **Appendix C**. The cost estimates take into account that the coalitions are currently monitoring during the storm season. However, these costs represent a high-end estimate, since they do not take into account other monitoring, planning, and management practice evaluation programs and requirements that are relevant to discharges of OP pesticides in the Sacramento Valley. For example, the cost estimations do not take into account monitoring activities associated with the Irrigated Lands Waiver program.

9.2.1 Watershed Approach

For a watershed group, the estimated annual monitoring, planning, and evaluation cost is approximately $0.3 million per year for the 736 growers who used either diazinon or chlorpyrifos, or $464 per grower. These costs estimates are detailed in **Table C-4** in **Appendix C**. Costs for the actual monitoring would be approximately $221,000 annually. These costs may be lower if a portion of the monitoring is already being performed under the Agricultural Waiver Monitoring Program or other monitoring programs. The monitoring costs are associated with determining compliance with water quality objectives, Loading Capacities, and load allocations. Additional costs for planning and evaluation by watershed groups include development of annual monitoring and implementation plans, annual reporting of monitoring and implementation results (including the effectiveness of management practices), and coordination of implementation activities. The total cost for these activities is estimated at approximately $120,000 annually. The planning and evaluation costs are associated with ensuring management practices are implemented, determining the degree of implementation, and reporting on the effectiveness of the implementation efforts in meeting water quality goals.

9.2.2 Individual Grower Approach

The estimated per-grower costs for monitoring, planning and evaluation using the individual grower approach are similar to those estimated for the Delta and the San Joaquin River Basin (McClure et al., 2006; Beaulaurier et al., 2005[17]). If growers report directly to the Central Valley Water Board, the estimated monitoring, planning, and evaluation cost is approximately $2,000 per grower and the total monitoring planning and evaluation cost to growers within the Sacramento and Feather Rivers Watersheds would be approximately $1.5 million. These costs are detailed in **Table C-5** in **Appendix C** and are explained in more detail below

[17] With cost corrections as described in Landau, 2006.

It is assumed that monitoring would need to take place at 736 discharge points, one for each grower. Each site would be monitored twice during the season(s) during which the pesticides are applied or runoff is expected to occur. The total monitoring cost would be approximately $1.2 million of the $1.5 million annual cost. These costs may be lower if a portion of the monitoring is already being performed under the Agricultural Waiver Monitoring Program. The monitoring costs could be substantially greater if the sample collection were contracted out instead of conducted by the grower. The monitoring costs are associated with determining compliance with load allocations. Additional costs for planning and evaluation by the grower would primarily consist of filling out standard forms developed by Central Valley Water Board staff for reporting and monitoring purposes. The cost to the grower for his/her time to prepare forms detailing management practice implementation and effectiveness is estimated to be $336 annually, for a total annual cost within the Sacramento and Feather Rivers Watersheds of approximately $247,000 of the 1.5 million annual expected cost.

9.2.3 Summary of Potential Grower Cost

The estimated annual cost of irrigation season alternative pest and water management costs range from $0 to $6.2 million. The estimated annual cost of monitoring, planning and management practice evaluation ranged from approximately $0.3 to $1.5 million. The Sacramento and Feather Rivers combined costs of alternative pest management practices, alternative water management practices, and monitoring and compliance activities for the major crops that use diazinon and chlorpyrifos are estimated to range from 0.3 to $7.7 million . These total costs are shown in **Table C-1** in **Appendix C**.

The estimated costs for practices represent a high-end estimate. It is likely that by meeting the DPR dormant spray regulations (DPR, 2006b), growers will not need to implement additional management practices to meet the requirements of this proposed Basin Plan Amendment (i.e. there should be little or no additional increase in cost). The irrigation season cost estimates also provide a high-end estimate since the cost estimates assume that all growers currently using diazinon or chlorpyrifos in the irrigation season (except for orchard growers using drip irrigation or microsprinklers) would need to change management practices. It is more likely that, if any additional practices were required that they would be limited to only those few areas where the loading capacity is not being met. The monitoring, planning and evaluation costs also represent a high end estimate, since they do not take into account other monitoring planning and management practice evaluation programs and requirements that are relevant to discharges of OP pesticides in the Sacramento and Feather Rivers Watersheds.

