CENTRAL VALLEY REGIONAL WATER QUALITY CONTROL BOARD

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

FOR

THE CONTROL OF PYRETHROID PESTICIDES DISCHARGES

FINAL STAFF REPORT

JUNE 2017

CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY

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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. Mention of specific products does not represent endorsement of those products by the Central Valley Water Board.

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LIST OF ACRONYMS AND ABBREVIATIONS

§	Section
µg/L	Micrograms per liter (0.1µg/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
DPR	California Department of Pesticide Regulation
CDFW	California Department of Fish and Wildlife
Central Valley Water Board	California Regional Water Quality Control Board – Central Valley Region
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
CMC	Criterion Maximum Concentration
CRWQCB-CVR	California Regional Water Quality Control Board – Central Valley Region
CWA	Federal Clean Water Act
CWC	California Water Code
Delta	Sacramento-San Joaquin Delta
ESA	Endangered Species Act
K_{DOC}	Dissolved organic carbon-water partition coefficient
K_{OC}	Organic carbon-water partition coefficient
LA	Load Allocation
lbs	Pounds
LC	Loading Capacity
MAA	Management Agency Agreement
MS4	Municipal separate storm sewer system
ng/L	Nanograms per liter (100 ng/L = 0.1µg/L)
NPDES	National Pollution Discharge Elimination System
NPS	nonpoint source
OPP	USEPA Office of Pesticide Programs
Porter-Cologne	Porter-Cologne Water Quality Control Act
QA	quality assurance
QC	quality control
POTW	Publicly-owned treatment works
PUR	Pesticide Use Report
Sac R	Sacramento River
SJR	San Joaquin River
State Water Board	State Water Resources Control Board

TMDL	Total Maximum Daily Load
UC Davis	University of California, Davis
USDA	United States Department of Agriculture
USEPA	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

GLOSSARY OF KEY TERMS

This glossary defines several key terms and how they are used in this report. These terms may have other definitions in different contexts.

Water quality criteria: Technical values derived using toxicity data as levels that are protective of beneficial uses.

Pyrethroid concentration goals: Numeric pyrethroid levels that provide reasonable protection of beneficial uses.

TMDL numeric targets: Quantitative values used to measure whether or not the applicable water quality standards are attained in a water body segment with total maximum daily loads.

Pyrethroid triggers: Numeric levels used as part of the conditional prohibition of discharge that if exceeded require dischargers to develop management plans for pyrethroids and implement management practices to reduce pyrethroid discharges.

Water quality objectives: Water quality objectives can be either narrative or numeric and are described in Basin Plans, which are adopted by Water Boards. Narrative water quality objectives describe a requirement or prohibit a condition harmful to beneficial uses. Numeric water quality objectives specify concentrations that if not exceeded will be protective of beneficial uses. This term is defined in the Porter-Cologne Water Quality Control Act (California Water Code).

Water quality standard: The combination of a water quality objective and the beneficial uses that the water quality objective is protecting, as well as anti-degradation requirements to protect existing uses and high quality waters. This term is defined in the Clean Water Act and water quality standards must be approved by USEPA.

EXECUTIVE SUMMARY

The purpose of this Staff Report is to provide the rationale and supporting documentation for proposed amendments to the Water Quality Control Plan (Basin Plan) for the Sacramento River Basin and San Joaquin River Basin (Central Valley Water Board, 2016a). The proposed amendments would establish controls for the discharges of pyrethroid pesticides into selected surface waters in the Sacramento and San Joaquin River Basin, and a phased program of implementation, including:

- A conditional prohibition of discharges of pyrethroid pesticides above certain concentrations into surface waters with aquatic life beneficial uses
- Total Maximum Daily Loads for pyrethroid pesticides in selected surface waters
- Recommendations for agencies that regulate the use of pesticides
- Proposed Board actions for the control of pesticide discharges
- Monitoring requirements and other provisions to ensure data and information is produced to assess progress and inform future Board actions
- Policies and monitoring requirements that address alternative pesticides to pyrethroids.

Pyrethroid pesticides are currently widely used for structural pest control in urban and residential areas, in various consumer use pest control products, and in agriculture in the Central Valley, throughout California, and the United States. Since the early 2000s, pyrethroids have been found at levels of concern in surface waters in the Sacramento and San Joaquin River Basins that receive urban storm water and/or agricultural discharges. The main sources of these pyrethroids are discharges from municipal storm water systems (also known as municipal separate storm sewer systems or MS4s) and agricultural lands. Pyrethroids have also been detected in municipal wastewater treatment plant, (also known as publicly owned treatment works or POTW) discharges at levels of concern. Fourteen surface water bodies in the Central Valley have been documented as impaired by pyrethroids, nine of these are impaired due to municipal storm water discharges, while five are due to agricultural discharges. A surface water body is considered impaired by a single or multiple pyrethroids when data indicate that these insecticides are found at concentrations that exceed applicable narrative water quality objectives established in the Water Quality Control Plan for the Sacramento and San Joaquin River Basins (Basin Plan) to protect aquatic life.

Six pyrethroids have been identified as priority constituents because they were identified as contributing to documented pyrethroids impairments and they have the

highest use in the Sacramento and San Joaquin River Basins on a mass basis. The six priority pyrethroids are bifenthrin, cyfluthrin, cypermethrin, esfenvalerate, lambda-cyhalothrin, and permethrin.

In order to address pyrethroids impairments and the need to control pyrethroid discharges throughout the Sacramento and San Joaquin River Basins, staff of the Central Valley Regional Water Quality Control Board (Central Valley Water Board or Board) have developed a proposed Basin Plan amendment that is discussed in this staff report. The Proposed Basin Plan Amendment for Pyrethroid Pesticides is provided following the Executive Summary.

Project Goal and Objectives

The overall goal for the proposed amendment is to establish clear requirements for the control of pyrethroid pesticide discharges that provide reasonable protection of beneficial uses in the Sacramento and San Joaquin River Watersheds, including the Delta.

<u>Primary Objectives</u>

1. Establishing measurable pyrethroid concentration goals that provide reasonable protection of beneficial uses.
2. Addressing existing impairments from pyrethroid pesticides through total maximum daily loads (TMDLs) or other means.
3. Developing reasonable and attainable implementation provisions to achieve the pyrethroid concentration goals.

<u>Additional Objectives</u>

4. Efficient process to address future impairments.
5. Provisions for addressing alternative/replacement pesticides.
6. A phased program that:
    a. Includes monitoring and data gathering to resolve uncertainties and inform the Board's future actions;
    b. Avoids unintended regulatory consequences, and
    c. Significantly improves water quality while uncertainties are being addressed.

<u>The Need for a Phased Approach</u>

Pyrethroids can be toxic to aquatic life at very low concentrations. Therefore potential concentration goals for the protection of aquatic life are very low, often below those detectable with current analytical limits, and there is uncertainty about the reductions needed, what practices or controls would be needed to attain the concentration goals, and resulting costs. The available data do indicate, however, that significant reductions

are needed to attain water quality objectives in water bodies receiving significant urban storm water or agricultural discharges.

There are several effective agricultural management practices to control pyrethroids, including source control efforts, many of which are already being implemented, and these have resolved some pyrethroid toxicity impairments. However, it is not known whether these practices will result in consistent attainment of pyrethroid concentrations below aquatic life protection criteria. Storm water and municipal wastewater dischargers have less management practices available. Notably they cannot control the use of pesticides by individuals in their service areas. Additionally, while POTW treatment significantly reduces pyrethroid concentrations, there are no wastewater treatment technologies that have been demonstrated to reliably achieve concentrations below aquatic life protection criteria. In urban areas, one of the primary means of source control is through the implementation of the authorities of agencies which regulate pesticide use. Because of the uncertainty of attainability of the pyrethroid concentration goals, there is also potential for unintended regulatory consequences, especially for Clean Water Act permitted municipal dischargers, when these goals are established as regulation.

In light of the need to reduce pyrethroid toxicity amid uncertainty, the proposed amendment is a phased approach, designed to move toward water quality improvement and ensure data are collected to resolve these uncertainties. This approach will allow the Board to revise Basin Plan requirements, including the prohibition triggers, TMDL allocations, and TMDL numeric targets, before these goals would need to be achieved.

Pyrethroid Concentration Goals

The first project objective is to establish measurable pyrethroid concentration goals to provide reasonable protection of beneficial uses as we address current uncertainty in analytical capabilities, reductions needed, and economic impacts. At this time the Board does not have enough information to complete the analysis required in the water code for the adoption of pyrethroid water quality objectives. More information is needed, especially on effectiveness of management practices in order to assess attainability of concentration goals and the costs of implementation that would be required to attain water quality objectives. Concentration goals are proposed to be established as numeric targets and allocations for TMDLs, and as triggers for the requirement of management practices in a conditional prohibition to move toward improved water quality while needed information is developed.

To determine appropriate levels for the pyrethroid concentration goals, fourteen alternatives were evaluated as potential pyrethroid concentration goals in the water column. These alternatives included the Basin Plan guidance of $^{1}/_{10}$ of the lowest LC_{50} (lethal concentration to 50% of the tested population) and water quality criteria derived

using several different methods. Each alternative was evaluated based on the project objectives. The evaluation resulted in a focus on criteria developed using the UC Davis methodology. The UC Davis methodology directs use of the 5th percentile of the statistical species sensitivity distribution, unless a more sensitive species falls below that value – at which point the 1st percentile is recommended. The 1st percentile UC Davis criteria were identified as being potentially overly conservative when compared to available ecotoxicity data because they were at least a factor of 4 below the lowest toxicity value in the data sets. For each pyrethroid, the lowest toxicity value in the data set was an LC_{50} for the aquatic invertebrate *Hyalella azteca*. *Hyalella spp.,* which includes *Hyalella azteca,* reside in the Sacramento and San Joaquin River basins. The *Hyalella azteca* LC_{50}s fell just higher than the 2.5 percentile, so both the 2.5 and 5th percentile UC Davis criteria were evaluated as providing reasonable protection to aquatic life beneficial uses, which have been identified as the most sensitive beneficial uses for pyrethroids. The UC Davis criteria are all significantly lower than concentrations currently observed in impaired waters, indicating significant reductions will be needed to attain water quality standards.

Staff recommends the 5th percentile UC Davis acute and chronic criteria (Table 1) for the pyrethroid concentration goals, recognizing and considering the need to provide reasonable beneficial use protection (i.e. balance the required level of protection with achievability and economic cost), the significant water quality improvements that will be needed to attain these concentration goals, uncertainty about potential costs and attainability, potential impacts of alternative pesticides, and the proposed phased regulatory approach which allows the concentration goals to be adjusted if needed.

Table 1. Recommended pyrethroid concentration goals.

	UC Davis 5th percentile criteria	
	Acute (ng/L)	Chronic (ng/L)
Bifenthrin	0.8	0.1
Cyfluthrin	0.8	0.2
Cypermethrin	1	0.3
Esfenvalerate	2	0.3
Lambda-cyhalothrin	0.7	0.3
Permethrin	6	1

<u>Considerations in Selecting Concentration Goals</u>

There are several conservative and non-conservative elements and other factors considered in the development of the UC Davis pyrethroid criteria and proposed concentration goals that affect their overall level of beneficial use protection. These include the averaging period and exceedance frequency of the UC Davis criteria,

reduced bioavailability due to binding to suspended solids, the additive toxicity of pyrethroids with other pyrethroids and other toxicants, temperature effects on pyrethroid toxicity, and potential toxic effects not directly incorporated into the criteria calculations. Additionally, there are key policy considerations for using aquatic life pesticide criteria (which are derived using toxicity information for the protection of aquatic life) as concentration goals in a regulatory program. These include the regulatory use of the concentration goals, attainability and costs, availability of analytical detection limits and potential impacts from alternative pesticides.

Criteria Averaging Periods and Exceedance Frequencies

One conservative assumption in the UC Davis method is that the averaging periods for the acute and chronic criteria are considerably shorter than the toxicity test durations they are derived from. The acute criteria averaging period is 1-hour, while acute toxicity tests are 96-hours long. The chronic criteria averaging period is 4-days, while the chronic toxicity tests are typically at least 7-day exposures. Toxic effects are typically seen at lower concentrations with longer exposure times, so having shorter averaging periods than the toxicity test exposures is a conservative assumption of the UC Davis method.

The UC Davis method also includes an exceedance frequency of not more than once every 3 years. This requirement means that if there are two or more exceedances of the concentration goal in a 3 year period, then the concentration goals would not be achieved. The 3 year exceedance frequency of the UC Davis method was chosen based on a literature review of ecosystem recovery studies. Several studies involving pyrethroids showed affected populations recovered from short pulse exposures in several weeks, but one pyrethroid study showed that populations had not fully recovered over 240 days after a short exposure. Most studies showed that recovery occurred in 3 years or less, so the 3 year exceedance frequency is conservative. The acute and chronic averaging periods and the exceedance frequency of the UC Davis are the same as those given in the USEPA guidelines for deriving aquatic life criteria.

Bioavailability and Sediment Toxicity

Staff recommends accounting for the reduced bioavailability of pyrethroids due to binding to suspended solids and dissolved organic matter. Bioavailability is the concept that pyrethroids bound to suspended solids or to dissolved organic matter have a much smaller toxic effect on aquatic organisms compared to pyrethroids that are freely dissolved. Pyrethroids are hydrophobic chemicals, meaning they have a strong tendency to bind to surfaces instead of being freely dissolved in water. In general, 70-99% of pyrethroids in a sample are bound to surfaces, thus only a small fraction of the total pyrethroid has the potential to cause toxicity to organisms in the water column. Protection of benthic organisms is also considered as the bound pyrethroids will settle

to the bed sediments. Equilibrium-partitioning calculations indicate that attainment of the concentration goals based on the UC Davis criteria in the water column would also likely resolve most of the toxicity to *Hyalella* observed in sediment toxicity testing. Sediment toxicity testing and sediment toxicity numeric targets are also included in the proposed amendment to ensure benthic organisms are protected.

It is not currently feasible to directly measure the freely dissolved pyrethroid concentration in commercial laboratories, although that may be possible in several years. Until direct measurement is feasible, staff is recommending that the freely dissolved pyrethroid concentration be calculated from the total pyrethroid concentration and the dissolved and particulate organic carbon concentrations in a given sample, and used to compare to the concentration goals. This recommendation is based on scientific literature on pyrethroids binding and bioavailability.

Additive Toxicity

Staff recommends accounting for additive toxicity when multiple pyrethroids are present in the water. Because all pyrethroids have the same general mode of toxic action, when multiple pyrethroids are present in a sample, their toxicity will be additive. Even when each pyrethroid is below its individual concentration goal, the levels can add up to cause a toxic effect. For this reason, staff recommends consideration of additive toxicity of the six priority pyrethroids via a formula that sums the concentration goal-normalized pyrethroids in a sample. The consideration of additive toxicity of pyrethroids is only possible for the six pyrethroids with concentration goals, which are the six highest use and most frequently detected pyrethroids. Other pyrethroids that do not have criteria could not be included in the proposed concentration goal, so total pyrethroid toxicity could be underestimated if other pyrethroids are present.

Pyrethroids also have additive effects with other pesticides and toxicants, such as metals and commonly used pesticides like organophosphates. These effects were considered in criteria derivation, but could not be included in the criteria since the effects could not be quantified across multiple species. Synergism between pyrethroids and piperonyl butoxide (PBO), a pesticide formulation additive and a known synergist of pyrethroids, was also considered in criteria derivation, but not accounted for because it could not be quantified in across multiple species. Increased toxicity of pyrethroids due to the presence of PBO has been documented in the project area (Weston et al. 2006).

Temperature Effects

Pyrethroid toxicity is dependent on water temperatures. This effect is not accounted for in the UC Davis criteria because it could not be adequately described quantitatively across multiple species. Most of the toxicity test data are based on tests at 20-25ºC, while ambient water temperatures in Central Valley waterways in winter are closer to

15ºC and can range above 30 ºC in some waterbodies during the summer. Pyrethroids have been demonstrated to be 2 to 3 times more toxic at 15ºC compared to the standard test temperature of 23 ºC. At 30 ºC toxicity would likely be lower, but pyrethroid toxicity at temperature above 23 ºC has not been tested or quantified. Therefore pyrethroids' toxic potential during winter storms may be greater than assumed in the concentration goals, and pyrethroids' toxic potential in warmer water bodies during summer runoff events may be less than assumed in the concentration goals.

Species Sensitivity

The most sensitive aquatic organism in the ecotoxicity data sets is the invertebrate *Hyalella azteca*. This species is a resident in the Sacramento and San Joaquin River Basins and is a source of food for many fish species. The chronic (4-day average concentration) 5th percentile UC Davis criteria for all but one pyrethroid are slightly below the 96-hour LC_{50} (concentration lethal to 50 percent of the tested population in a 4-day test) values for *Hyalella azteca*, The chronic 5th percentile criterion for one pyrethroid is equal to the *Hyalella* LC_{50} values. The acute 5th percentile UC Davis criteria are slightly above the *Hyalella* LC_{50} values, while the 2.5 percentile criteria are all below the *H. azteca* LC_{50} values. There are other species resident in the Project Area that are also relatively sensitive to pyrethroids. Estuarine mysid shrimp, such as *Americamysis bahia*, reside in the Delta, but were not included in criteria derivation because the data for these species are from saltwater toxicity testing and only freshwater toxicity tests were included for criteria derivation.