9.3 Estimated Costs to NPDES Permittees

As discussed previously, all urban uses of diazinon and almost all urban uses of chlorpyrifos are being phased out. Therefore, it is not anticipated that NPDES permittees (municipal storm water permittees or publicly owned treatment works) will be required to implement additional management measures or treatment technologies to control diazinon or chlorpyrifos.

Additionally, any diazinon or chlorpyrifos monitoring that is currently part of an NPDES permit is not expected to increase or change as a result of adoption of this Basin Plan Amendment. Therefore, no change in control costs or monitoring costs is projected to occur for NPDES permit holders with adoption of this Basin Plan Amendment.

9.4 Potential Sources of Financing

In general, the potential sources of funding for agricultural water quality programs do not change significantly by crop type. The sources of funding identified in the Basin Plan for the agricultural subsurface drainage program and rice pesticide program are also potential funding sources for this program. These sources include:

1. Private financing by individual sources.
2. Bonded indebtedness or loans from government institutions.
3. Surcharge on water deliveries to lands contributing to the water quality problem.
4. Ad Valorem tax on lands contributing to the water quality problem.
5. Taxes and fees levied by a district created for the purpose of drainage management.
6. State or federal grants or low-interest loan programs.
7. Single purpose appropriations from federal or State legislative bodies (including land retirement programs).

Specific state and federal grant and loan programs include:

1. USDA Environmental Quality Incentive Program (EQIP) grants, administered by the Natural Resources Conservation Service (NRCS)
2. Consolidated grant program administered by the State Water Resources Control Board, including Proposition 40 grants, 319 NPS Implementation Program grants, and Proposition 50 CalFed Watershed Program grants
3. State Revolving Fund Loan program for NPS pollution

10.0 CALIFORNIA ENVIRONMENTAL QUALITY ACT (CEQA) REVIEW

The proposed Basin Plan Amendment does not prescribe any particular changes in land use or require any specific changes in pesticide use. The analysis of potential environmental impacts is, therefore, based on reasonably foreseeable changes in pest management methods or approaches to controlling diazinon and chlorpyrifos runoff. This CEQA review is based on the reasonably foreseeable alternative strategies that agricultural users of diazinon and chlorpyrifos could employ in response to the proposed Basin Plan Amendment.

Urban users of diazinon and chlorpyrifos are not considered in detail in this analysis, since those uses are being phased out in the time frame for compliance with the proposed Basin Plan Amendment.

10.1 Environmental Checklist Form

10.1.1 Project title

Basin Plan Amendment to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Diazinon and Chlorpyrifos Runoff into the Sacramento and Feather Rivers

10.1.2 Lead agency name and address

California Regional Water Quality Control Board, Central Valley Region
11020 Sun Center Drive #200
Rancho Cordova, CA 95670

10.1.3 Contact person and phone number

Paul Hann, Environmental Scientist
(916) 464-4628

10.1.4 Project location

Sacramento River Watershed and Feather River Watershed; Sacramento River from below Keswick Dam to the Delta Boundary; Feather River from below Oroville Dam to the Sacramento River

10.1.5 Project sponsor's name and address

California Regional Water Quality Control Board, Central Valley Region
11020 Sun Center Drive #200
Rancho Cordova, CA 95670

10.1.6 General plan designation

Not applicable

10.1.7 Zoning

Not applicable

10.1.8 Description of project

The Central Valley Water Board is proposing to amend the Water Quality Control Plan (Basin Plan) for the Sacramento River and San Joaquin River Basins. The purposes of the proposed Basin Plan Amendment are to amend and adopt water quality objectives for the Sacramento and Feather Rivers and to adopt an implementation strategy to bring dischargers of diazinon and chlorpyrifos into compliance with the water quality objectives. The proposed Basin Plan Amendment also establishes the maximum diazinon and chlorpyrifos loading capacity, waste load allocations, and load allocations for the Sacramento and Feather Rivers as required by the Clean Water Act § 303(d)(1)(C).

10.1.9 Surrounding land uses and setting

The areas affected by this Basin Plan Amendment include the Sacramento River watershed below Keswick Dam and the Feather River watershed below Oroville Dam. The land uses in the area include agriculture, urban, open space, and wildlife habitat.

10.1.10 Other public agencies whose approval is required

State Water Resources Control Board
Office of Administrative Law
U.S. Environmental Protection Agency

ENVIRONMENTAL FACTORS POTENTIALLY AFFECTED:

The environmental resource categories identified below are analyzed herein to determine whether the Proposed Project would result in adverse impacts to any of these resources. None of the categories below are checked because the Proposed Project is not expected to result in "significant or potentially significant impacts" to any of these resources.

- ☐ Aesthetics
- ☐ Hazards & Hazardous Materials
- ☐ Public Services
- ☐ Agriculture Resources
- ☐ Hydrology/Water Quality
- ☐ Recreation
- ☐ Air Quality
- ☐ Land Use Planning
- ☐ Biological Resources
- ☐ Mineral Resources
- ☐ Utilities/Service Systems
- ☐ Cultural Resources
- ☐ Noise
- ☐ Mandatory Findings of Significance
- ☐ Geology/Soils
- ☐ Transportation/Traffic

On the basis of this initial evaluation:

☒ I find that the proposed Basin Plan Amendment could not have a significant effect on the environment.

☐ I find that although the proposed Basin Plan Amendment could have a significant effect on the environment, there will not be a significant effect in this case because feasible alternatives and/or feasible mitigation measures exist that would substantially lessen any significant impact. These alternatives are discussed in the attached written report.

☐ I find that the proposed Basin Plan Amendment may have a significant effect on the environment. There are no feasible alternatives and/or mitigation measures available which would substantially lessen any significant adverse impacts. See attached written report for a discussion of this determination.

No potentially significant impacts from this proposed action were identified.

Signature *Date*

PAMELA C. CREEDON
Executive Officer
California Regional Water Quality Control Board,
Central Valley Region

EVALUATION OF ENVIRONMENTAL IMPACTS

This Environmental Checklist has been prepared in compliance with the requirements of CEQA relating to certified regulatory programs.

Impact	Potentially Significant Impact	Potentially Significant Unless Mitigation Incorporation	Less Than Significant Impact	No Impact
I. AESTHETICS Would the Project:				
a) Have a substantial adverse effect on a scenic vista?	☐	☐	☐	☒
b) Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway?	☐	☐	☐	☒
c) Substantially degrade the existing visual character or quality of the site and its surroundings?	☐	☐	☐	☒
d) Create a new source of substantial light or glare which would adversely affect day or nighttime views in the area?	☐	☐	☐	☒
II. AGRICULTURE RESOURCES: In determining whether impacts to agricultural resources are significant environmental effects, lead agencies may refer to the California Agricultural Land Evaluation and Site Assessment Model (1997) prepared by the California Department of Conservation as an optional model to use in assessing impacts on agriculture and farmland. Would the Project:				
a) Convert Prime Farmland, Unique Farmland, or Farmland of Statewide importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?	☐	☐	☐	☒
b) Conflict with existing zoning for agricultural use, or a Williamson Act contract?	☐	☐	☐	☒
c) Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland, to non-agricultural use?	☐	☐	☐	☒
III. AIR QUALITY – Where available, the significance criteria established by the applicable air quality management or air pollution control the District may be relied upon to make the following determinations. Would the Project:				
a) Conflict with or obstruct implementation of the applicable air quality plan?	☐	☐	☐	☒
b) Violate any air quality standard or contribute substantially to an existing or projected air quality violation?	☐	☐	☐	☒

Impact	Potentially Significant Impact	Potentially Significant Unless Mitigation Incorporation	Less Than Significant Impact	No Impact
c) Result in a cumulatively considerable net increase of any criteria pollutant for which the Project region is non-attainment under an applicable federal or state ambient air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors)?	☐	☐	☐	☒
d) Expose sensitive receptors to substantial pollutant concentrations?	☐	☐	☐	☒
e) Create objectionable odors affecting a substantial number of people?	☐	☐	☐	☒
IV. BIOLOGICAL RESOURCES – Would the Project:				
a) Have a substantial adverse effect, either directly, or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulators, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?	☐	☐	☐	☒
b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations or by the California Department of Fish and Game or US fish and Wildlife Service?	☐	☐	☐	☒
c) Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?	☐	☐	☐	☒
d) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?	☐	☐	☐	☒
e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?	☐	☐	☐	☒