Pyrethroids can also have sublethal effects on fish at low concentrations similar to those toxic to sensitive invertebrates. Chronic sublethal effects on inland silverside, fish that reside in the Delta, have been demonstrated at levels equal to the lethal toxicity values (LC_{50}) for *Hyalella azteca.* This study was not available when the UC Davis criteria were derived, but all the UC Davis chronic criteria are below this effect level. Endocrine disruption of reproductive functions in salmon due to inhibition of the olfactory response to pheromonal cues has also been demonstrated at low pyrethroid concentrations (Moore and Waring 2001). These olfactory effects were considered, but not included in criteria derivation calculations because they could not be directly linked to survival, growth or reproduction and effect concentrations were not quantified due to detection limits.

Water Quality Improvements Needed

The proposed concentration goals are well below current concentrations in pyrethroid-impaired waterbodies in urban and agricultural areas, so attaining these goals in these water bodies and throughout the Sacramento and San Joaquin River basins will be a

significant water quality improvement, requiring significant reductions in discharges in many areas. Due to a lack of monitoring data and limitations in analytical detection limits, there is considerable uncertainty as to what reductions will be needed to attain the proposed concentration goals in most discharges in order to meet the TMDL allocations and prohibition triggers.

Analytical Capabilities

Commercial analytical methods that can reliably detect pyrethroids at the proposed pyrethroid concentration goals are not currently available. However analytical methods for pyrethroids are continuing to be developed and improved. Detection limits are currently close to allowing determination of attainment of the concentration goals based on the UC Davis 5th percentile criteria, but well above the lower criteria concentrations.

Available Controls and Costs

Effective agricultural management practices to control pyrethroids, many of which are already being implemented, include improved pest management and use of alternative pesticides to reduce pyrethroid use, application practices that reduce potential for overspray and drift, and practices that reduce or slow runoff, and reduce or capture sediments in runoff such as vegetation and improved water management. While these practices are generally effective, it is not known whether the practices will result in consistent attainment of pyrethroid concentrations below the values being considered as TMDL numeric targets and/or prohibition triggers.

Best management practices for municipal storm water and wastewater dischargers include education and outreach activities, such as encouraging reduced pesticide use and proper pesticide use, reduced runoff, and pollution prevention activities, such as reducing the municipalities' own use of pesticides, and use of integrated pest management and coordination with regulators of pesticide use. In some cases, features such as constructed wetlands can reduce pyrethroid concentrations, but these may not be feasible for many MS4 and POTW facilities. Municipal wastewater treatment by the POTWs has been shown to significantly reduce pyrethroid concentrations, but the levels POTWs can consistently attain in effluent using any of the currently feasible wastewater treatment technologies are uncertain. While the available practices and technology for the MS4s and POTWs can reduce pyrethroid concentrations, they are not known to be consistently effective at reducing pyrethroids to levels which would attain water quality standards. This is especially a concern in urban environments because, under California law, storm water and municipal wastewater dischargers are prohibited from regulating the use of pesticides by individuals in their service areas. In these areas, one of the primary means of source control is implementation of the authorities of agencies that regulate pesticide use: the California Department of Pesticide Regulation (DPR);

County Agricultural Commissioners; and USEPA's Office of Pesticide Programs (OPP), but the overall reductions that can be attained in urban areas remains uncertain.

Due to the uncertainty in the extent of reductions needed and uncertainty about the effectiveness of management practices and other actions to reduce concentrations, there is significant uncertainty as to the overall costs of attainment of the proposed concentration goals based on the 5th percentile. The proposed regulatory approach was designed to meet the goal of reasonable and attainable implementation requirements, but the costs to implement practices to control pyrethroids are likely to be significant with concentration goals based on the 5th percentile. Attaining concentration goals based on more stringent criteria (based on the 2.5th percentile) would likely be more costly, as larger reductions would be needed and more dischargers would need to implement practices to reduce concentrations.

Regulatory Use of the Concentration Goals

The concentration goals are proposed for use as prohibition triggers and in TMDL allocations – both of which apply at the point of discharge. Therefore additional dilution will likely be available in many receiving waters and resulting pyrethroid concentrations in receiving waters will likely be significantly less, thus providing an additional margin of safety. While the proposed regulatory approach was designed to avoid unintended regulatory consequences, potential for regulatory consequences due to non-attainment of the concentration goals would be greater with concentration goals based on the 2.5th percentile.

Alternative Pesticides

Potential impacts from alternative pesticides and the need to have a balanced approach to regulation of all pesticide discharges is also a key consideration. If the pyrethroid concentration goals are lower than what can be considered reasonable and achievable, the members of the regulated community who have control over pesticide applications will most likely seek alternative pesticides with less rigorous water quality regulatory controls than those for pyrethroids.

Proposed Concentration Goals

Staff recommends concentration goals based on the 5th percentile UC Davis acute and chronic criteria, adjusted for bioavailability and additivity. These concentration goals provide reasonable protection of aquatic ecosystems during the first phase of the program while management practices are initiated and additional information on achievability and cost are documented. A significant reduction in pyrethroid concentrations will be realized by attaining the proposed concentration goals. Additionally, the concentration goals are proposed for use as prohibition triggers and

TMDL allocations – both of which apply at the point of discharge. Additional dilution will likely be available in most receiving waters – thereby resulting in significantly lower pyrethroid concentrations in receiving waters and providing a margin of safety. Finally, toxicity monitoring will be utilized to assess potential additive or synergistic effects and if pyrethroids are contributing to beneficial use impacts. The overall regulatory approach, in combination with the concentration goals, monitoring, and implementation provisions, will meet the project objectives and overall project goal of establishing clear requirements for the control of pyrethroid pesticide discharges that provide reasonable protection of beneficial uses.

Proposed Regulatory Approach

Staff is proposing a phased overall regulatory approach to meet the project objectives. A phased approach will provide the flexibility needed for adaptive management, while also providing assurances that progress will be made towards attainment of water quality standards in impaired waters. The proposed regulatory approach would require the implementation of reasonable management practices, coordination with pesticide regulators, and data gathering in the near term to inform the Board on possible future actions.

There are four main components of this regulatory approach:

1. **Monitoring** and data gathering to inform the Board's future actions.
2. Addressing pyrethroid water quality impairments via:
    a. **Total Maximum Daily Loads (TMDLs)** to address nine impairments in urban water bodies (Sacramento & Roseville). Under the phased approach, the TMDLs would be re-visited before the compliance deadline.
    b. Pollution control requirements that will address pyrethroid impairments in five water bodies that are currently on the 303(d) list due to pyrethroids impairments with agricultural runoff sources. These requirements would support Integrated Report **Category 4b demonstrations** that would meet EPA expectations for demonstrating that TMDLs are not required for water bodies in which existing regulatory requirements are expected to result in attainment of pyrethroid water quality standards.
3. A **conditional prohibition** of pyrethroid discharges to all water bodies with aquatic life beneficial uses in the Sacramento River and San Joaquin River basins. Discharge above concentration triggers would be prohibited unless management practices to reduce discharges of pyrethroids are being implemented.
4. **Continued Coordination** with Department of Pesticide Regulation (DPR) and USEPA Office of Pesticide Programs.

<u>Monitoring and Data Gathering</u>

Monitoring and data gathering to inform the Board's future actions is the first component of the regulatory approach. Initial baseline monitoring will serve to characterize the extent to which water bodies may be receiving pyrethroids at levels exceeding the concentration goals and the levels in different sources (agricultural, urban storm water, POTWs). Baseline monitoring will be focused on water bodies that have not been previously identified as impaired by pyrethroids. The baseline monitoring results will provide the information needed to determine where implementation of management practices is needed to prevent future impairments. Trend monitoring will continue in order to track pyrethroid levels over time as management practices are implemented, and data and information will be gathered regarding treatment feasibility, management practices effectiveness and costs.

Addressing Impaired Waterbodies with TMDLs and Alternative Pollution Control Requirements (Category 4b)

The second component of the regulatory approach will accomplish the second project objective of addressing the existing pyrethroids water quality impairments. The proposed amendment addresses the federal Clean Water Act requirement that the Board establish Total Maximum Daily Loads (TMDLs) or other pollution control requirements to address pollutant exceedances that result in water quality impairments (i.e., federal Clean Water Act section 303(d) listings). The proposed amendment will establish TMDLs for nine water bodies that are currently on the 303(d) list due to pyrethroids impairments with urban runoff sources. The proposed amendment will also establish pollution control requirements that will address pyrethroid impairments in five water bodies that are currently on the 303(d) list due to pyrethroids impairments with agricultural runoff sources.

Basin-Wide Conditional Prohibition

The third regulatory component is the establishment of a conditional prohibition of pyrethroids above the concentration goals. This component is aimed at preventing future impairments and addressing areas where pyrethroids may be negatively affecting beneficial uses. The proposed amendment would establish a conditional prohibition for discharges of six pyrethroid pesticides to all water bodies with aquatic life beneficial uses in the Sacramento River and San Joaquin River basins, with the exception of those water bodies covered under pyrethroids TMDLs. Under the conditional prohibition, discharges of pyrethroids at concentrations that exceed numeric pyrethroid triggers are prohibited unless a discharger is implementing a management plan to reduce pyrethroid levels in their discharges. Under the conditional prohibition, it is anticipated that some municipal storm water dischargers, agricultural dischargers, and publicly-owned treatment works (POTWs) would be required to implement management practices to reduce pyrethroid discharges and a monitoring program to track effectiveness and cost. The requirement to implement management practices addresses the third project

objective of developing reasonable and attainable implementation provisions. Dischargers would be required to develop management plans and choose practices to implement. This framework represents an adaptive management approach so that dischargers and the Board may continue learning about the effectiveness of different practices as well as their economic impact.

Coordination with Pesticide Regulatory Agencies

The fourth regulatory component is coordination with the agencies with legal authority to regulate pesticide use. Such coordination aims to improve source control to reduce current and future water quality impairments caused by pyrethroids and replacement products alike. The agencies that regulate pesticide use are the California Department of Pesticide Regulation (DPR) and U.S. Environmental Protection Agency (USEPA). Coordination between the Board, dischargers and the pesticide regulatory agencies is an important component of the overall regulatory approach because DPR and USEPA are the only agencies that have the authority to affect product registrations, product labels, require mitigation or adopt regulations for the use of pesticides. The proposed amendment contains actions for the Central Valley Water Board to support the project goals and recommendations for DPR and USEPA to continue and enhance their roles in preventing water quality impairments by pesticides.

Regulatory Timeline

A timeline of the phased regulatory approach in the proposed amendment includes a short timeline for dischargers to impaired waters to develop management plans, an initial 2 year period to complete baseline monitoring in areas where pyrethroid levels have not been thoroughly assessed and a year following that to develop management plans. There will be staff updates to the Board every 3 years to report on progress of the control program and a commitment for the Board to re-visit the pyrethroids control program in 15 years as part of the triennial review processes. There is a proposed deadline of 20 years for impaired waters to be attaining standards. When the Board re-visits the pyrethroids control program, the goal is to have enough information to complete a full analysis of the Water Code 13241 factors for adopting a water quality objective. At that time, the Board may consider whether adopting a pyrethroids water quality objective is reasonable and necessary to protect beneficial uses. In order to complete the analysis of 13241 factors, more information is needed on effectiveness of management practices in order to assess attainability of concentration goals and the costs of implementation that would be required to attain water quality objectives. The monitoring and information gathering requirements in the proposed amendment are designed to collect this information.

The proposed amendment represents the continuing efforts of the Board to establish a comprehensive program to control discharges of pesticides that pose a significant risk to surface water quality in the Sacramento River and San Joaquin River basins.

PROPOSED BASIN PLAN AMENDMENT FOR PYRETHROID PESTICIDES

The proposed amendment describes a pyrethroids control program that includes:

1) Actions for the Central Valley Water Board,
2) Recommendations for the agencies that regulate pesticide use (California Department of Pesticide Registration and U.S. EPA),
3) A conditional prohibition for pyrethroid discharges in exceedance of numeric triggers for Sacramento and San Joaquin River Basin water bodies with the aquatic life beneficial uses,
4) Total maximum daily loads for pyrethroids for impaired waters in urban areas, which include numeric targets that will be used to assess attainment of the wasteload allocations,
5) Requirements for addressing water bodies on the 303(d) list for pyrethroids in agricultural areas,
6) Monitoring requirements to assess baseline conditions as well as continued trend monitoring, and
7) A timeline for the Board to re-visit the pyrethroids control program in a phased approach, including regular updates on the program.

Note: Text additions are noted by being underlined and ~~deletions~~ of existing Basin Plan text are noted by ~~strikeout~~.

Changes to Chapter IV, Implementation

Under **"Regional Water Board Prohibitions"**

Add the following:

X. Pyrethroid Pesticides Discharges

Beginning [3 years from OAL approval date], discharges of pyrethroid pesticides at concentrations that exceed pyrethroid triggers (Table IV-Z) to water bodies with designated or existing[1] WARM and/or COLD beneficial uses are prohibited unless a discharger is implementing a pyrethroid management plan to reduce pyrethroid levels in their discharges. Pyrethroid management plans must identify specific management practices for controlling pyrethroid pesticides that will be implemented and are subject to approval processes within the Boards' applicable regulatory programs. In reviewing the pyrethroid management plans, the Executive Officer or designee shall consider the potential impact of the pyrethroid discharge and whether the actions proposed are commensurate with the potential impact. Draft pyrethroid management plans must be submitted at least 6 months prior to [3 years from OAL approval date]. Dischargers shall begin implementing their pyrethroid management plans within 30 days after receipt of written approval of their management plan. For municipal storm water and municipal and domestic wastewater dischargers, management plans are deemed approved and ready to implement if no written approval is provided after 9 months, unless the Executive Officer provides written notification to extend the approval process. Multiple dischargers that are subject to the above requirements may elect to develop and submit a joint pyrethroid management plan. Such a joint pyrethroid management plan must clearly identify the management practices or actions for which each individual discharger is responsible. If concentrations in a discharge not covered under a pyrethroid management plan are found to exceed the pyrethroid triggers after [3 years from OAL approval date], the discharger must submit a draft pyrethroid management plan for approval within 1 year of identifying the exceedance, during which time they are not considered out of compliance, and begin implementing the pyrethroid management plan within 30 days after receipt of written approval of the pyrethroid management plan. Further implementation provisions relating to the conditional prohibition of pyrethroid pesticide discharges are given in the Implementation chapter under the header Pyrethroid Pesticides Control Program (p. IV-xxx) and monitoring requirements are described in the Surveillance and Monitoring chapter under the header Pyrethroid Pesticides Discharges (p. V-xxx).

[1] Existing as defined in Title 40 of the Code of Federal Regulations, section 131.3(e)

The pyrethroid triggers are intended to be used to indicate when pyrethroid management plans need to be developed and management practices are to be implemented by the discharger. When the triggers are exceeded in monitoring or as part of a toxicity evaluation, the discharger may be required to initiate trend monitoring. These actions will provide information on achievability and costs to the Board to inform future evaluation of potential water quality objectives. The pyrethroid triggers are not for use as numeric water quality-based effluent limitations or for reasonable potential analysis.

Discharges of pyrethroids that are subject to pyrethroid TMDL requirements are not subject to the conditional prohibition.

Table IV-Z. Numeric triggers for pyrethroid pesticides *(including all stereoisomers)*.

Pyrethroid Concentration Calculation

Concentrations of pyrethroid pesticides must be above reporting limits (limits of quantitation) to be included; concentrations reported as not-detected or as below the limit of quantitation will be considered as zero (0) in the below formulas. Guidance on acceptable analytical methods is given in the Surveillance and Monitoring chapter under the header Pyrethroid Pesticides Discharges (p. V-xx).

Freely dissolved pyrethroid concentrations may be used in the below formulas to determine the sum of acute and chronic additive concentration goal units (CGUs). The freely dissolved concentration of each quantified pyrethroid pesticide in a sample may be directly measured or estimated using partition coefficients. Methods for direct measurement must be approved by the Executive Officer before they are used to determine the freely dissolved pyrethroid concentrations that are used for determining exceedances of the pyrethroid pesticides numeric triggers. To estimate the freely dissolved concentration of a pyrethroid pesticide with partition coefficients, the following equation shall be used:

$$C_{dissolved} = \frac{C_{total}}{1 + (K_{OC} \times [POC]) + (K_{DOC} \times [DOC])}$$

Where:

$C_{dissolved}$ = concentration of a an individual pyrethroid pesticide that is in the freely dissolved phase (ng/L),
C_{total} = total concentration of an individual pyrethroid pesticide in water (ng/L),
K_{OC} = organic carbon-water partition coefficient for the individual pyrethroid pesticide (L/kg),
[*POC*] = concentration of particulate organic carbon in the water sample (kg/L),which can be calculated as [POC]=[TOC]-[DOC],
K_{DOC} = dissolved organic carbon-water partition coefficient (L/kg),
[*DOC*] = concentration of dissolved organic carbon in the sample (kg/L).