Impact	Potentially Significant Impact	Potentially Significant Unless Mitigation Incorporation	Less Than Significant Impact	No Impact
f) Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan?	☐	☐	☐	☒
V. CULTURAL RESOURCES – Would the Project:				
a) Cause a substantial adverse change in the significance of a historical resource as defined in §15064.5?	☐	☐	☐	☒
b) Cause a substantial adverse change in the significance of an archaeological resource pursuant to §15064.5?	☐	☐	☐	☒
c) Directly or indirectly destroy a unique paleontological resource of site or unique geological feature?	☐	☐	☐	☒
d) Disturb any human remains, including those interred outside of formal cemeteries?	☐	☐	☐	☒
VI. GEOLOGY AND SOILS – Would the Project:				
a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:	☐	☐	☐	☒
i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.	☐	☐	☐	☒
ii) Strong seismic ground shaking?	☐	☐	☐	☒
Iii) Seismic-related ground failure,, including liquefaction?	☐	☐	☐	☒
iv) Landslides?	☐	☐	☐	☒
b) Result in substantial soil erosion or the loss of topsoil?	☐	☐	☐	☒
c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the Project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse?	☐	☐	☐	☒
d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform building Code (1994), creating substantial risks to life or property?	☐	☐	☐	☒
VII. HAZARDS AND HAZARDOUS MATERIALS – Would the Project:				

Impact	Potentially Significant Impact	Potentially Significant Unless Mitigation Incorporation	Less Than Significant Impact	No Impact
a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?	☐	☐	☐	☒
b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment?	☐	☐	☐	☒
c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?	☐	☐	☐	☒
d) Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?	☐	☐	☐	☒
e) For a Project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the Project result in a safety hazard for people residing or working in the Project area?	☐	☐	☐	☒
f) For a Project within the vicinity of a private airstrip, would the Project result in a safety hazard for people residing or working in the Project area?	☐	☐	☐	☒
g) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?	☐	☐	☐	☒
h) Expose people or structures to a significant risk of loss, injury or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands?	☐	☐	☐	☒
VIII. HYDROLOGY AND WATER QUALITY – Would the Project:				
a) Violate any water quality standards or waste discharge requirements?	☐	☐	☐	☒

Impact	Potentially Significant Impact	Potentially Significant Unless Mitigation Incorporation	Less Than Significant Impact	No Impact
b) Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of preexisting nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted?	☐	☐	☐	☒
c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site?	☐	☐	☐	☒
d) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which results in flooding on- or off-site?	☐	☐	☐	☒
e) Create or contribute runoff water which exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff?	☐	☐	☐	☒
f) Otherwise substantially degrade water quality?	☐	☐	☐	☒
g) Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map?	☐	☐	☐	☒
h) Place within a 100-year flood hazard area structures which would impede or redirect flood flows?	☐	☐	☐	☒
i) Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam?	☐	☐	☐	☒
j) Inundation by seiche, tsunami, or mudflow?	☐	☐	☐	☒
IX. LAND USE AND PLANNING – Would the Project:				
a) Physically divide an established community?	☐	☐	☐	☒

Impact	Potentially Significant Impact	Potentially Significant Unless Mitigation Incorporation	Less Than Significant Impact	No Impact
b) Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the Project (including, but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect?	☐	☐	☐	☒
c) Conflict with any applicable habitat conservation plan or natural community conservation plan?	☐	☐	☐	☒
X. MINERAL RESOURCES – Would the Project:				
a) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?	☐	☐	☐	☒
b) Result in the loss of availability of a locally-important mineral resource recovery site delineated on a local general plan, specific plan or other land use plan?	☐	☐	☐	☒
XI. NOISE – Would the Project result in:				
a) Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?	☐	☐	☐	☒
b) Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels?	☐	☐	☐	☒
c) A substantial permanent increase in ambient noise levels in the Project vicinity above levels existing without the Project?	☐	☐	☐	☒
d) A substantial temporary or periodic increase in ambient noise levels in the Project vicinity above levels existing without the Project?	☐	☐	☐	☒
e) For a Project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the Project expose people residing or working in the Project area to excessive noise levels?	☐	☐	☐	☒

Impact	Potentially Significant Impact	Potentially Significant Unless Mitigation Incorporation	Less Than Significant Impact	No Impact
f) For a Project within the vicinity of a private airstrip, would the Project expose people residing or working in the Project area to excessive noise levels?	☐	☐	☐	☒
XII. POPULATION AND HOUSING – Would the Project?				
a) Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?	☐	☐	☐	☒
b) Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere?	☐	☐	☐	☒
c) Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere?	☐	☐	☐	☒
XIII. PUBLIC SERVICES				
a) Would the Project result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts in order to maintain acceptable service ratios, response times or other performance objectives for any of the public services:				
Fire protection?	☐	☐	☐	☒
Police protection?	☐	☐	☐	☒
Schools?	☐	☐	☐	☒
Parks?	☐	☐	☐	☒
Other public facilities?	☐	☐	☐	☒
XIV. RECREATION				
a) Would the Project increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?	☐	☐	☐	☒
b) Does the Project include recreational facilities or require the construction or expansion of recreational facilities which might have an adverse physical effect on the environment?	☐	☐	☐	☒
XV. TRANSPORTATION/TRAFFIC – Would the Project:				

Impact	Potentially Significant Impact	Potentially Significant Unless Mitigation Incorporation	Less Than Significant Impact	No Impact
a) Cause an increase in traffic which is substantial in relation to the existing traffic load and capacity of the street system (i.e., result in a substantial increase in either the number of vehicle trips, the volume to capacity ratio to roads, or congestion at intersections?	☐	☐	☐	☒
b) Exceed, either individually or cumulatively, a level of service standard established by the county congestion/management agency for designated roads or highways?	☐	☐	☐	☒
c) Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that results in substantial safety risks?	☐	☐	☐	☒
d) Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?	☐	☐	☐	☒
e) Result in inadequate emergency access?	☐	☐	☐	☒
f) Result in inadequate parking capacity?	☐	☐	☐	☒
g) Conflict with adopted policies, plans, or programs supporting alternative transportation (e.g., bus turnouts, bicycle racks)?	☐	☐	☐	☒
XVI. UTILITIES AND SERVICE SYSTEMS – Would the Project?				
a) Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board?	☐	☐	☐	☒
b) Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?	☐	☐	☐	☒
c) Require or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?	☐	☐	☐	☒
d) Have sufficient water supplies available to serve the Project from existing entitlements and resources, or are new or expanded entitlements needed?	☐	☐	☐	☒

Impact	Potentially Significant Impact	Potentially Significant Unless Mitigation Incorporation	Less Than Significant Impact	No Impact
e) Result in a determination by the wastewater treatment provider which serves or may serve the Project that it has adequate capacity to serve the Project's projected demand in addition to the provider's existing commitments?	☐	☐	☐	☒
f) Be served by a landfill with sufficient permitted capacity to accommodate the Project's solid waste disposal needs?	☐	☐	☐	☒
g) Comply with federal, state, and local statutes and regulations related to solid waste?	☐	☐	☐	☒
XVII. MANDATORY FINDINGS OF SIGNIFICANCE				
a) Does the Project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number of restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?	☐	☐	☐	☒
b) Does the Project have impacts that are individually limited, but cumulatively considerable? ("Cumulatively considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probably future projects)?	☐	☐	☐	☒
c) Does the Project have environmental effects which will cause substantial adverse effects on human beings, either directly or indirectly?	☐	☐	☐	☒

10.2 Thresholds Of Significance

For the purposes of making impact determinations, potential impacts were determined to be significant if the Proposed Project or its alternatives would result in changes in environmental condition that would, either directly or indirectly, cause a substantial loss of habitat or substantial degradation of water quality or other resources.

10.3 Discussion of Environmental Impacts

The analysis of potential environmental impacts is based on the possible changes in pest management methods or possible approaches to controlling runoff of diazinon and chlorpyrifos in response to the proposed Basin Plan Amendment. The evaluation is based on the alternative strategies described in **Section 6.5** of this report, in Karkoski et al., (2003) and in Beaulaurier et al., (2005).

10.3.1 Aesthetics

The proposed Basin Plan Amendment will likely result in changes in pest management practices on crops. Potential practices are described in **Section 6.5** of this report, in Karkoski et al., (2003), and in Beaulaurier et al., (2005). None of those practices would alter any scenic vistas, damage scenic resources, degrade the visual character of any site, or adversely affect day or nighttime views.

10.3.2 Agricultural Resources

The alternative strategies described in **Section 6.5** of this report, Karkoski et al. (2003) and Beaulaurier et al. (2005), or other potential strategies that could be pursued by growers, are unlikely to lead to a conversion of agricultural land to other uses. Conservation buffers, which may be installed to reduce runoff containing pesticides, are considered to be agricultural land.