Site-specific or alternative study-based partition coefficients approved by the Executive Officer may be used in the above equation. If site-specific or alternative study-based partition coefficients are not available or have not been approved, the following partition coefficients shall be used in the above equation:

	Ambient Waters		*Wastewater Effluents*	
Pyrethroid Pesticide	K_{OC} (L/kg)	K_{DOC} (L/kg)	K_{OC} (L/kg)	K_{DOC} (L/kg)
Bifenthrin	4,228,000	1,737,127	15,848,932	800,000
Cyfluthrin	3,870,000	2,432,071	3,870,000	2,432,071
Cypermethrin	3,105,000	762,765	6,309,573	200,000
Esfenvalerate	7,220,000	1,733,158	7,220,000	1,733,158
Lambda-cyhalothrin	2,056,000	952,809	7,126,428	200,000
Permethrin	6,075,000	957,703	10,000,000	200,000

Acute Pyrethroid Trigger

The acute additive pyrethroid pesticides numeric trigger is equal to one (1) acute additive concentration goal unit (CGU) not to be exceeded more than once in a three year period. The CGUs are calculated as the sum of individual measured pyrethroid concentration-to-acute concentration goal ratios, as defined in the following formula. For calculation of CGUs, available samples collected within the applicable averaging period for the numeric trigger will be used to determine exceedances of the trigger. Freely dissolved pyrethroid concentrations may be used in the numerator of each ratio if appropriate data are available, as described in the equation to calculate freely dissolved concentrations given above.

$$CGU_{acute} = \frac{C_{bif}}{ACG_{bif}} + \frac{C_{cyf}}{ACG_{cyf}} + \frac{C_{cyp}}{ACG_{cyp}} + \frac{C_{esf}}{ACG_{esf}} + \frac{C_{lcy}}{ACG_{lcy}} + \frac{C_{per}}{ACG_{per}}$$

Where:

C_{bif} = Average concentration of bifenthrin in ng/L from a 1-hour averaging period,
C_{cyf} = Average concentration of cyfluthrin in ng/L from a 1-hour averaging period,
C_{cyp} = Average concentration of cypermethrin in ng/L from a 1-hour averaging period,
C_{esf} = Average concentration of esfenvalerate in ng/L from a 1-hour averaging period,
C_{lcy} = Average concentration of lambda-cyhalothrin in ng/L from a 1-hour averaging period,
C_{per} = Average concentration of permethrin in ng/L from a 1-hour averaging period,
ACG_{bif} = Bifenthrin acute concentration goal of 0.8 ng/L,
ACG_{cyf} = Cyfluthrin acute concentration goal of 0.8 ng/L,
ACG_{cyp} = Cypermethrin acute concentration goal of 1 ng/L,
ACG_{esf} = Esfenvalerate acute concentration goal of 2 ng/L,
ACG_{lcy} = Lambda-cyhalothrin acute concentration goal of 0.7 ng/L,
ACG_{per} = Permethrin acute concentration goal of 6 ng/L,
CGU_{acute} = The sum of measured pyrethroid concentration-to-acute concentration goal ratios, rounded to one significant figure. A sum exceeding one (1) indicates an exceedance of the acute additive pyrethroid pesticides numeric trigger.

Chronic Pyrethroid Trigger

The chronic additive pyrethroid pesticides numeric trigger is equal to one (1) chronic additive concentration goal unit not to be exceeded more than once in a three year period. The chronic CGUs are calculated as the sum of individual measured pyrethroid concentration-to-chronic concentration goal ratios, as defined in the following formula. For calculation of CGUs, available samples collected within the applicable averaging period for the numeric trigger will be used to determine exceedances of the trigger. Freely dissolved pyrethroid concentrations may be used in the numerator of each ratio if appropriate data are available, as described in the equation to calculate freely dissolved concentrations given above.

$$CGU_{chronic} = \frac{C_{bif}}{CCG_{bif}} + \frac{C_{cyf}}{CCG_{cyf}} + \frac{C_{cyp}}{CCG_{cyp}} + \frac{C_{esf}}{CCG_{esf}} + \frac{C_{lcy}}{CCG_{lcy}} + \frac{C_{per}}{CCG_{per}}$$

Where:

C_{bif} = Average concentration of bifenthrin in ng/L from a 4-day averaging period,
C_{cyf} = Average concentration of cyfluthrin in ng/L from a 4-day averaging period,
C_{cyp} = Average concentration of cypermethrin in ng/L from a 4-day averaging period,
C_{esf} = Average concentration of esfenvalerate in ng/L from a 4-day averaging period,
C_{lcy} = Average concentration of lambda-cyhalothrin in ng/L from a 4-day averaging period,
C_{per} = Average concentration of permethrin in ng/L from a 4-day averaging period,
CCG_{bif} = Bifenthrin chronic concentration goal of 0.1 ng/L,
CCG_{cyf} = Cyfluthrin chronic concentration goal of 0.2 ng/L,
CCG_{cyp} = Cypermethrin chronic concentration goal of 0.3 ng/L,
CCG_{esf} = Esfenvalerate chronic concentration goal of 0.3 ng/L,
CCG_{lcy} = Lambda-cyhalothrin chronic concentration goal of 0.3 ng/L,
CCG_{per} = Permethrin chronic concentration goal of 1 ng/L,
$CGU_{chronic}$ = The sum of measured pyrethroid concentration-to-chronic concentration goal ratios, rounded to one significant figure. A sum exceeding one (1) indicates an exceedance of the chronic additive pyrethroid pesticides numeric trigger.

Under "**Recommended for Implementation by Other Agencies**" (p. IV-29.01-30.00)

Add the following:

California Department of Pesticide Regulation (DPR)

Like the Regional Water Board, DPR is part of the California Environmental Protection Agency. It regulates pesticide product sales and use within California pursuant to the California Food and Agricultural Code. When DPR evaluates whether to register a pesticide product, one consideration is the potential for environmental damage. As a part of the pesticide registration process DPR seeks to identify pesticide products whose use or runoff may result in adverse environmental impacts and condition or deny product registration accordingly. DPR is mandated to protect water quality from environmentally harmful pesticide materials and can implement mitigation measures when monitoring data provides evidence of adverse environmental impacts.

Consistent with its authorities, DPR should continue to implement the following actions:

1) Conduct statewide urban and agricultural monitoring program to identify pesticides applied in such a manner that runoff does or could cause or contribute to water quality concerns;
2) Deny registration to pesticide products during registration evaluation process that present an unacceptable risk to surface water;
3) Require registrants to provide information necessary to assess potential water quality impacts as a condition of registration, including, when necessary, development of analytical methods with adequately low limits of quantification in appropriate matrices;
4) Continue and enhance efforts to evaluate the potential for registered pesticide products to cause or contribute to water quality concerns, including consideration of fate and transport of pesticide discharges from wastewater treatment plants, urban runoff, and agricultural sources. Continuous evaluation efforts include monitoring, assessment, and special studies to address identified data gaps;
5) Notify USEPA of potential deficiencies in product labels for products that threaten water quality;
6) Work directly with registrants to address product uses specific to California environmental concerns;
7) Where necessary, develop and modify pesticide use regulations to address pesticide uses that are causing unacceptable water quality impacts;

8) Continue and enhance education and outreach programs to encourage integrated pest management and less toxic pest control (work with County Agricultural Commissioners, urban runoff management agencies, and the University of California Statewide Integrated Pest Management Program to coordinate activities);
9) Continue and enhance, in coordination with county agricultural commissioners, implementation and enforcement of water quality protection regulations and label requirements, including urban surface water protection regulations;
10) Continue and enhance reporting on progress and challenges in implementing water quality protection-related efforts for pesticides with concentrations of concern.

U. S. Environmental Protection Agency (USEPA) Office of Pesticide Programs

USEPA is responsible for implementing the Federal Insecticide, Fungicide, and Rodenticide Act and the Clean Water Act. USEPA is therefore responsible for ensuring that both federal pesticide laws and water quality laws are implemented. USEPA should exercise its authorities to ensure that foreseeable pesticide applications do not cause or contribute to water column or sediment toxicity in the Region's waters. Because some pesticides pose water quality risks, USEPA should implement the following actions:

1) Continue to improve the pesticide registration and registration review processes to ensure that pesticide applications and resulting discharges are protective of water quality and do not cause water quality impairments (i.e., restrict uses or application practices to manage risks). This should include consideration of fate and transport of pesticide discharges from wastewater treatment plants, urban runoff, and agricultural runoff;
2) Continue and enhance education and outreach programs to encourage integrated pest management and less toxic pest control;
3) Require registrants to provide information necessary to assess potential water quality impacts as a condition of registration, including, when necessary, adequate ecotoxicity data to develop water and sediment quality criteria for pesticides of concern and development of analytical methods with adequately low limits of quantification in appropriate matrices;
4) Complete studies to address critical data needs;
5) Respond in a timely manner to identified deficiencies in product labels for products that threaten water quality;

6) Continue and enhance internal coordination efforts between the Office of Pesticide Programs and the Office of Water to implement the above-stated actions to ensure pesticide registration decisions protect water quality.

Under "**Pesticide Discharges from Nonpoint Sources**" (p. IV-33.31):
Make the following revisions:

~~Pesticide Discharges Pesticide Discharges from Nonpoint Sources~~ Pesticide Discharges

Central Valley Regional Water Quality Control Board Actions
The Regional Water Board will implement the following actions related to programs regulating pesticide discharges:

1) Track USEPA and DPR pesticide evaluation and registration activities as they relate to water quality and share monitoring and research data with USEPA and DPR;
2) When necessary, request that USEPA coordinate implementation of the Federal Insecticide, Fungicide, and Rodenticide Act and the Clean Water Act;
3) Encourage USEPA and DPR to fully address water quality concerns within their pesticide registration and use regulation processes, including urban runoff and wastewater discharges as well as agricultural runoff. This shall include providing comments in coordination with the State Water Resources Control Board on USEPA registration reviews for pesticides of concern;
4) Work with DPR, County Agricultural Commissioners, and the Structural Pest Control Board to promote pesticide application practices that result in discharges that comply with water quality regulations by participating in and providing support for regulatory and educational activities that promote these practices;
5) Assemble available information (such as monitoring data) to assist USEPA and DPR in taking actions necessary to protect water quality;
6) Use authorities (e.g., through permits or waste discharge requirements) to require implementation of best management practices and control measures to minimize pesticide discharges to surface waters;
7) Staff will provide periodic updates to the Board on overall progress at addressing pesticide related water quality concerns. These updates may include implementation control programs for specific pesticides, and coordination with USEPA and DPR.

8) Work with stakeholders to develop a Pyrethroid Research Plan no later than [2 years from the OAL approval date] that will describe research and studies to inform future iterations of this control program (e.g., potential objectives, program refinement). The Board will coordinate and consult with the Delta Science Program, Delta Independent Science Board, Delta Stewardship Council, Department of Fish and Wildlife, and Delta Regional Monitoring Program, as appropriate, and will seek to implement the plan through available funding mechanisms; including, but not limited to grants, bonds, agency/department funding, fees, etc. Topics of the Plan could include: potential refinement of partition coefficients; further assessing the need to incorporate temperature effects in toxicity relationships; consideration of synergists and potential mixture effects with other commonly occurring contaminants (e.g., piperonyl butoxide) on pyrethroid toxicity; consideration of the need for chronic toxicity values for taxa for which data are not currently available; evaluation of sub-lethal effects; fate and transport of particulate bound pyrethroids; consideration of monitoring and laboratory methods for both pyrethroid chemistry and toxicity testing and inter-laboratory comparison.

Add the following subheading and text:

Pyrethroid Pesticides Control Program

In order to reduce discharges of pyrethroids to surface waters, the pyrethroids control program will rely on coordination with the agencies that regulate pesticide use (California Department of Pesticide Regulation and U.S. EPA Office of Pesticide Programs), implementation of management practices as part of a conditional prohibition to address elevated levels of pyrethroids before a water body becomes impaired, and data collection to inform future actions. The pyrethroids control program is taking a phased approach and the Board will periodically re-visit the program in the future to consider whether additional actions are required.

1. The Regional Water Board will take actions and encourage actions by other agencies that support attainment of the narrative water quality objective for toxicity with respect to pyrethroid pesticides, as specified in the Basin Plan under the heading Pesticide Discharges.

2. Following [OAL approval date], the Board will require monitoring information from dischargers, as described in the Monitoring and Surveillance Chapter under the heading Pyrethroid Pesticides Discharges (p. V-xx).

3. The pyrethroid pesticides numeric triggers represent maximum allowable levels above which additional management actions may be required. The Regional Water Board may seek additional reductions in pyrethroid pesticides concentrations and exceedance frequencies if such reductions are necessary to account for additive effects with pyrethroids not identified in Table IV-Z or synergistic effects with other chemicals or to protect beneficial uses.

4. The Regional Water Board will review the pyrethroid pesticides prohibition, the pyrethroid pesticides total maximum daily load allocations, the numeric pyrethroid triggers, and the implementation provisions for pyrethroid pesticide discharges in the Basin Plan no later than [15 years from the effective date of this amendment] as part of the Triennial Review process or other process. Following this review, the Regional Water Board may consider the adoption of pyrethroid water quality objectives. Board staff will provide updates to the Regional Water Board on the progress of the pyrethroids control program at least every 3 years as part of the Triennial Review or Executive Officer report, beginning with the first Triennial Review scheduled after [2 years from the effective date of this amendment].

5. **Addressing Known Water Quality Impairments**
   a. Total Maximum Daily Loads for Pyrethroids in Urban Water Bodies
      The loading capacity for each water body segment listed in Table IV-X is equal to the numeric triggers for pyrethroids (Table IV-Z). Wasteload allocations equal to the loading capacity are assigned to all permitted municipal separate storm sewer systems (MS4s) that discharge to Table IV-X water bodies. Compliance with wasteload allocations will be determined using appropriate representative receiving water monitoring as described in Chapter V, Surveillance and Monitoring (V-xx).

      The following TMDL numeric targets will be used to protect aquatic life:
      1) Pyrethroid Pesticides Water Column Additivity Numeric Target
         The numeric target is equal to the Acute Pyrethroid Trigger and Chronic Pyrethroid Trigger in Table IV-Z and applies to the receiving waters listed in Table IV-X.
      2) Pyrethroid-Caused Sediment Toxicity Numeric Target
         The pyrethroid-caused sediment toxicity numeric target is the evaluation of the narrative water quality objective for toxicity using standard aquatic toxicity tests to determine toxicity in bed sediments. The toxic determination is based on comparison of the test organism's response to the sample and a control. The standard aquatic toxicity test in Table IV-Y will be used to determine

compliance with the sediment toxicity numeric target. If other stressors are identified as the cause of toxicity, it will not be considered an exceedance of the pyrethroid-caused sediment toxicity numeric target.

Table IV-Y. Sediment toxicity test to evaluate the Sediment Toxicity Numeric Target

Parameter	Test	Biological Endpoint Assessed
Sediment Toxicity	*Hyalella azteca* (10-day)	Survival

In the water bodies listed in Table IV-X, discharges shall be reduced to ensure attainment of the pyrethroid numeric targets and allocations as soon as practicable but no later than [20 years from effective date of this amendment].

MS4 permittees who discharge to water bodies listed in Table IV-X shall attain the wasteload allocations by developing and implementing a Pesticide Plan that identifies management practices to reduce pyrethroid pesticides in urban runoff to the maximum extent practicable. MS4 permittees who discharge to water bodies listed in Table IV-X are required to submit pyrethroid management plans (which may be included in existing pesticide management plans) for the control of pyrethroid pesticide discharges to those water bodies no later than [1 year from the effective date of this amendment]. Pyrethroid management plans may include actions required by state and federal regulations. The pyrethroid management plan can be included with the MS4's storm water management plan, as appropriate. The management practices listed in 6C shall be considered for inclusion in the pyrethroid management plan. A MS4 discharger has the discretion to implement any of the practices listed in 6C, or may identify others that are not included here, but must provide justification to the Board regarding their decision whether to select or not select each management practice listed in 6C. Management practices may be implemented by individual urban runoff management entities, jointly by two or more entities acting in concert, or cooperatively through a regional or statewide approach that addresses urban pesticide water pollution, including with domestic or municipal wastewater dischargers, as appropriate.

A progress report shall be provided to the Board annually or at a frequency consistent with a discharger's permit requirements to document the management practices that have been implemented, to evaluate attainment of the wasteload allocations, and to identify effective actions to be taken in the future. The progress report can be included in existing reports to the Board, as appropriate. If the management practices do not result in attainment of the wasteload

allocations, then the MS4 discharger shall either identify reasonable and feasible additional/alternative practices for implementation if any are available, or provide a justification for why current practices will result in attainment by the compliance date. This justification may include actions required by state and federal regulations.

Table IV-X. Water body segments with Total Maximum Daily Loads (TMDLs) for pyrethroid pesticides

Water Body Segment
Arcade Creek
Chicken Ranch Slough
Curry Creek (Placer and Sutter Counties)
Elder Creek
Kaseberg Creek (tributary to Pleasant Grove Creek, Placer County)
Morrison Creek
Pleasant Grove Creek (upstream of Fiddyment Road)
Pleasant Grove Creek, South Branch
Strong Ranch Slough

b. Agricultural Waters Bodies with Known Pyrethroid Pesticides Impairments
Discharges of pyrethroid pesticides to water bodies listed in Table IV-W will be controlled using existing Regional Water Board regulatory programs. Agricultural dischargers (either individual dischargers or a discharger group or coalition) to water bodies listed in Table IV-W are required to submit pyrethroid management plans (or modifications to existing pesticide management plans) for the control of pyrethroid pesticide discharges to those water bodies no later than [60 days from the effective date of this amendment]. The pyrethroid management plans will describe the actions that dischargers will take to reduce pyrethroid pesticides discharges to levels that do not exceed the narrative water quality objective for toxicity by the required compliance date.

At a minimum, pyrethroid management plans for agricultural dischargers to the water bodies listed in Table IV-W must describe:

1) The sources of pyrethroid pesticides causing nonattainment of narrative water quality objective for toxicity;
2) The actions that the dischargers will take to reduce pyrethroid pesticides discharges and attain the narrative water quality objective for toxicity as soon as practicable, but no later than [20 years from effective date of this amendment];
3) A schedule for the implementation of those actions;

4) A monitoring plan to track effectiveness of pollution control practices;
5) The process for revising the pyrethroid management plan if the actions do not effectively reduce pyrethroid pesticides discharges or the implemented actions have water quality impacts that must be addressed.