Central Valley Water Board staff has reviewed the potential range of costs of the proposed implementation program, as well as the potential range of costs of alternative pest management strategies and water management practices that might be employed by growers. This review has shown that growers have a wide range of alternatives to diazinon and chlorpyrifos available to both maintain control of pests and to minimize or eliminate water quality impacts. Based on the wide range of options available, growers should be able to choose an approach appropriate to their crop and field that will minimize costs, allow them to continue farming, and meet water quality objectives and load allocations.

The review has also shown the availability of alternative irrigation methods that could be implemented to reduce diazinon and chlorpyrifos in irrigation runoff. As with alternative pest control methods, there is a range of irrigation options available, and growers should be able to choose an approach appropriate to their crop and field that will minimize costs, allow them to continue farming, and meet water quality objectives.

The availability of Federal and State government funds for environmental conservation (See **Section 9.4**) should allow growers to offset some of their costs, if they choose an approach that requires a large capital investment

10.3.3 Air Quality

Implementation of some of the alternative pest management strategies and pesticide application technologies, especially those that result in a reduction in diazinon and chlorpyrifos use rates, could lead to a reduction in aerial drift, and therefore an improvement in air quality.

Some of the alternative pest management practices could lead growers to switch from diazinon and chlorpyrifos to other pesticides. In response to a Central Valley Water Board request, the DPR has evaluated those alternative pesticides to determine whether air quality could be impacted by use of the alternatives. It is DPR's opinion that a reduction in the use of diazinon and chlorpyrifos would result in an improvement in air quality, even if an increase in the use of alternative pesticides, such as carbaryl or pyrethroids, occurs (Segawa, 2004).

Under the Toxic Air Contaminant Program, DPR prioritizes pesticides for air monitoring based on human toxicity, use patterns, and volatility. The DPR and the California Air Resources Board monitor for a number of pesticides. In addition to the Toxic Air Contaminant Program, DPR tracks emissions of volatile organic compounds (VOCs) from pesticide products because they are precursors to ozone. It is unlikely that changes in use patterns due to regulatory action on diazinon and chlorpyrifos will cause DPR's goals for reduction of VOC emissions from pesticides to be exceeded (Segawa, 2004).

Changes to water management practices should result in improved water conservation. This will not have any affect on air quality.

10.3.4 Biological Resources

The proposed Basin Plan Amendment is designed to reduce diazinon and chlorpyrifos in runoff to levels that are not toxic to organisms in the Sacramento and Feather Rivers. Therefore, effects of this Basin Plan Amendment on biological communities should be positive. Growers also currently use other pesticides, including pyrethroid and carbamate insecticides that, when present in runoff or in aquatic sediments, could have a negative effect on biological resources. These insecticides are commonly used on a variety of crops and under a wide range of conditions. Growers who currently use diazinon and chlorpyrifos may choose to switch to these or to other products to control pests in response to this Basin Plan Amendment, causing a further increase in the use of other pesticides.

In order to prevent the substitution of other potential biologically damaging pesticides for diazinon and chlorpyrifos, this Basin Plan Amendment includes monitoring requirements that will allow the Central Valley Water Board to identify potential impacts of pesticides

in runoff. The Basin Plan Amendment also requires agricultural pesticide dischargers to implement control measures to insure compliance with water quality objectives when alternatives to diazinon and chlorpyrifos have the potential to contaminate surface water or groundwater. The Basin Plan currently contains water quality objectives that do not allow pesticides to impact beneficial uses, including aquatic life use. This Basin Plan Amendment does not change in any way, the applicability of these objectives. This Basin Plan Amendment also reinforces existing Central Valley Water Board policies regarding additive toxicity by explicitly addressing the additivity of diazinon and chlorpyrifos and alternatives to diazinon and chlorpyrifos.

Changes to water management practices should result in improved water conservation. Conserved water is potentially available to enhance in-stream flows and for other uses. This should not have any negative effect on biological resources.

10.3.5 Cultural Resources

Implementation of the proposed Basin Plan Amendment is unlikely to affect cultural resources. None of the potential practices that growers might implement are likely to change the significance of any historical or archaeological resource, destroy a unique paleontological resource or geologic feature, or disturb any human remains.

10.3.6 Geology and Soils

Implementation of the Basin Plan Amendment will not affect the geology of the region and will not expose people to additional geologic hazards. Growers may plant cover crops or buffer strips to increase soil infiltration and reduce runoff, which will likely reduce soil erosion. Changes to water management practices should result in improved water conservation, and will not result in increased erosion or siltation.

10.3.7 Hazards and Hazardous Materials

During its regulatory process, DPR examines hazards posed by pesticides to workers and the public. Each product is evaluated for potential hazards, and any conditions necessary for the safe use of the material are required on the label or in specific regulations. Some of these requirements include use of protective clothing and respirators, use of a closed system for mixing and loading, or special training requirements for workers applying the pesticide.

Some of the pesticides that growers may use as alternatives to diazinon and chlorpyrifos, such as azinphos methyl, methidathion, and carbaryl, are restricted use pesticides. Restricted use pesticides require permits to purchase and apply, and usually require special handling procedures. Propargite is on DPR's Minimal Exposure Pesticide list, and requires special protection for workers due to its toxicity. Implementation of this Basin Plan Amendment should not result in any increased exposure to hazards or hazardous material.

10.3.8 Hydrology and Water Quality

None of the potential options to reduce diazinon and chlorpyrifos in runoff are likely to result in changes in drainage patterns that would increase erosion or siltation, increase the rate or amount of surface runoff, increase the risk of flooding, contribute to increases in storm water runoff that would exceed the capacity of stormwater drainage systems, or increase the chance of inundation by seiche, tsunami, or mudflow.

One of the approaches to reducing diazinon and chlorpyrifos in runoff is to increase the infiltration of stormwater into soil, rather than allowing it to run off the end of the orchard or field. Increasing infiltration is not likely to result in groundwater contamination with pesticides, especially in soils with moderate to high clay and organic matter content. Pyrethroids, and some of the alternatives to diazinon and chlorpyrifos have very high soil adsorption coefficients that cause them to bind tightly to soils, and therefore these pesticides would not be carried more than a few inches below the soil surface. Other pesticides break down quickly through microbial decomposition and, therefore, do not persist long enough to be carried to groundwater.

The Basin Plan Amendment includes a policy that requires growers to evaluate whether an alternative pesticide could potentially result in groundwater contamination or violation of surface water quality objectives. The policy states that growers should use an alternative that will not result in groundwater contamination or violation of surface water quality objectives.

Changes to water management practices should result in improved water conservation. Conserved water is potentially available to enhance in-stream flows and for other uses. Reducing runoff of diazinon and chlorpyrifos may also result in the reduction of other contaminants (e.g. nutrients and sediment), which would enhance water quality. This Basin Plan Amendment is not expected to have any negative effect on hydrology and water quality.

10.3.9 Land Use and Planning

Implementation of the proposed Basin Plan Amendment should not result in any changes in land use or planning. See discussion of Agricultural Resources above.

10.3.10 Mineral Resources

The effect of the proposed Basin Plan Amendment should be limited to land currently under agricultural production, and there should be no impact to mineral resources.

10.3.11 Noise

The proposed Basin Plan Amendment could lead to changes in the way in which diazinon and chlorpyrifos are applied. The alternative practices should not lead to any

increase in exposure to noise. The proposed Basin Plan Amendment should have no impact on noise in the project area.

10.3.12 Population and Housing

The proposed Basin Plan Amendment will likely result in changes in pest management practices on orchards and certain field crops. Those changes in pest management practices would not directly or indirectly induce population growth in the area, displace existing housing, or displace people. The proposed Basin Plan Amendment should not have an impact on population and housing.

10.3.13 Public Services

The proposed Basin Plan Amendment will not have an impact on public services. If the implementation program for the Basin Plan Amendment is administered at the county level, CASs may need to add as many as two additional staff, depending on the county. These potential staff increases should not require new or altered government facilities.

10.3.14 Recreation

There should be no increase in use of parks or recreational facilities or the need for new or expanded recreational facilities as a result of this proposed Basin Plan Amendment.

10.3.15 Transportation/Traffic

The proposed Basin Plan Amendment will not have an impact on transportation/traffic. None of the potential alternative practices should result in changes in traffic or require changes in traffic infrastructure.