Pyrethroid management plans may address discharges to multiple downstream water bodies for which discharge reductions are required. Pyrethroid management plans may include actions required by state and federal regulations. Revisions to pyrethroid management plans may be required if applicable triggers are not achieved. If a water body that is not attaining the narrative water quality objective for toxicity with respect to pyrethroid pesticides is being used by the discharger to represent water quality conditions in multiple water bodies, pyrethroid management plans must address pyrethroid pesticides in all of the represented water bodies.

Table IV-W Water body segments with known pyrethroid pesticide impairments receiving agricultural discharges.

Water Body Segment
Del Puerto Creek
Hospital Creek (San Joaquin and Stanislaus Counties)
Ingram Creek (from confluence with Hospital Creek to Highway 33 crossing)
Ingram Creek (from confluence with San Joaquin River to confluence with Hospital Creek)
Mustang Creek (Merced County)

6. Conditional Prohibition Implementation Components

a. Municipal Storm Water Discharges

Dischargers subject to the conditional prohibition of pyrethroid pesticides discharges are required to develop and implement pyrethroid management plans to reduce pyrethroid levels in their discharges to the maximum extent practicable. A pyrethroid management plan may be included in the discharger's storm water management plan (SWMP). A pyrethroid management plan must identify a set of management practices that, taken as a whole, may be reasonably expected to effectively reduce pyrethroid levels in their discharges, and to consider whether there are potential water quality concerns with replacement insecticide products. The management practices listed in 6C shall be considered for inclusion in a discharger's pyrethroid management plan. A pyrethroid management plan may include any of the practices listed in 6C, or may identify others that are not included here, but must provide justification to the Board regarding their decision whether to select or not select each practice listed in 6C. Pyrethroid management plans may include actions required by state and federal regulations.

Management practices may be implemented by individual urban runoff management entities, jointly by two or more entities acting in concert, or cooperatively through a regional or statewide approach that addresses urban pesticide water pollution, including with domestic or municipal wastewater dischargers, as appropriate.

A progress report shall be provided to the Board annually or at a frequency consistent with the discharger's permit requirements to document the management practices that have been implemented, to evaluate pyrethroid concentrations with respect to the pyrethroid triggers, and to identify effective actions to be taken in the future. The progress report can be included in other reports submitted to the Board, as appropriate. If the management practices do not result in discharge concentrations at or below the pyrethroid numeric triggers, then the MS4 discharger shall either identify any available, reasonable and feasible additional/alternative practices for implementation, or provide a justification for why current practices are expected to result in achieving the triggers within a reasonable timeframe. This justification may include actions required by state and federal regulations.

Pyrethroid management plans are completed when it can be demonstrated that the Acute and Chronic Pyrethroid Triggers are not exceeded in discharges and the demonstration is approved by the Executive Officer.

b. Municipal and Domestic Wastewater Discharges
Dischargers subject to the conditional prohibition of pyrethroid pesticides discharges are required to develop and implement pyrethroid management plans to reduce pyrethroid levels in their discharges. Pyrethroid management plans, which can be included in dischargers' Pollution Prevention Plan, shall identify management practices to reduce discharges of pyrethroid pesticides. The pyrethroid triggers are intended to indicate when management practices are to be implemented by the discharger; the pyrethroid triggers are not criteria for interpreting the narrative toxicity objective, and are not for use as numeric water quality-based effluent limitations or for reasonable potential analysis.

A pyrethroid management plan must identify a set of management practices that taken as a whole, may be reasonably expected to effectively reduce pyrethroid levels in their discharges, and to consider whether there are potential water quality concerns with replacement insecticide products. The management practices listed in 6C shall be considered for inclusion in a discharger's pyrethroid management plan. In considering management practices for

pyrethroids, a domestic or municipal wastewater discharger has the discretion to implement any of the practices listed in 6C, or may identify others that are not included here, but must provide justification to the Board regarding decision whether to select or not select each practice listed in 6C. Management practices may be implemented by individual NPDES permittees, jointly by two or more permittees acting in concert, or cooperatively through a regional or statewide approach, including with municipal storm water dischargers, as appropriate.

Mid-term and end-term progress reports shall be provided to the Board to document the management practices that have been implemented and to track effectiveness during each permit term. These progress reports can be included in existing reports to the Board as appropriate. If the management practices are inadequate to result in pyrethroid discharge concentrations at or below the numeric triggers in Table IV-Z, then the modification of the pyrethroid management plan will be required to identify additional actions to be taken to reduce pyrethroid discharges if reasonable and feasible actions are available or a justification for why current practices will result in achieving the applicable triggers within a reasonable timeframe. This justification may include actions required by state and federal regulations.

Pyrethroid management plans are completed when it can be demonstrated that the Acute and Chronic Pyrethroid Triggers are not exceeded in discharges and the demonstration is approved by the Executive Officer.

c. Best Management Practices for Storm Water and Wastewater Dischargers
The following management practices shall be considered by municipal storm water dischargers and by municipal and domestic wastewater dischargers and implemented as appropriate. Some of these practices may be accomplished by participation in organizations such as California Stormwater Quality Association (CASQA), which coordinates with DPR and other organizations taking actions to protect water quality from the use of pesticides in the urban environment. Other practices may also be proposed. If the State Water Resources Control Board establishes a statewide water quality control plan that requires best management practices for the control of urban pesticide discharges, compliance with those requirements shall be deemed in compliance with this section.

Education and outreach activities

1) Undertake targeted outreach programs to encourage communities within a discharger's jurisdiction to reduce their reliance on pesticides that threaten water quality, focusing efforts on those most likely to use pesticides that

threaten water quality, potentially by working with DPR, County Agricultural Commissioners, and the University of California Statewide Integrated Pest Management Program, or other entities as appropriate;

2) Make available point-of-purchase outreach materials to pesticide retailer(s) in or near the Permittee's jurisdiction. These materials shall provide targeted information on proper pesticide use and disposal, potential adverse impacts on water quality, and less toxic methods of pest prevention and control.
3) Conduct outreach to Permittee's residents and businesses who may hire structural pest control and landscape professionals that contains messages that (a) explain the links between pesticide usage and water quality; and (b) provides information about structural pest control IPM certification programs and IPM for landscape professionals;
4) Encourage public and private management practices (e.g., landscape design, irrigation management, etc.) that minimize pesticide runoff.

Pesticide pollution prevention activities

1) Reduce reliance on pyrethroids and other pesticides that threaten water quality by adopting and implementing policies or procedures that minimize the use of pesticides that threaten water quality in the discharger's operations and on the discharger's property;
2) Develop and implement an Integrated Pest Management policy that:
    a. Is consistent with IPM as defined by the University of California Statewide IPM Program (UC-IPM) or the California Structural Pest Control Board definition.
    b. Applies to all Permittee staff who conduct or contract for pest management and to pest management vendors under contract to the Permittee.
    c. Assigns responsibilities to a designated staff position and/or department to coordinate Permittee activities and ensure that the IPM policy is implemented.

Support of Pollution Prevention through the Pesticide Regulatory Process

1) Track USEPA and DPR pesticide evaluation and registration activities as they relate to surface water quality and encourage these agencies to accommodate urban water quality concerns within their pesticide registration processes. This may include assembling and submitting available information (such as monitoring data) to USEPA and DPR during public comment periods to assist in their pesticide evaluation and registration activities. This best management practice would be

implemented most effectively through a cooperative regional or statewide approach.

d. Agricultural Discharges
If the prohibition trigger is exceeded in a receiving water after [3 years from OAL approval date], all dischargers in the areas represented by that receiving water monitoring location shall implement a pyrethroid management plan for pyrethroids. Pyrethroid management plans may be developed by a third-party representing multiple dischargers in an area under a Water Board regulatory program, such as the Irrigated Lands Regulatory Program or Dairy Order. Pyrethroid management plans are due no later than 1 year after the discharger or the Board identifies that an applicable trigger has been exceeded.

7. Vector Control Discharges
Discharges of pyrethroid pesticides from vector control applications are subject to the *Statewide NPDES Permit for Biological and Residual Pesticide Discharges to waters of the United States from Vector Control Applications*. Vector control dischargers are not subject to any additional implementation provisions for attainment of the pyrethroid triggers or TMDLs for pyrethroids.

Under **"Estimated Costs of Agricultural Water Quality Control Programs and Potential Sources of Financing"** (p. IV-38.00-40.00)

Add the following subheading and text:

Pyrethroid pesticides discharges into Sacramento River and San Joaquin River basin waters

Estimated costs for implementation of practices to control pyrethroid pesticide discharges are encompassed in the costs of the Long-Term Irrigated Lands Regulatory Program, as described above.

Estimated costs for monitoring and reporting associated with the pyrethroid pesticide control program are 1.4 million dollars per year (2017 dollars). This is a high-end estimate, as similar monitoring and reporting costs would likely be incurred due to other Board Requirements to meet pre-existing Basin Plan requirements under the Long-Term Irrigated Lands Regulatory Program.

Potential funding sources include:

1. Those identified in the San Joaquin River Subsurface Agricultural Drainage Control Program and the Pesticide Control Program.

Changes to Chapter V, Surveillance and Monitoring

Add the following subheading and text:

Pyrethroid Pesticides Discharges

The Regional Water Board will require pyrethroid pesticides dischargers to provide information to the Board. This 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. For dischargers that do not discharge to water bodies listed in Table IV-X and Table IV-W, the Board will require baseline monitoring to be completed by [2 years following OAL approval] and continued trend monitoring to occur after [3 years following OAL approval], except for municipal and domestic wastewater dischargers, which is set forth below. The baseline and trend monitoring will be designed to meet the goals outlined for each discharger type below. The Regional Water Board will work through existing regulatory programs to ensure that the goals of the monitoring program are met. If the required timelines cannot be met through existing processes, the Executive Officer has the discretion to authorize 13267 and/or 13383 orders, and/or extend the timeline for baseline monitoring. With Executive Officer approval, representative monitoring programs, including coordinated regional or statewide monitoring programs, may be used to meet the monitoring requirements.

Pyrethroid monitoring plans must describe at a minimum the proposed sampling frequency, sampling locations, and toxicity test and analytical methods for baseline and/or trend monitoring and can be provided as part of other monitoring plans as appropriate. Pyrethroid monitoring plans shall be approved by the Executive Officer before the data can be used to meet the monitoring requirements of this section. If reliable commercial analytical methods are available with reporting limits at or below the pyrethroid pesticides numeric trigger concentrations in the matrix being monitored, those methods shall be considered by dischargers for monitoring of pyrethroid pesticides. Methods with reporting limits above the pyrethroid trigger concentrations may be used if methods with reporting limits at or below the pyrethroid trigger concentrations are not available or based on the consideration of other factors, such as cost or the reporting limit needed after the calculation of freely dissolved pyrethroid concentrations. When evaluating the toxicity test and analytical methods, the Executive Officer will consider Environmental Laboratory Accreditation Program (ELAP) accreditation, associated quality assurance and quality control provisions, scientifically peer reviewed methods, results of interlaboratory comparison studies, and/or other factors.

Changes in monitoring frequency may result if information such as pesticide use data, pesticide registration status, allowable pesticide uses, use restrictions, management practices, runoff potential, or other monitoring studies indicates additional or less monitoring is needed to meet the monitoring requirements, which may include discontinuation of pyrethroid pesticides monitoring. Monitoring for pyrethroid pesticides and alternative insecticides can be discontinued upon a discharger showing that the specific pesticide is not found, or is not reasonably expected to be found, in receiving waters at concentrations with the potential to exceed the pyrethroid wasteload allocations and/or Acute and Chronic Pyrethroid Triggers or levels of concern for alternative insecticides.

Municipal Storm Water

Pyrethroid monitoring plans that address municipal storm water discharges to TMDL water bodies (Table IV-X) shall be designed to collect information necessary to:

1) Determine whether receiving waters are attaining the Pyrethroid Pesticides Water Column Additivity Numeric Targets and whether the wasteload allocations are being attained in discharges as measured at representative receiving water locations by providing pyrethroid and dissolved and particulate organic carbon concentration data;

2) Determine whether bed sediments are attaining the Sediment Toxicity Numeric Target. In order to link sediment toxicity to pyrethroid pesticides, chemical analysis of the sediment for pyrethroid pesticides shall be performed if the sediment is toxic;

3) Provide *Hyalella azteca* toxicity test data to determine whether pyrethroid pesticides are causing or contributing to exceedances of the narrative water quality objective for toxicity in surface waters;

4) Determine whether the implementation of management practices is sufficient to attain the TMDL Allocations and Numeric Targets.

5) In cooperation with the Regional Water Board, USEPA and DPR, determine if monitoring and reporting programs for alternatives to pyrethroid pesticides are necessary and identify alternative insecticides for which monitoring might be appropriate with consideration of the commercial availability of acceptable analytical methods. If an alternative insecticide is identified as appropriate for monitoring, monitoring shall be performed by the discharger to determine whether alternatives to

pyrethroid pesticides are being discharged at concentrations with the potential to cause or contribute to exceedances of applicable water quality objectives.

Pyrethroid monitoring for municipal storm water that does not discharge to TMDL water bodies (Table IV-X) shall include baseline monitoring and, if required, trend monitoring.

Baseline pyrethroids monitoring for municipal storm water discharges shall be designed to collect information necessary to:

1) Determine through representative receiving water monitoring whether discharges from municipal separate storm sewer systems are exceeding the Acute and Chronic Pyrethroid Triggers (Table IV-Z) by providing pyrethroid and dissolved and particulate organic carbon concentration data;

2) Provide pyrethroid and dissolved and particulate organic carbon concentration data and *Hyalella azteca* toxicity test data to determine whether pyrethroid pesticides are causing or contributing to exceedances of the narrative water quality objective for toxicity in surface waters or bed sediments. With Executive Officer approval, the baseline monitoring requirements may be met by submittal of a report, including a compilation and interpretation of representative monitoring data, demonstrating that the required information has been collected and is sufficient to make the required determinations.

Pyrethroids trend monitoring for municipal storm water discharges shall be designed to collect information necessary to meet the above goals for the baseline monitoring, as well as:

3) Determine the effectiveness of management practices that are implemented to reduce pyrethroid levels in discharges;

4) In cooperation with the Regional Water Board, USEPA and DPR, determine if monitoring and reporting programs for alternatives to pyrethroid pesticides are necessary and identify alternative insecticides for which monitoring might be appropriate with consideration of the commercial availability of acceptable analytical methods. If an alternative insecticide is identified as appropriate for monitoring, monitoring shall be performed by the discharger to determine whether alternatives to pyrethroid pesticides are being discharged at concentrations with the potential to cause or contribute to exceedances of applicable water quality objectives.

Discharges from Agricultural Operations

The pyrethroid monitoring plans that address agricultural discharges to water bodies named in Table IV-W shall be representative of those water bodies and designed to collect information necessary to:

1) Determine whether receiving waters are attaining the Acute and Chronic Pyrethroid Triggers (Table IV-Z) by providing pyrethroid and dissolved and particulate organic carbon concentration data;

2) Determine whether receiving waters and bed sediments are attaining the narrative water quality objective for toxicity by providing *Hyalella azteca* toxicity test data;

3) Determine whether the implementation of management practices is sufficient to attain the Acute and Chronic Pyrethroid Triggers (Table IV-Z) in receiving waters.

4) Determine whether alternatives to pyrethroid pesticides are being discharged at concentrations that have the potential to cause or contribute to exceedances of applicable water quality objectives.

Pyrethroid monitoring for agricultural discharges that do not discharge to water bodies named in Table IV-W shall include baseline monitoring and, if required, trend monitoring.

Baseline pyrethroids monitoring for agricultural discharges shall be designed to collect information necessary to:

1) Determine through representative receiving water monitoring whether discharges from agricultural operations are exceeding the Acute and Chronic Pyrethroid Triggers (Table IV-Z) by providing pyrethroid and dissolved and particulate organic carbon concentration data;

2) Determine whether pyrethroid pesticides are causing or contributing to exceedances of the narrative water quality objective for toxicity in surface waters or bed sediments by providing *Hyalella azteca* toxicity test data.

Pyrethroids trend monitoring for agricultural discharges shall be designed to collect information necessary to meet the above goals for the baseline monitoring, as well as:

3) Determine the extent of implementation of management practices to reduce off-site movement of pyrethroid pesticides and whether these practices are sufficient to attain the Acute and Chronic Pyrethroid Triggers;

4) Determine whether alternatives to pyrethroid pesticides are being discharged at concentrations that have the potential to cause or contribute to exceedances of applicable water quality objectives.

Municipal and Domestic Wastewater

The monitoring requirements discussed in this section do not apply to facilities that discharge <1 million gallons per day unless requested by the Executive Officer. For all other municipal and domestic wastewater dischargers, monitoring for pyrethroid pesticides will be required concurrently with effluent characterization monitoring at least as long as pyrethroid pesticides specified in Table IV-Z are registered for use in the collection service area or at the discretion of the Executive Officer.

Baseline pyrethroids monitoring for municipal or domestic wastewater discharges shall be conducted concurrently with effluent characterization monitoring and shall be designed to collect information necessary to:

1) Determine whether pyrethroid concentrations in municipal or domestic wastewater discharges are exceeding Acute and Chronic Pyrethroid Triggers (Table IV-Z) by providing pyrethroid and dissolved and particulate organic carbon concentration data;

2) Provide pyrethroid and dissolved and particulate organic carbon concentration data and *Hyalella azteca* toxicity test data to determine whether municipal or domestic wastewater discharges of pyrethroids are causing or contributing to exceedances of the narrative water quality objective for toxicity in receiving waters;

Pyrethroids trend monitoring for municipal or domestic wastewater discharges shall commence after the effluent characterization monitoring has been completed or after being directed to start such monitoring by the Executive Officer. The trend monitoring and reporting program shall be designed to collect information necessary to meet the above goals for the baseline monitoring, as well as:

3) Determine the effectiveness of management practices that are implemented to reduce pyrethroid levels in discharges;

4) In cooperation with the Regional Water Board, USEPA, and DPR, determine if monitoring and reporting for alternatives to pyrethroid pesticides is necessary and identify alternative insecticides for which monitoring might be appropriate with consideration of the commercial availability of acceptable analytical methods. If an alternative insecticide is identified as appropriate for monitoring, monitoring shall be performed by the discharger to determine whether alternatives to pyrethroid pesticides are being discharged at concentrations with the potential to cause or contribute to exceedances of applicable water quality objective.

1 INTRODUCTION

The purpose of this staff report is to provide the rationale and supporting documentation for a proposed amendment to the Water Quality Control Plan for the Sacramento and San Joaquin River Basin (Basin Plan) to address pyrethroid pesticides.

The Porter-Cologne Water Quality Control Act requires the Water Boards to develop water quality objectives for the reasonable protection of beneficial uses in surface water and a program of implementation for achieving water quality objectives. Additionally, section 303(d) of the federal Clean Water Act requires states to identify waters that do not meet water quality standards and to establish total maximum daily loads (TMDLs) or other pollution control requirements to address impairments. In accordance with the Water Quality Control Policy for Addressing Impaired Waters (SWRCB 2005) and Clean Water Act section 303(d) requirements, TMDLs and/or other pollution controls are required to address the pyrethroid impairments in the Sacramento and San Joaquin River basins. To comply with federal and state requirements, the Central Valley Water Board staff developed a proposed Basin Plan amendment to establish a control program for discharges of pyrethroid pesticides that is consistent with providing reasonable protection of beneficial uses.

The overall goal for the proposed amendment is to establish clear requirements for the control of pyrethroid pesticide discharges that provide reasonable protection of beneficial uses in the Sacramento and San Joaquin River Watersheds, including the Delta. The proposed amendment is also designed to move toward water quality improvements as current uncertainties in analytical capabilities, bioavailability, and economic impacts are addressed. The primary objectives of the project are (1) to establish measureable objectives or targets for pyrethroid concentrations that provide reasonable protection of beneficial uses, (2) to address existing impairments from pyrethroid pesticides through total maximum daily loads (TMDLs) or other means, and (3) to develop reasonable and attainable implementation provisions to achieve the target pyrethroid concentrations. Additional objectives include developing an efficient process to address future impairments and developing provisions for addressing alternative or replacement pesticides.

Due to the very low pyrethroid concentrations being considered to protect aquatic life, uncertainty in the characterization of the extent of the pyrethroid problem, the potential reductions needed, and the effectiveness of management practices and technology to control pyrethroid discharges, and the corresponding potential regulatory implications, staff and stakeholders have spent significant time identifying and evaluating potential regulatory alternatives. Staff is proposing a phased approach in the proposed amendment that would require the implementation of reasonable management

practices, coordination with pesticide regulators, and data gathering in the near term to inform the Board on possible future actions. The proposed amendment includes total maximum daily loads for urban water bodies with pyrethroids impairments, requirements for addressing water bodies on the 303(d) list for pyrethroids in agricultural areas, and a conditional prohibition of discharge for pyrethroids to water bodies with designated or existing warm and cold freshwater habitat (WARM and COLD, respectively) throughout the basin.

In developing the proposed amendment, reasonable alternatives were considered for each of the components and they are described in this staff report. This staff report begins by giving background information on the Project Area, pyrethroid pesticides in the basin and their effects on aquatic ecosystems, and recent regulatory developments affecting pyrethroid use in section 2. Section 3 presents the alternatives considered and the staff recommendation for the overall regulatory approach and the geographic scope of where the pyrethroids control program would apply. TMDLs and the pyrethroid concentration goals are linked to the protection of beneficial uses, which is discussed in section 4. The alternatives considered for pyrethroid concentration goals in both aqueous and sediment matrices are presented in section 5, as well as the staff recommendations. Section 6 summarizes the rationale and staff recommendations for addressing impaired waters, and describes the different approaches for addressing current impairments in urban and agricultural watersheds. The proposed implementation program and surveillance and monitoring requirements associated with the pyrethroids control program are described in sections 7 and 8, respectively. The costs to dischargers that may result from adoption of the proposed amendment are estimated in section 9. When adopting a Basin Plan amendment, the Regional Water Board must ensure that it is consistent with existing State Water Board and Regional Water Board policies; the consistency of the proposed amendment with these policies is discussed in section 10.

The Board's environmental review of the proposed Basin Plan amendments is contained in this staff report, including the environmental checklist in section 1, which is considered to be "substitute environmental documentation" or "SED".

Public participation and agency consultation that were a part of the development of the proposed amendment are summarized in section 12.

The proposed Basin Plan amendment language is given following the Executive Summary. Basin Plan amendments are not effective until they are approved by the State Water Board and the regulatory provisions are approved by the State Office of Administrative Law. The United States Environmental Protection Agency (USEPA) also must review and approve amendments that add or modify water quality standards for waters of the United States.

2 BACKGROUND

Pyrethroid insecticides are a class of pesticides that are widely used in agriculture and in urban settings, and include 25 active ingredients registered in California. The highest use pyrethroids in California are bifenthrin, cyfluthrin, cypermethrin, esfenvalerate, lambda-cyhalothrin, and permethrin. Recent monitoring has identified pyrethroids at levels of concern in waters of the Sacramento River and San Joaquin River watershed in both agricultural and urban areas. Ambient sediment and water samples had concentrations of pyrethroid pesticides at levels that were toxic to aquatic invertebrates and exceeded narrative water quality objectives for toxicity and pesticides.

As a result of the observation of pyrethroid contamination, several water bodies in the Sacramento and San Joaquin Valleys have been identified on the Clean Water Act Section 303(d) list ("303(d) List") as not attaining the water quality standards established in the Water Quality Control Plan for the Sacramento River Basin and the San Joaquin River Basin (Basin Plan) (SWRCB 2010). The Clean Water Act requires that impaired water body segments on the 303(d) List must be addressed through the development of total maximum daily loads (TMDLs) or be addressed by other agency programs. None of the water bodies on the 303(d) List for pyrethroid concentrations in exceedance of the narrative toxicity and pesticide objectives currently have TMDLs established to control pyrethroids (SWRCB 2010). Additionally, there are numerous water bodies in the Sacramento River and San Joaquin River basins for which there are no monitoring data, but where there is potential for elevated levels of pyrethroids due to nearby uses.

Following the development of previous Basin Plan amendments to address the insecticides chlorpyrifos and diazinon, it was determined that a comprehensive Basin Plan amendment addressing multiple water bodies and multiple pesticides would likely be more cost effective and efficient than developing Basin Plan amendments and TMDLs for individual water bodies and individual compounds. Therefore, a comprehensive basin planning effort was initiated to address pyrethroids as a class of compounds throughout the Sacramento River and San Joaquin River basins.

The purpose of this staff report is to provide the analysis in support of a proposed amendment to the Water Quality Control Plan for Sacramento River and San Joaquin River Basins (Basin Plan) for the control of discharges of pyrethroid pesticides. Provisions are also included in the proposed amendment to address replacement products and additive toxicity. The primary goal of this Basin Plan amendment is to provide a clear regulatory framework for the protection of surface water quality from pyrethroid pesticides in the Sacramento River and San Joaquin River basins, including the Sacramento-San Joaquin Delta.

2.1 Project Area

The Basin Plan covers the entirety of the Sacramento and San Joaquin River drainage basins. The basins are bound by the crests of the Sierra Nevada on the east and the Coast Range and Klamath Mountains on the west. They extend some 400 miles from the California - Oregon border southward to the headwaters of the San Joaquin River. The geographic scope or “Project Area” for the proposed amendment includes the entire area described in the Basin Plan as the Sacramento River and San Joaquin River Basins (Figure 2-1). The Tulare Lake Basin was not included in the scope, as it is covered by a separate Basin Plan.

Weather in the Project Area can be described as having a Mediterranean climate with most of the precipitation occurring between the months of November and March and hot, dry summers. Overall annual precipitation in the Project Area generally increases from south to north. In addition to the natural hydrologic processes of rainfall runoff, snowmelt, and base flow from groundwater discharge, flows in many water bodies in the Project Area, including the Delta and all of the rivers except the Cosumnes are highly managed and affected by reservoir releases, water diversions, irrigation return flows, and sometimes diversions through bypasses. Many of the rivers and streams in the Project Area receive runoff from agricultural and/or urban land, particularly those water bodies on the valley floor. 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 or drainage district. In other instances, the conveyances to a river or stream may be operated by a single discharger.

The geographic region under consideration is large and varied in terms of topography, hydrology, and water sources. For the purpose of analysis and discussion of sources, the region is divided into the Sacramento River Watershed and the San Joaquin River Watershed (Figure 2-2). The delineations of these watersheds are described in the Basin Plan.

The Project Area is approximately 27.2 million acres and contains over 4.3 million acres of agricultural land (ICF International 2010, 2011). There are also over 1.1 million acres (roughly 1,700 square miles) of urban land in the Project Area. Nearly 80 domestic and municipal wastewater treatment plants discharge to surface waters within the proposed Project Area, as well as over 60 municipal separate storm sewer systems (MS4s).

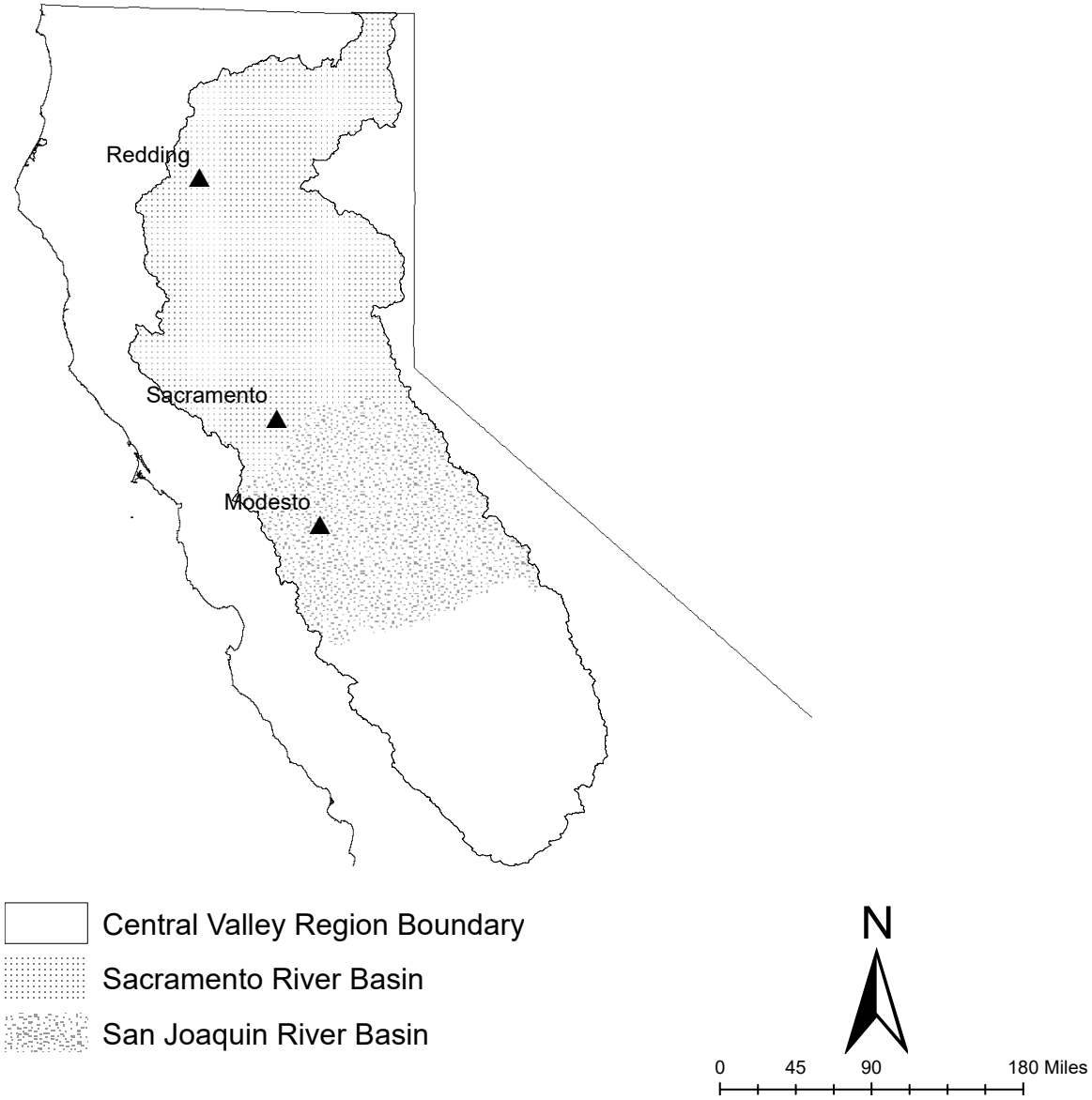

Figure 2-1 Pyrethroids Basin Plan amendment Project Area nested within the Central Valley Water Board boundaries

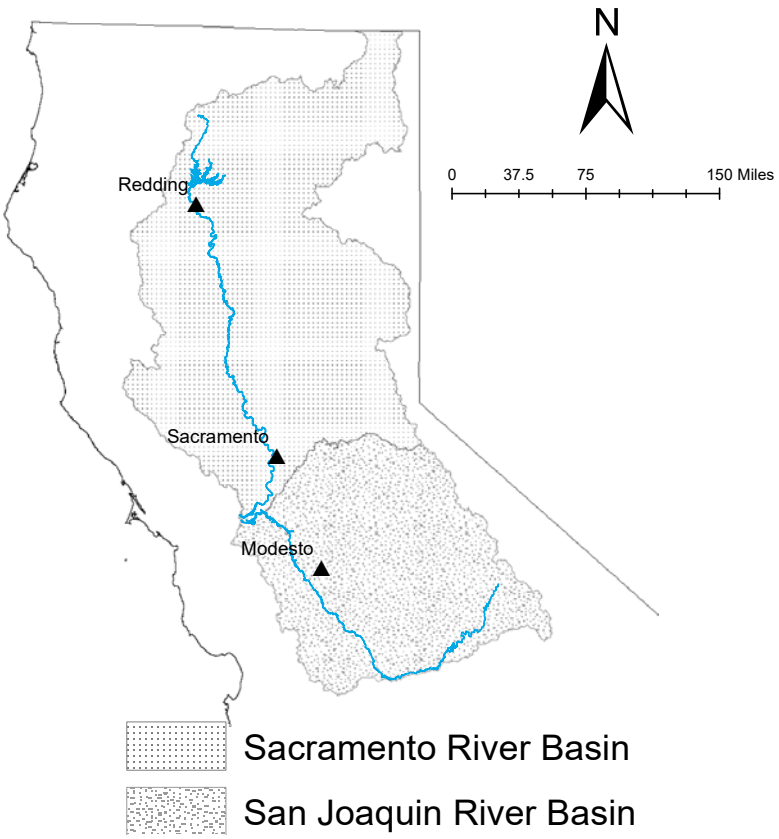

Figure 2-2 Watersheds within the Pyrethroids Basin Plan amendment Project Area – Sacramento River watershed and San Joaquin River watershed

2.2 Pyrethroid Pesticides

There are 25 pyrethroid active ingredients registered for use in California, however this staff report only focuses on six pyrethroids: bifenthrin, cyfluthrin, cypermethrin, esfenvalerate, lambda-cyhalothrin, and permethrin. The focus is on these six pyrethroids because they have the highest use in the Project Area (Figure 2-3), are frequently detected and associated with toxicity in ambient samples, particularly in sediments, and they have physical-chemical properties and toxicity profiles that indicate they are the most likely to cause water quality impairments. The registered uses of pyrethroids include agricultural crops, nurseries, urban structural and landscaping sites, pre-construction termiticides, and home and garden uses, among others (CDPR 2012, Spurlock and Lee 2008).

Section 2.2.1 provides a summary of pyrethroid pesticides use and trends. Section 2.2.2 provides a summary of the sources, pathways and environmental fate of pyrethroid pesticides to provide understanding of how they reach surface waters, where they are found, and how long they will persist in the environment. A summary of the toxic effects

of pyrethroids on aquatic organisms is provided in section 2.2.3. Finally, section 2.3 summarizes the identified pyrethroids water quality impairments in the Project Area.

2.2.1 Use

This section presents information on the use of various pyrethroids over the past decade. Pesticide use data compiled and analyzed in this report were from January 2002 through December 2011. Pyrethroid use data were obtained from the Pesticide Use Report (PUR) database maintained by the California Department of Pesticide Regulation (CDPR 2012). Geographic Information Systems (GIS) and database software were used to select, filter and total reported pesticide use data for the Project Area to analyze the timing and locations of application, sites of application (crops, etc.) and trends in uses. Agricultural uses are reported to DPR and are included in the PUR database with detailed information on application location (in terms of MTRS, Median/Township/Range/Section). This information was used to select agricultural use from within the Project Area.

Non-agricultural pesticide applications by pest control professionals are also reported to DPR and are included in the PUR database by county without detailed location information. For counties that are partially within the Sacramento River and San Joaquin River basin, the non-agricultural use for that county was estimated by determining the fraction of the land area within the basin, and calculating that same fraction of the use (lbs.) for the county. The counties that are partially within the basin and the fraction within the basin are Alameda (0.1005), Alpine (0.3779), Contra Costa (0.37), El Dorado (0.8779), Fresno (0.2233), Glenn (0.936), Lake (0.7714), Lassen (0.3209), Modoc (0.56), Napa (0.4602), Nevada (0.8219), Placer (0.8332), San Benito (0.0338), Sierra (0.785), Siskiyou (0.1796), and Solano (0.616).