10.3.16 Utilities and Service Systems

The proposed Basin Plan Amendment will likely result in changes in pest management practices on orchards and some field crops. No wastewater treatment requirements for diazinon and chlorpyrifos in agricultural runoff have been established by the Central Valley Water Boards. No wastewater treatment requirements have been established for diazinon and chlorpyrifos from other potential sources, such as urban runoff or municipal treatment plants in the project area, due to the phase-out of the use of these pesticides in urban settings. The proposed Basin Plan Amendment should not result in changes in wastewater treatment requirements.

None of the potential alternative practices would cause the construction of new water or wastewater treatment plants or the expansion of existing plants for control of diazinon and chlorpyrifos in runoff from agricultural fields. The phase-out of the residential use of diazinon and chlorpyrifos makes it highly unlikely that these pesticides would be present in the effluent of municipal wastewater treatment plants at levels requiring additional wastewater treatment controls.

The proposed Basin Plan Amendment does not require and should not result in the construction or expansion of new storm water drainage facilities. The most feasible practices for the control of diazinon and chlorpyrifos in agricultural runoff are changes in on-field practices, including changes in pest management and water management practices.

The proposed Basin Plan Amendment should not result in significant changes in water supply. One of the potential alternative practices that could be used by growers would be the use of cover crops to increase infiltration and reduce surface runoff of water, which may contain diazinon, chlorpyrifos and other contaminants. The use of cover crops may or may not require additional irrigation water, but it should also result in reduced evaporation from soil surfaces, with little net change in irrigation water needs. Changes to water management practices should result in improved water conservation.

The proposed Basin Plan Amendment should not require any changes in wastewater treatment services. The potential practices that could be applied by growers should not result in any changes in the generation of solid waste and therefore should not impact landfill capacity. The potential practices that could be applied by growers should not result in any changes in the generation of solid waste and therefore should not affect compliance with federal, state, or local statutes and regulations related to solid waste.

10.3.17 Mandatory Findings of Significance

The Basin Plan Amendment is designed to reduce diazinon and chlorpyrifos concentrations in the Sacramento and Feather Rivers, and to ensure that increased use of the alternatives to these pesticides will not degrade water quality. The water quality objectives and Allocations established by this Basin Plan Amendment are designed to eliminate the impacts of diazinon and chlorpyrifos to aquatic life in the Sacramento and Feather Rivers. This Basin Plan Amendment does not require or allow any changes in pesticide application practices that could degrade the quality of the environment or have environmental effects that could cause substantial indirect or direct adverse effects on human beings.

The proposed Basin Plan Amendment will likely result in changes in pest management and water management practices on orchards and on some field crops. Growers may use other pesticides instead of diazinon and chlorpyrifos, and they may apply pesticides less frequently. The Central Valley Water Board's Basin Plan Amendment , therefore, addresses the identified water quality impacts from diazinon and chlorpyrifos in runoff, as well as the potential impact of other pesticides applied to orchards and fields.

There are no probable future changes in Central Valley Water Board programs that would lead to cumulatively significant impacts when combined with likely impacts from the proposed Basin Plan Amendment.

11.0 PUBLIC PARTICIPATION AND AGENCY CONSULTATION

Two public workshops have been held to in the preparation of this proposed Basin Plan Amendment. A public workshop was held on 23 May 2006 in Yuba City to obtain comments on the proposed scope of the Basin Plan Amendment. Another public CEQA Scoping Meeting was held on 15 February 2007 to address the change in project scope to include chlorpyrifos. As of the writing of this report, four letters commenting on the scope of this proposed Basin Plan Amendment have been received. These comments are responded to in **Appendix F**.

The Staff Report was issued in March 2007 and another public workshop is scheduled for 2 April 2006 in Sacramento to provide information and obtain comments related to this draft Staff Report and the proposed Basin Plan Amendment. In addition to outreach efforts that have taken place with this Basin Plan Amendment, extensive public participation and agency consultation occurred during the adoption of the previous Basin Plan Amendments, upon which this Basin Plan Amendment is largely based. Staff has reviewed comments received during the previous Basin Plan Amendments to ensure that any issues of concern addressed during the previous efforts are also adequately addressed in the current effort.

The following agencies participated in the development of this draft Basin Plan Amendment, through receipt of mailings pertaining to development of the Basin Plan Amendment, attendance at public workshops, and submission of comments on the Basin Plan Amendment: California Department of Pesticide Regulation; California Department of Fish and Game; National Oceanic and Atmospheric Administration – Fisheries; U.S. Fish and Wildlife Service; and U.S. Environmental Protection Agency.

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