Pyrethroids are applied in both urban and agricultural areas of the Sacramento and San Joaquin River Basins, with the mass applied split almost evenly between agricultural (49%) and non-agricultural (51%) uses. In the urban areas, pyrethroids are primarily used for structural pest control, which accounted for 92% of reported non-agricultural uses from 2002-2011. The agricultural uses of pyrethroids are diverse and used on a wide variety of crops in the Project Area. The top eight crops based on pounds applied and acres treated were the same, although not in the same order: almonds, alfalfa, tomatoes, rice, walnut, pistachio, peach, and corn.

Individual, non-professional pesticide applications by homeowners, local businesses, etc. are not reported to the California Department of Pesticide Regulation (DPR), and therefore data on these uses are not readily available. These uses are potentially important based on frequent detections at moderate to high concentrations in urban

streams, thus, analyses of sales data are summarized to characterize what is known about these uses. In order to estimate outdoor residential use of pyrethroids and other pesticides, DPR conducted a survey of products sold in retail stores in California (Osienki et al. 2010). In this 2010 survey of four stores, pyrethroids represented 46% of insecticides found on the shelves of home improvement stores, with bifenthrin, permethrin, and lambda-cyhalothrin being the most prevalent active ingredients. Pyrethroids accounted for 23% of all pesticides surveyed and 46% of the insecticides available, making them the most commonly available class of pesticides.

A 2008 report prepared for the San Francisco Estuary Project estimated residential pyrethroid use based on sales and use data from DPR from 2000-2006 (TDC Environmental 2008). The authors found that pyrethroid use in urban areas had increased significantly from 2000 to 2006, and that pyrethroids were the most commonly applied insecticides in urban areas of California. They also report that statewide more than 90% of estimated urban pyrethroid use was by professional applicators for structural pest control for the period 2005-2006. The unreported residential pyrethroid use for the 2 year period 2005-2006 was estimated to be very small for most compounds, as most urban applications are made by professionals and are reported to DPR. Unreported residential use was estimated to be a significant percentage of all urban use (by pounds of active ingredient) for bifenthrin (12.5%), esfenvalerate (~100%), lambda-cyhalothrin (45%), and tralomethrin (~100%) for the same time period. Overall, unreported residential use of pyrethroids was estimated to be 6.6% of all urban use based on pounds of active ingredient. These estimates have significant uncertainty associated with them because it is assumed that the sales data for a given year reflect the actual use of those pesticides that year; in reality, pesticides purchased by homeowners may be stored or only partially used the year they were purchased. In addition, these are statewide estimates, and are not specific to the Project Area.

Both agricultural and non-agricultural uses of pyrethroids increased from the early 1990s to the 2000s and then remained relatively steady, with year-to-year fluctuations. Non-agricultural uses of pyrethroids declined in the years 2008-2010 from their peak in 2004-2007; this trend corresponds with the nationwide economic decline in these years (Figure 2-4). Non-agricultural use increased in 2011 back to levels seen in the mid-2000s, likely due to improvements in the housing market and economy and new product registrations. It is not suspected that other pesticides were taking the place of pyrethroids for non-agricultural uses. Non-agricultural uses are expected to continue to increase back to pre-recession levels as the economy improves.

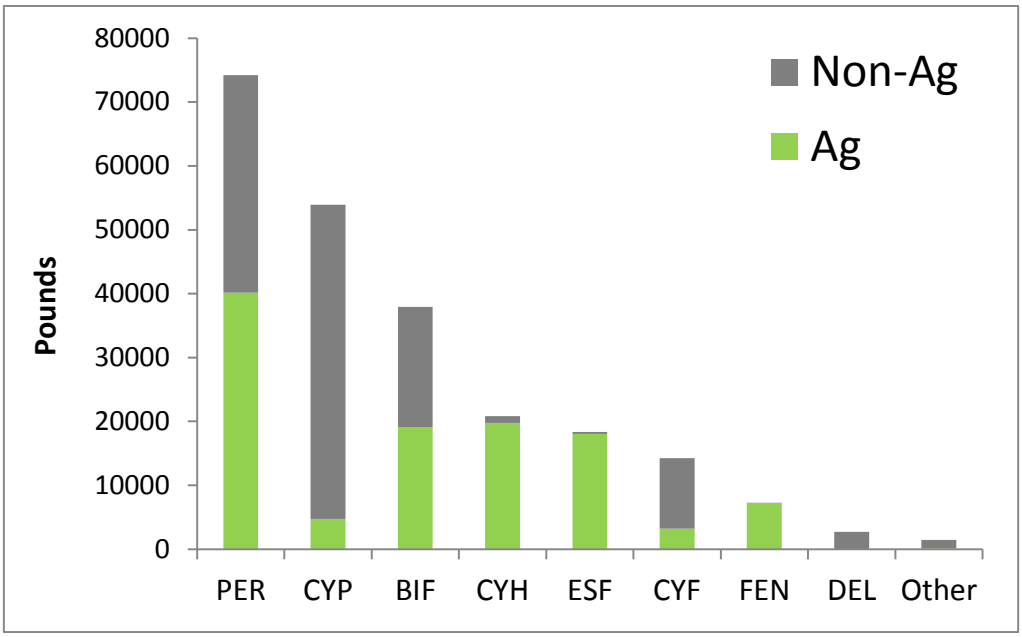

Figure 2-3 Average annual pyrethroid use for the period 2002-2011 in the Project Area
PER = permethrin, CYP = cypermethrin and S-cypermethrin, BIF = bifenthrin, CYH = gamma-cyhalothrin and lambda-cyhalothrin, ESF = esfenvalerate and fenvalerate, CYF = cyfluthrin and beta-cyfluthrin, FEN = fenpropathrin, DEL = deltamethrin, and Other = sum of remaining registered active ingredients.

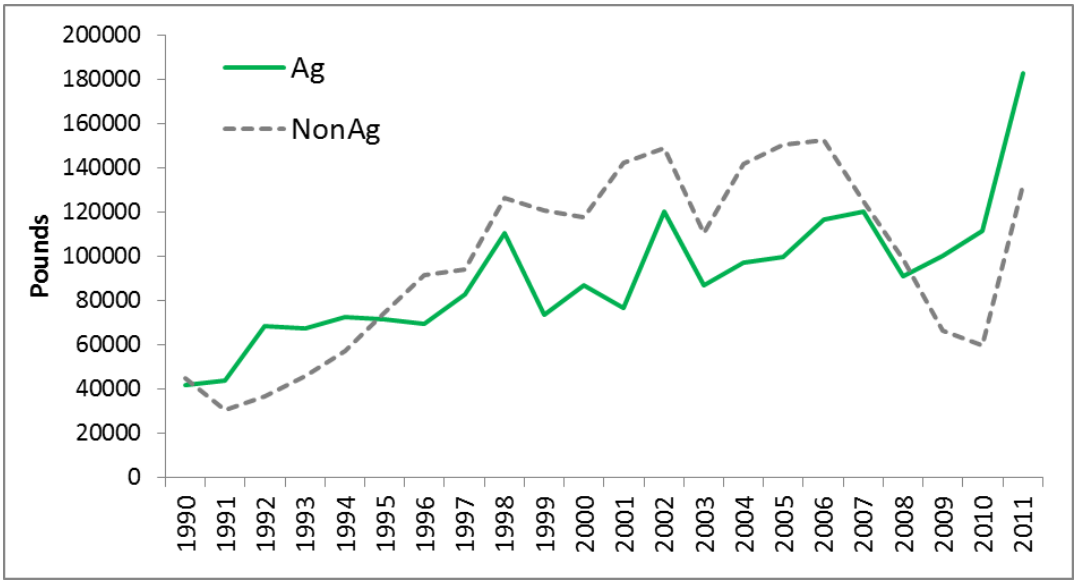

Figure 2-4 Trends in agricultural and non-agricultural use of all pyrethroids in the Project Area

Agricultural use of pyrethroids was relatively steady from 2002-2010, followed by a significant increase in 2011 (Figure 2-4). The number of acres treated increased for many crops from 2010 to 2011, including all of the eight top crops, and it appears that bifenthrin accounts for much of the increased use (Figure 2-5). Of particular note is an

increase in bifenthrin use on almonds; almond acres treated with bifenthrin increased 50% from 2009 to 2010, and increased another 123% from 2010 to 2011. The likely cause for this increase is that new bifenthrin products were registered for use on almonds that account for the majority of the increased use. Another likely contributing factor is that the number of acres planted in almonds has been steadily increasing over the last decade (USDA 2013).

Pyrethroid use in agriculture is highest in the summer months, while non-agricultural uses have much less variation across the seasons in the Project Area (Figure 2-6). Two pesticide-use seasons were defined for this analysis: the rainy season (December through February) and the dry season (March through November). The majority of overall use from 2002-2011 occurred in the dry season (87%), with 20% of the total use in July. Only 7% of the reported agricultural pyrethroid use occurred during the rainy season in this period, primarily in January. The highest agricultural use occurred in July and accounted for 28% of the average yearly use. Non-agricultural use also peaked in July, but these uses are spread more evenly throughout the year compared to agricultural uses. Approximately 20% of non-agricultural use occurred in the 3-month dormant season, when storm events are most likely to occur.

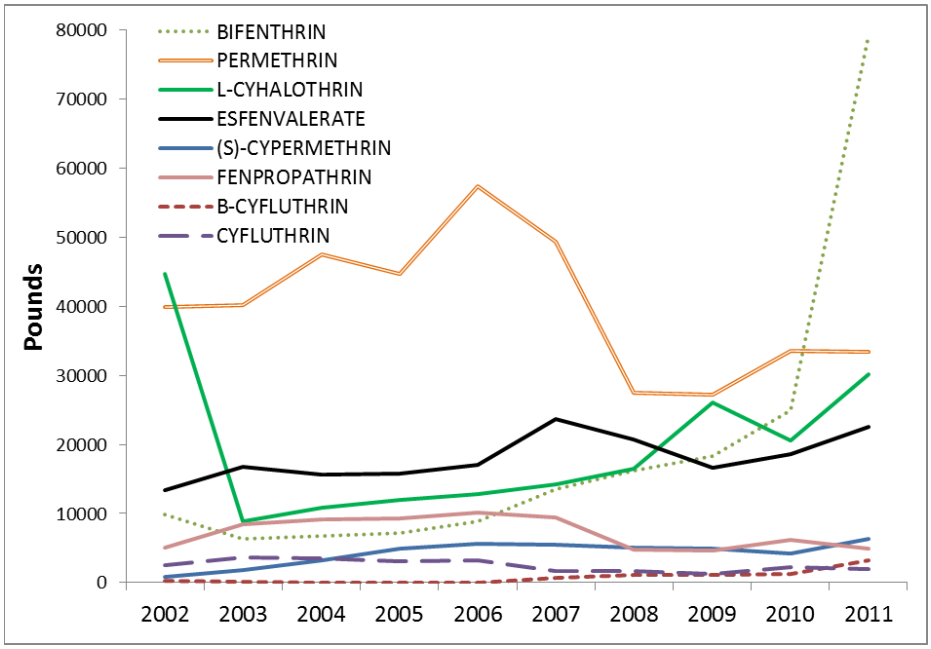

Figure 2-5 Agricultural use of the top eight compounds in the Project Area from 2002-2011

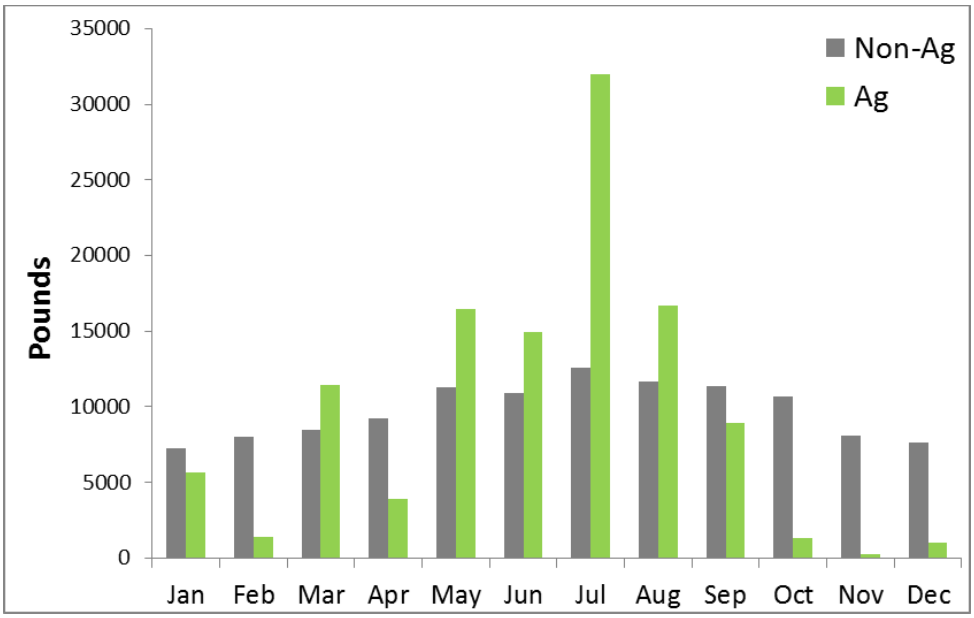

Figure 2-6 Average monthly pyrethroid use in the Project Area for 2002–2011

2.2.2 Sources and Fate of Pyrethroids in Aquatic Ecosystems

2.2.2.1 Sources and Pathways

The sources of pyrethroid insecticides in the Sacramento River and San Joaquin River basins include runoff from both urban and agricultural applications (Weston and Lydy 2010) and wastewater treatment plant (WWTP) effluents (Markle et al. 2014, Parry and Young 2013, Weston and Lydy 2010, Weston et al. 2013a). A fraction of urban and agricultural pyrethroid applications can reach surface water during rainfall or irrigation events, when residual pyrethroids can migrate with storm water runoff or irrigation return water, and enter streams, rivers, creeks and sloughs.

Non-agricultural urban sources of pyrethroids in surface waters have been widely documented in the Project Area (Weston et al. 2005, Weston and Lydy 2010). Pyrethroids have been frequently detected in storm sewers that collect runoff from residential neighborhoods. Loading from urban sources is greater in the rainy season when storm runoff reaches surface waters. However, outdoor surface applications of pyrethroids by professional applicators are now restricted with recent changes in labels and regulations (section 2.4.2).

Agricultural runoff is a known source of pyrethroids, and they are often bound to sediments and particulate matter in runoff (Domagalski et al. 2010, Gan et al. 2005, Werner et al. 2002, Weston et al. 2004, 2009). Effective agricultural management

practices to control pyrethroids include those that reduce runoff and particularly those that reduce or capture sediments in runoff.

Wastewater treatment plant (WWTP) effluents have also been identified as a source of pyrethroids to surface waters (Markle et al. 2014, Parry and Young 2013, Weston and Lydy 2010, Weston et al. 2013a). Pathways of pyrethroids to WWTPs have not been clearly identified, but possibilities include indoor uses that enter sewers by being poured down the drain when cleaning or washing items or areas with pyrethroid residues from indoor pest treatments, washing of clothes impregnated with pyrethroids, washing pets containing residual pyrethroids from flea treatments, and underground termite injections reaching leaky sewer laterals. Weston et al. (2013a) sampled sewer interceptors in Sacramento residential areas where storm and sewer collection systems are separate and found that pyrethroid concentrations in the interceptor samples were not significantly different from plant influent concentrations. This indicates that indoor pyrethroid uses likely represent a significant fraction of total mass loading to wastewater treatment plants and that outdoor sources are not likely a significant contributor. A source identification study undertaken to identify pathways of organophosphate pesticides to WWTPs also concluded that residential sources were the largest contributor to mass loading compared to commercial sources, such as pet grooming facilities (Singhasemanon et al. 1998). This study is relevant because pyrethroids were the primary replacement products when residential uses of organophosphates were phased out early 2000s, and the products have similar residential use patterns (Teerlink 2014).

2.2.2.2 Environmental Fate

Pyrethroids are moderately persistent in the environment and have been detected in sediments and surface waters (Amweg et al. 2006, Budd et al. 2007, Gan et al. 2005, Hladik and Kuivila 2009, Weston et al. 2004). These pesticides have a strong tendency to adsorb to particles and are not likely to volatilize (Table 2-1). In soils, pyrethroids can be degraded by hydrolysis, microbial degradation and photolysis, and lost to surface water via runoff. Many pyrethroids degrade in soils and water in a few days, but bifenthrin appears to be much more persistent than the other pyrethroids (Casjens 2002, Fecko 1999, He et al. 2008, Imgrund 2003, Jones 1999, Laskowski 2002). Bifenthrin may take as long a year to degrade, indicating that this compound in particular has the potential to accumulate in sediments.

Pyrethroids have low aqueous solubilities, ranging from 1 to 6 parts per billion (ppb) depending on the compound, indicating that solubility is probably limiting the movement of pyrethroids into solution for transport in moving water (Table 2-1). Due to pyrethroids' low solubilities and high tendency to adsorb to soil, they tend to move off of crops, soil

and other surfaces and into surface water via particles in runoff from rainfall and irrigation (Domagalski et al. 2010, Gan et al. 2005, Werner et al. 2002, Weston et al. 2004, 2009). In water, pyrethroids can be degraded by hydrolysis, photolysis, and microbial degradation, and lost via sorption to particles or dissolved organic matter. These processes can be influenced by pH, temperature, salinity and other water quality parameters. In general, pyrethroids degrade more rapidly in alkaline water than neutral or acidic waters (Laskowski 2002). The rates of hydrolysis of aqueous pyrethroids increase with high pH, and many pyrethroids are stable to hydrolysis in neutral or acidic (pH 5) conditions (Laskowski 2002). Reported values for pyrethroids' photolysis half-lives in water range from 0.673 days for cyfluthrin to 408 days for bifenthrin (Laskowski 2002).

Studies of pyrethroid degradation in sediments indicate that bifenthrin has a higher likelihood to accumulate in sediments than the other five pyrethroids, but that under some conditions all of these pyrethroids have the potential to persist for long periods (i.e., half-lives > 1 year). Degradation is slowed at lower temperatures in both aerobic and anaerobic conditions. Available studies are summarized below.

Aerobic and anaerobic half-lives have been reported for pyrethroids tested in several California sediments in spiked-sediment laboratory experiments (Meyer et al. 2013, Qin et al. 2006). In one study, aerobic half-lives for cyfluthrin, cypermethrin, esfenvalerate, lambda-cyhalothrin and permethrin ranged from 2.9 to 60 days for three sediments (Meyer et al. 2013). In another study, aerobic half-lives for cypermethrin and permethrin ranged from 53 to 85 days and 102 to 126 days, respectively, for two sediments. Bifenthrin aerobic half-lives were notably longer compared to the five other pyrethroids, ranging from 87.6 days to 630 days in these two studies (Meyer et al. 2013, Qin et al. 2006). Anaerobic half-lives were longer than aerobic half-lives for all pyrethroids, ranging from 104 to 770 days for bifenthrin and 20.1 to 154 days for the other five pyrethroids.

Studies of sediment half-lives in environmental samples have also been performed with California sediments (Gan et al. 2005, Budd et al. 2011). In these studies, reported half-lives are generally longer than those reported in the spiked-sediment experiments. Aerobic half-lives for bifenthrin in sediments collected from the environment range from 428 to 483 days (Gan et al. 2005) to stable with no degradation detected (Budd et al. 2011). Anaerobic half-lives for bifenthrin range from 251 to 1,733 days to stable. Aerobic half-lives for cyfluthrin, cypermethrin, esfenvalerate, lambda-cyhalothrin, and permethrin are shorter than those for bifenthrin and range from 39 to 312 days to stable under some conditions. Anaerobic half-lives are not always longer in environmental samples and range from 21 to 693 days.

Pyrethroids have low potential to bioconcentrate in aquatic organisms because they are typically rapidly metabolized or eliminated. Reported bioconcentration factors range widely, from 2.6 to 3,280,000 L/kg, but pyrethroids do not appear to biomagnify up the food chain (Fojut et al. 2012, Kelley 2003). Organisms typically eliminate accumulated pyrethroids rapidly, for example, in one study half-lives of pyrethroids in rainbow trout ranged from 37 ± 4 h for permethrin to 78 ± 22 h for cypermethrin (Muir et al. 1994). Pyrethroids have been detected in environmental tissue samples in California, but these detections have not been clearly linked to toxic effects. For example, a recent study detected cyfluthrin, bifenthrin and permethrin in embryos of two species of estuarine crabs in Stege Marsh and Bodega Bay (Smalling et al. 2010).

Table 2-1 Physical-chemical properties of six pyrethroids

	Bif	Cyf	Cyp	Esf	λ-cyh	Per
Molecular weight	422.9[c]	434.3[i]	416.3[i]	419.9[c]	449.850[k]	391.288[k]
Density (g/mL)	1.21[d] (geomean, n=2)	1.28[c] (20°C)	1.24[c] (20°C)	1.26[c]	1.33[c] (25°C)	1.23[k] (geomean, n=2)
Water solubility (mg/L)	0.001[d] (geomean, n=2)	0.0023[i] (20°C)	0.004[d] (geomean, n=2)	0.006[i] (25°C)	0.0047[d] (geomean, n=4)	0.0057[d] (geomean, n=2)
Melting point (°C)	69.3[d] (geomean, n=2)	60[c]	71.2[d] (geomean of extremes)	48.4[c] (geomean of extremes)	48.3[c] (geomean of extremes)	36.4[d] (geomean of extremes)
Vapor pressure (Pa)	2.41×10^{-5} [d] (geomean, n=2)	2×10^{-6} [i]	2.87×10^{-7} [d] (geomean, n=2)	2×10^{-7} [i] (25°C)	2.0×10^{-7} [d] (20°C) (geomean, n=3)	3.74×10^{-6} [d] (geomean, n=4)
Henry's Law constant (Pa m^3 mol^{-1})	0.24[d] (geomean, n=2)	0.37[i]	0.0238[d] (geomean, n=3)	1.419×10^{-2} [i]	1.96×10^{-2} [d] (geomean, n=2)	0.12[d] (geomean, n=2)
log K_{oc}[a]	6.26[e,f,g] (geomean, n=12)	6.47[e,g] (geomean, n=8)	6.50[e,g] (geomean, n=8)	6.68[e,f,g] (geomean, n=12)	6.32[e,g] (geomean, n=8)	6.52[e,f,g] (geomean, n=12)
log K_{ow}[b]	7.48[h]	6.86[h]	6.81[h]	7.17[h]	7.06[h]	7.08[h]

Geomean: geometric mean. [a] Log-normalized organic carbon-water partition coefficient, [b]Log-normalized octanol-water partition coefficient, [c]Tomlin 2003, [d]Fojut et al. 2012, [e]Chickering 2014, [f]Yang et al. 2006b, [g]Cui and Gan 2013, [h]Dix 2014, [i]Laskowski 2002, [j]Kelley 2003, [k]Mackay et al. 2006.

2.2.3 Toxic Effects of Pyrethroids

Pyrethroids can be acutely toxic to aquatic life, and aquatic invertebrates are particularly sensitive to these compounds (Fojut et al. 2012). As discussed in section 5, aquatic life is the beneficial use that is most sensitive to pyrethroids. Pyrethroids are nerve agents that induce paralysis in invertebrates in acute exposures (Miller and Salgado 1985). Aquatic organisms are inherently more sensitive to these pesticides because pyrethroids can affect an enzyme used in osmoregulation (Clark and Matsumura 1982, Siegfried 1993). Acute effect levels for *Hyalella azteca,* the test species that is the most sensitive to pyrethroids, are summarized in Table 2-2.

Table 2-2 Acute toxicity values for *Hyalella azteca* in aqueous and sediment exposures
LC_{50}: lethal concentration to 50% of the test population

	Aqueous LC_{50} (ng/L)	Sediment LC_{50} (μg/g OC)
Bifenthrin	0.50[a]	0.43 (geomean, n=4)[g,h]
Cyfluthrin	0.55[b]	1.08 (geomean, n=2)[g]
Cypermethrin	0.56[c]	0.34 (geomean, n=3)[i]
Esfenvalerate	0.85[d]	1.53 (geomean, n=3)[g]
λ-cyhalothrin	0.3[e]	0.45 (mean, n=2)[g]
Permethrin	7.0[f]	8.68 (geomean, n=3)[g]

[a]Bradley 2013a, [b]Bradley 2013b, [c]Bradley 2013c, [d]Bradley 2013d, [e]Bradley 2013e, [f]Bradley 2013f, [g]Amweg et al. 2005, [h]Amweg and Weston 2007, [i]Maund et al. 2002.

Sublethal effects caused by pyrethroids have been documented, such as reduced growth (Goedkoop et al. 2010), disruption of reproductive functions (Moore and Waring 2001), and impaired swimming performance (Beggel et al. 2011). A recent summary article listed the types of sublethal effects documented to be caused by pyrethroids in the Sacramento-San Joaquin Delta, which include: general stress, immune system, osmoregulation, nervous system, muscular system, endocrine system (reproductive), tissue effects/histopathology, necrosis/apoptosis, growth, development, deformities, behavior, and reproductive output (Fong et al. 2016). These types of sublethal effects were demonstrated in a variety of fish and invertebrates, including the endangered Delta smelt, Chinook salmon, and Sacramento splittail.

Pyrethroids and their metabolites have also been identified as endocrine disrupting compounds, meaning they can interfere or mimic hormone signaling, which can lead to various effects in organisms (Brander et al. 2016). Endocrine disruption by pyrethroids has been demonstrated to have reproductive effects in fish, such as decreased fecundity, egg production, and fertilization rates (Brander et al. 2016). For example, endocrine disruption of reproductive functions in Atlantic salmon due to inhibition of the olfactory response to pheromonal cues have been demonstrated at <4 ng/L cypermethrin (Moore and Waring 2001). USEPA conducted endocrine disruption screening for five pyrethroids that included examining estrogen, androgen, and thyroid signaling pathways. Based on a weight of evidence, USEPA concluded there was no convincing evidence of potential interaction with the endocrine pathways for bifenthrin, cyfluthrin, esfenvalerate, and permethrin (USEPA 2015a, b, d, e). Screening results were mixed for cypermethrin and additional testing was recommended (USEPA 2015c).

A recent study demonstrated that environmental levels of bifenthrin in stream sediments can result in altered insect emergence and a trophic cascade effects in aquatic ecosystems at concentrations around 0.2 μg/g OC, which is about half of the *Hyalella*

azteca LC_{50} (Rogers et al. 2016). In controlled experiments mimicking small streams, bifenthrin-contaminated sediments caused reduced abundance and biomass of larval macroinvertebrates, as well as fewer species occurring – meaning a loss of diversity or richness. A trophic cascade occurred that resulted in an increase in algal abundance due to fewer macroinvertebrates feeding on alga. This type of alteration may provide favorable conditions for algal blooms in streams. The Pyrethroid Working Group had concerns with this study and asserted that data interpretation may not fully support the conclusions, as described by Hall (2016).

When present in a mixture, pyrethroids display approximately additive toxicity (Trimble et al. 2009). Toxicity varies between compounds, although species sensitivity seems to be relatively consistent across pyrethroids (Fojut et al. 2012, Giddings et al. 2014).

2.3 Pyrethroid Pesticides Water Quality Impairments

This section presents a summary of the bifenthrin, cyfluthrin, cypermethrin, esfenvalerate, lambda-cyhalothrin, and permethrin concentrations in surface waters in the Project Area. Pyrethroid pesticides have been detected in water bodies within the Project Area at concentrations that exceed water quality standards, based on narrative water quality objectives established in the Basin Plan for the protection of aquatic life. Table 2-3 lists the water bodies in the Project Area that are on the current (2010) Clean Water Act section 303(d) list of water bodies not meeting water quality standards due to pyrethroids (SWRCB 2010). There are 15 listings in the Project Area and each listing is a unique water body segment-pollutant combination. All of the 303(d) listings for pyrethroids in the Central Valley Region are for water bodies within the Project Area. Under section 303(d) of the Clean Water Act, total maximum daily loads or other pollution control requirements that will result in attainment of water quality standards are required for all 15 listings in the Project Area. The data used for the pyrethroids 303(d) listings are described for each listing in sections 2.3.1 and 2.3.2.

In the 2010 update to the 303(d) list, there was one water column listing for the pyrethroid cis-permethrin and one water column listing for the pyrethroid bifenthrin. For the cis-permethrin listing, one-tenth of a LC_{50} for *Tanytarsus sp*. was used as the evaluation guideline, which was 0.033 μg/L (SWRCB 2010). For the bifenthrin listing, the evaluation guideline was one-tenth of a LC_{50} for *Hyalella azteca*, which was 0.00093 μg/L (SWRCB 2010). The CDFW interim criteria for permethrin and cypermethrin described in section A.3 were also used as evaluation guidelines, although there were no listings for these compounds based on the data available during that 303(d) list update. There were 13 listings for sediment toxicity caused by pyrethroids on the 2010 update to the 303(d) list.

Table 2-3 Project Area water bodies on California's 303(d) list due to pyrethroid concentration exceeding water quality standards (SWRCB 2010)

Water body Segment	Bifenthrin 303(d) listing	Cis-permethrin 303(d) listing	Pyrethroids 303(d) listing	Listing(s) Addressed by Existing TMDL
Sacramento River Watershed				
Arcade Creek			X	
Chicken Ranch Slough			X	
Curry Creek (Placer and Sutter Counties)			X	
Elder Creek			X	
Kaseberg Creek (tributary to Pleasant Grove Creek, Placer County)			X	
Morrison Creek			X	
Pleasant Grove Creek (upstream of Fiddyment Rd)			X	
Pleasant Grove Creek, South Branch			X	
Strong Ranch Slough			X	
Sacramento River Watershed Total			***9***	***0***
San Joaquin River Watershed				
Del Puerto Creek	X		X	
Hospital Creek (San Joaquin and Stanislaus Counties)			X	
Ingram Creek (from confluence with Hospital Creek to Hwy 33 crossing)			X	
Ingram Creek (from confluence with San Joaquin River to confluence with Hospital Creek)			X	
Mustang Creek (Merced County)		X		
San Joaquin River Watershed Total	***1***	***1***	***4***	***0***
Grand Total	1	1	13	Total 303 (d) listings: 15
Addressed by Existing TMDLs	0	0	0	Total Addressed by Existing TMDLs: 0
Listings Requiring TMDLs	1	1	13	Total Listings Requiring TMDLs: 15

The evaluation guideline used for these listings was a statistically significant difference between the sample and control sediments using Dunnett's test in 10-day *Hyalella azteca* sediment toxicity tests. To evaluate sediment chemistry data, laboratory sediment toxicity values (LC_{50}s) for *Hyalella azteca* were used.

The 2012 update to the 303(d) list was recently completed for three Regional Boards (North Coast, Colorado River Basin, and Lahontan), although the Central Valley Region has not been updated since 2010 (SWRCB 2015). The 2012 update for these regions include updated evaluation guidelines for pyrethroids, and these same values will be used for other Regions as they are updated, including the Central Valley Region, which includes the Project Area. In this section, recent water column concentration data in the Project Area are compared to the evaluation guidelines currently being used by the Regional Water Boards to interpret narrative water quality objectives for pyrethroids (Table 2-4).

Table 2-4 Most recent evaluation guidelines for pyrethroids (SWRCB 2015).

	Water Column (µg/L)[a]	Sediment (µg/g OC)
Bifenthrin	0.0006	0.43
Cyfluthrin	0.00004	1.1
Cypermethrin	0.0002	0.3
Esfenvalerate	1.13	1.5
Lambda-cyhalothrin	0.0005	0.44
Permethrin	0.002	8.9

[a]Water column evaluation guidelines for bifenthrin, cyfluthrin, cypermethrin, lambda-cyhalothrin, and permethrin are intended to be evaluated for a 4-day averaging period (Fojut et al. 2012).

In order to describe current pyrethroids concentrations in the Project Area, data from the California Environmental Data Exchange Network (CEDEN) was compiled and analyzed for the time period April 2003 through September 2013. Table 2-5 and Table 2-6 summarize aqueous and sediment concentration data by water body category and compares the data to the evaluation guidelines presented in Table 2-4. Wastewater treatment plant data was available for Vacaville, Stockton, and Sacramento (Parry and Young 2013, Weston and Lydy 2010, Weston et al. 2013a) were also included in the summary of aqueous concentration data (Table 2-5).

When evaluating the available concentration data, it is important to keep in mind the following key factors:

1) Monitoring in this large Project Area has been highly variable and the available data are a result of the monitoring studies and programs implemented. The concentrations observed in a particular water body or site are highly dependent on the timing and frequency of sampling, and the data for a particular watershed or

geographic area also are highly dependent on which water bodies and sites are sampled.

2) Monitoring tends to occur in sites downstream of potential sources. Therefore, monitoring tends to be more representative of water bodies in areas with higher pesticide use.
3) All of the aqueous concentrations data have analytical detection limits that are above levels of concern. Data where pyrethroids were not detected, but where detection limits were greater than the evaluation guidelines, were not excluded from the data summaries, but it should be noted that lack of detection does not necessarily indicate that a water body is attaining the evaluation guideline.
4) Conversely, these water column data are total concentrations. If the freely dissolved fraction was compared to the evaluation guideline, exceedance frequencies would be significantly lower.
5) The sites and time periods with more frequent and well-timed data collection (especially during key runoff events) and lower analytical detection limits are better characterized than the sites and time periods with few data and/or higher detection limits.
6) The dynamics of pesticide use patterns, management practice implementation, and changes in the registered uses of these pesticides have affected and will continue to affect the presence of these pesticides in surface waters.

In both aqueous and sediment samples, bifenthrin stands out for having the highest detection frequencies and exceedances of evaluation guidelines in all water body types. Bifenthrin has high usage in both urban and agricultural areas, and in sediments is more persistent than the other five pyrethroids. Overall, urban water bodies tend to have higher detection frequencies and exceedances of evaluation guidelines than other water body types. Detection frequencies of pyrethroids in sediments are generally higher than in water samples, but exceedances are generally less frequent. A summary of aqueous and sediment detections of pyrethroids for each water body type are described in more detail below.

For water bodies in agricultural areas, the detection frequency of aqueous pyrethroids is very low, ranging from 0.3-2% for the six pyrethroids (Table 2-5). However, pyrethroids are detected in sediments much more frequently, ranging from 7.5-50% (Table 2-6). While the aqueous concentration sample size for agricultural waters is large, many of these analyses had detection limits that greatly exceeded the evaluation guidelines to which the results are compared. This is true for samples in all of the water body categories, but it stands out more in the agricultural data set because of the large sample size. The maximum aqueous concentrations detected in agricultural water bodies are generally higher than in other water body categories, although it should be noted that these are whole water concentrations. Whole water concentrations include pyrethroids bound to particles, which is why the maximum concentrations reported are above the aqueous solubilities for some of these compounds. Maximum sediment

concentrations detected are also higher in agricultural waters for the four pyrethroids with significant agricultural use (bifenthrin, esfenvalerate, lambda-cyhalothrin and permethrin).

The detection frequencies of aqueous pyrethroids in water bodies in urban areas varied by compound and were particularly high for bifenthrin (49%; Table 2-5). Bifenthrin also had the highest detection frequency in sediment (89%; Table 2-6). Likewise, bifenthrin had the highest percentage of evaluation guideline exceedances in both water and sediments. Permethrin and cyfluthrin had the next highest detection frequencies in urban water bodies in water, but were significantly less likely to be detected or exceed evaluation guidelines than bifenthrin. In sediments, bifenthrin, permethrin, lambda-cyhalothrin, cyfluthrin and cypermethrin were all detected frequently (52-89%), but only bifenthrin, cyfluthrin and cypermethrin sediment concentrations exceeded the evaluation guidelines. In urban water bodies, the pyrethroids with the highest maximum concentrations were bifenthrin and permethrin in water, and bifenthrin, cypermethrin, and permethrin in sediment.

In water bodies with mixed urban and agricultural land use, detection frequencies generally fell between what was observed in urban and agricultural water bodies (Table 2-5 and Table 2-6). Similar to urban water bodies, bifenthrin had the highest detection frequency in water (21%), and similar to agricultural water bodies, esfenvalerate and lambda-cyhalothrin followed, with detection frequencies in water of 15% and 13%, respectively. In sediments, bifenthrin had by far the highest detection frequency (79%), followed by lambda-cyhalothrin (40%), as well as moderate detection frequencies of the remaining four pyrethroids (23-29%; Table 2-6). If any pyrethroid was detected in water in a 4-day averaging period, the average concentration during that 4-day period nearly always exceeded the evaluation guideline. In contrast, few detections in sediment exceeded evaluation guidelines in mixed water bodies, except for bifenthrin (18%) (Table 2-6). The maximum aqueous concentrations in mixed land use water bodies were generally higher than in urban water bodies and typically lower than in agricultural water bodies, except for cypermethrin. In sediments, maximum concentrations in mixed water bodies were lower than in agricultural or urban water bodies for bifenthrin and permethrin and fell between maximum levels for urban and agricultural water bodies for the other four pyrethroids.

There were relatively few samples from municipal WWTP effluents, and the data is from three studies that included plants in Sacramento, Stockton, and Vacaville (Table 2-5). Permethrin and bifenthrin had the highest detection frequencies, followed by lambda-cyhalothrin and cypermethrin. Permethrin, bifenthrin, and cypermethrin have the highest non-agricultural uses, whereas lambda-cyhalothrin has relatively low non-agricultural use (section 2.2.1), so the number of detections of lambda-cyhalothrin are somewhat

unexpected. All detections of pyrethroids exceeded the evaluation guidelines. The maximum concentrations in effluents were much lower compared to samples collected in ambient waters in urban, agricultural, or mixed use areas. As for all of the sample data in Table 2-5, these concentrations do not account for bioavailability. One of the studies included in the WWTP effluent data set also reported freely dissolved concentrations for six samples (Parry and Young 2013). If the freely dissolved concentrations are compared to the evaluation guidelines for these samples, then only one of six samples exceeds the evaluation guidelines.

Table 2-5 Aqueous concentrations of pyrethroid pesticides in the Sacramento River and San Joaquin River Basin
Bif: bifenthrin, cyf: cyfluthrin, cyp: cypermethrin, esf: esfenvalerate, λ-cy: lambda-cyhalothrin, per: permethrin.

Water Body Type		Bif	Cyf	Cyp	Esf	λ-cy	Per
2015 Evaluation Guidelines (ng/L)		**0.6**	**0.04**	**0.2**	**1,130**	**0.5**	**2**
Water Bodies in Agricultural Areas	Number of Samples	1,240	1,236	1,403	1,418	1,306	1,406
	Number of Detections (% detect)	19 (2%)	7 (0.6%)	4 (0.3%)	24 (2%)	20 (2%)	8 (0.6%)
	Number of 4-day Averages	1,123	1,122	1,289	1,292	1,191	1,292
	Number of exceedances of evaluation guideline (% exceedances of total samples)	19 (1.7%)	7 (0.6%)	4 (0.3%)	0 (0%)	20 (2%)	8 (0.6%)
	Maximum Concentration (ng/L)	430	12	77	731	130	230
Water Bodies in Urban Areas	Number of Samples	88	88	88	88	88	88
	Number of Detections (% detect)	43 (49%)	12 (14%)	5 (6%)	0 (0%)	7 (8%)	13 (15%)
	Number of 4-day Averages	52	53	52	52	52	52
	Number of exceedances of evaluation guideline (% exceedances of total samples)	30 (58%)	10 (19%)	4 (8%)	0 (0%)	7 (13%)	11 (21%)
	Maximum Concentration (ng/L)	106	20	10	nd	13	110
Water Bodies in Areas with Mixed Urban and Agricultural Land Use	Number of Samples	108	108	108	130	108	108
	Number of Detections (% detect)	23 (21%)	7 (6%)	7 (6%)	19 (15%)	14 (13%)	12 (11%)
	Number of 4-day Averages	107	107	107	123	107	107
	Number of exceedances of evaluation guideline (% exceedances of total samples)	22 (21%)	6 (6%)	6 (6%)	0 (0%)	13 (12%)	11 (10%)
	Maximum Concentration (ng/L)	272	25	818	10	17	26
Municipal Wastewater Treatment Plant Effluent	Number of Samples	30	24	30	18	30	30
	Number of Detections (% detect)	16 (53%)	1 (4%)	7 (23%)	1 (6%)	9 (30%)	18 (60%)
	Number of 4-day Averages	30	24	30	18	30	30
	Number of exceedances of evaluation guideline (% exceedances of total samples)	16 (53%)	1 (4%)	7 (23%)	0 (0%)	9 (30%)	18 (60%)
	Maximum Concentration (ng/L)	6.3	1.7	17	3.7	5.5	45.3

Considering all of the water concentration data for pyrethroids, the detection frequencies appear to be quite low, but these data are obscured by reporting limits that in only a few instances are low enough to be equal to the evaluation guidelines. In most aqueous samples, the reporting limits are significantly higher than the evaluation guidelines, so the only detections are exceedances. Analytical methods have greatly improved for pyrethroids over the last decade and in more recent data the reporting limits may be closer to the evaluation guidelines for most pyrethroids. As more aqueous concentration data is gathered with the improved detection limits, it will provide a clearer picture of the attainment of water quality standards in the Project Area.

Table 2-6 Sediment concentrations of pyrethroid pesticides in the Sacramento River and San Joaquin River Basin

Bif: bifenthrin, cyf: cyfluthrin, cyp: cypermethrin, esf: esfenvalerate, λ-cy: lambda-cyhalothrin, per: permethrin.

Water Body Type		Bif	Cyf	Cyp	Esf	λ-cy	Per
2015 Evaluation Guidelines (μg/g OC)		**0.43**	**1.1**	**0.3**	**1.5**	**0.44**	**8.9**
Water Bodies in Agricultural Areas	Number of Samples	193	188	188	193	193	193
	Number of Detections (% detect)	96 (50%)	14 (7.5%)	14 (7.5%)	65 (34%)	83 (43%)	68 (35%)
	Number of exceedances of evaluation guideline (% exceedances of total samples)	34 (18%)	0 (0%)	1 (0.5%)	6 (3%)	12 (6%)	1 (0.5%)
	Maximum Concentration (μg/g OC)	23	0.26	0.47	8.1	14	14.9
Water Bodies in Urban Areas	Number of Samples	27	27	27	27	27	27
	Number of Detections (% detect)	24 (89%)	15 (56%)	14 (52%)	4 (15%)	16 (59%)	20 (74%)
	Number of exceedances of evaluation guideline (% exceedances of total samples)	14 (52%)	5 (19%)	8 (30%)	0 (0%)	0 (0%)	0 (0%)
	Maximum Concentration (μg/g OC)	6.2	3	4.9	0.13	0.3	4.8
Water Bodies in Areas with Mixed Urban and Agricultural Land Use	Number of Samples	109	111	111	111	109	109
	Number of Detections (% detect)	86 (79%)	28 (25%)	32 (29%)	27 (24%)	44 (40%)	25 (23%)
	Number of exceedances of evaluation guideline (% exceedances of total samples)	20 (18%)	3 (3%)	8 (7%)	0 (0%)	2 (2%)	0 (0%)
	Maximum Concentration (μg/g OC)	5.2	1.75	1.6	0.3	1.5	3.2

Overall pyrethroids in sediments were most likely to exceed evaluation guidelines in urban water bodies. In agricultural and mixed water bodies, only bifenthrin had a

significant number of exceedances of the evaluation guidelines. Bifenthrin has relatively high use in both urban and agricultural areas and is more persistent in sediments than other pyrethroids; this combination may explain why bifenthrin stands out among the six pyrethroids in detections and exceedances of evaluation guidelines.

2.3.1 Pyrethroid pesticide impairments in urban watersheds

This section provides a detailed examination of data from the 303(d)-listed water bodies in the Sacramento River watershed to assess their current status. The data included in these descriptions is not constrained to the 2003-2013 time period used above in the summary tables. All data referred to was extracted from the CEDEN database in March 2015, unless otherwise noted. In this section, as above, aqueous concentration data are compared to the most recent evaluation guidelines (Table 2-4).

2.3.1.1 Arcade Creek

Arcade Creek is located in the metropolitan area of Sacramento and it flows west into the Natomas East Main Drainage Canal (also called Steelhead Creek). Arcade Creek was 303(d)-listed in 2010 for pyrethroids based on sediment toxicity and sediment concentrations of pyrethroids. The data used as the basis for these listings was collected in 2004 and 2005. Hall et al. (2012) collected sediment at 11 sites within Arcade Creek in 2009 and analyzed them for pyrethroids. Pyrethroids were detected in sediments from all 11 sites, but only two of the sites had pyrethroids at concentrations that exceeded the evaluation guidelines. The available data indicates that pyrethroids are exceeding water quality standards in Arcade Creek and specific pollution control requirements must be established.

2.3.1.2 Chicken Ranch Slough

Chicken Ranch Slough is located in the metropolitan area of Sacramento and it flows southwest into the lower American River. Chicken Ranch Slough was 303(d)-listed in 2010 for pyrethroids based on sediment toxicity and sediment concentrations of pyrethroids. The data used as the basis for these listings was collected in 2004 and 2005. Pyrethroids data was collected in Chicken and Strong Ranch Sloughs in 2009 and 2010 and six of six samples had aqueous pyrethroids concentrations that exceeded the evaluation guidelines. The available data indicates that pyrethroids are exceeding water quality standards in Chicken Ranch Slough and specific pollution control requirements must be established.

2.3.1.3 Curry Creek

Curry Creek is located in the Sacramento River valley and begins in the city of Roseville, which is in the northern metropolitan area of Sacramento, and flows west into the Pleasant Grove Creek Canal, and then onto the Sacramento River. Curry Creek was 303(d)-listed in 2010 for pyrethroids based on sediment toxicity and sediment

concentrations of pyrethroids. The data used as the basis for these listing was collected in 2004 and 2005. No additional data for Curry Creek has been identified, thus the available data indicates that pyrethroids are exceeding water quality standards in Curry Creek and specific pollution control requirements must be established.

2.3.1.4 Elder Creek

Elder Creek is located in the metropolitan area of Sacramento and it flows west into Morrison Creek, which flows to the Sacramento River. Elder Creek is located within the legal Delta boundary. Elder Creek was 303(d)-listed in 2010 for pyrethroids based on sediment toxicity and sediment concentrations of pyrethroids. No additional data for Elder Creek has been identified, thus the available data indicates that pyrethroids are exceeding water quality standards in Elder Creek and specific pollution control requirements must be established.

2.3.1.5 Kaseberg Creek

Kaseberg Creek is located in the Sacramento River valley and begins in the city of Roseville, which is in the northern metropolitan area of Sacramento, and flows west into Pleasant Grove Creek. Kaseberg Creek was 303(d)-listed in 2010 for pyrethroids based on sediment toxicity and sediment concentrations of pyrethroids. The data used as the basis for these listing was collected in 2004. In two studies, Hall et al. (2009, 2012) collected sediment samples from four sites within the Kaseberg Creek watershed in 2006, 2007, and 2008. All four sites had measurable pyrethroids in sediments in the samples from 2006, 2007, and 2008. Three sites in each year had pyrethroids at sediment concentrations expected to cause toxicity to the test organism *Hyalella azteca*. The available data indicates that pyrethroids are exceeding water quality standards in Kaseberg Creek and specific pollution control requirements must be established.

2.3.1.6 Morrison Creek

Morrison Creek is located within the legal Delta boundary in the metropolitan area of Sacramento and it flows west into the Sacramento River. Morrison Creek was 303(d)-listed in 2010 for pyrethroids based on sediment toxicity and sediment concentrations of pyrethroids. No additional data for Morrison Creek has been identified, thus the available data indicates that pyrethroids are exceeding water quality standards in Morrison Creek and specific pollution control requirements must be established.

2.3.1.7 Pleasant Grove Creek (upstream of Fiddyment Rd)

Pleasant Grove Creek is located in the Sacramento River valley and flows through the northern metropolitan area of Sacramento, including the city of Roseville. It flows west out of the city through agricultural lands before reaching the Sacramento River. A segment of Pleasant Grove Creek upstream of Fiddyment Road was 303(d)-listed in 2010 for pyrethroids based on sediment toxicity and sediment concentrations of

pyrethroids. The data used as the basis for these listing was collected in 2004. Hall et al. (2009, 2012) collected sediment samples from three sites within the Pleasant Grove Creek watershed upstream of Fiddyment Road in 2006, 2007, and 2008. All three sites had measurable pyrethroids in sediments in the samples from 2006, 2007 and 2008. Two sites in 2006 and 2007 had pyrethroids at sediment concentrations that exceeded the evaluation guidelines. The available data indicates that pyrethroids are exceeding water quality standards in Pleasant Grove Creek upstream of Fiddyment Road and specific pollution control requirements must be established.

2.3.1.8 Pleasant Grove Creek, South Branch

The south branch of Pleasant Grove Creek is located in the Sacramento River valley and flows through the city of Roseville, which is in the northern metropolitan area of Sacramento. The south branch flows northwest into the main branch of Pleasant Grove Creek. The south branch of Pleasant Grove Creek was 303(d)-listed in 2010 for pyrethroids based on sediment toxicity and sediment concentrations of pyrethroids. The data used as the basis for these listing was collected in 2004. Hall et al. (2009, 2012) collected sediment samples from four sites within the Pleasant Grove Creek, South Branch watershed in 2006, 2007, and 2008. All four sites had measurable pyrethroids in sediments in the samples from 2006, 2007 and 2008. One, two, and four sites had pyrethroids at sediment concentrations expected to cause toxicity to the test organism *Hyalella azteca* in 2006, 2007, and 2008, respectively. The available data indicates that pyrethroids are exceeding water quality standards in Pleasant Grove Creek, South Branch and specific pollution control requirements must be established.

2.3.1.9 Strong Ranch Slough

Strong Ranch Slough is located in the metropolitan area of Sacramento and it flows southwest into Chicken Ranch Slough, shortly before it reaches the lower American River. Strong Ranch Slough was 303(d)-listed in 2010 for pyrethroids based on sediment toxicity and sediment concentrations of pyrethroids. The data used as the basis for these listings was collected in 2004 and 2005. Pyrethroids data was collected in Chicken and Strong Ranch Sloughs in 2009 and 2010 and six of six samples had aqueous pyrethroids concentrations that exceeded the evaluation guidelines. The available data indicates that pyrethroids are exceeding water quality standards in Strong Ranch Slough and specific pollution control requirements must be established.

2.3.2 Pyrethroid pesticide impairments in agricultural watersheds

2.3.2.1 Del Puerto Creek

Del Puerto Creek is located on the west side of the San Joaquin Valley in Stanislaus County. Del Puerto Creek flows from the foothills through rural and irrigated agricultural lands into the San Joaquin River. Del Puerto Creek was 303(d)-listed in 2006 for

pyrethroids based sediment toxicity, and it was listed for bifenthrin in 2010 based on aqueous concentrations in the water column. The data used as the basis for the pyrethroids sediment listing was collected in 2001-2002, and the data used for the bifenthrin listing was collected in 2003-2006. An additional five sediment samples from two sites in Del Puerto Creek were analyzed for pyrethroids, as triggered by sediment toxicity testing, in 2009, 2010, 2011, and 2012. All five samples contained multiple pyrethroids, ranging from three to five compounds per sample. The sediment pyrethroid concentrations in each sample exceeded the evaluation guidelines. The available data indicates that pyrethroids are exceeding water quality standards in Del Puerto Creek and specific pollution control requirements must be established.

2.3.2.2 Hospital Creek

Hospital Creek is located on the west side of the San Joaquin Valley in Stanislaus County. Hospital Creek flows from the foothills through rural and irrigated agricultural lands into Ingram Creek, which flows to the San Joaquin River. Hospital Creek was 303(d)-listed in 2010 for pyrethroids based on sediment toxicity and sediment concentrations of pyrethroids. The data used as the basis for these listings was collected in 2004. An additional six sediment samples from Hospital Creek were analyzed for pyrethroids, as triggered by sediment toxicity testing, in 2009, 2010, 2011, and 2012. All six samples contained pyrethroids, ranging from one to four compounds per sample. The sediment pyrethroid concentrations in three of the six samples exceeded the evaluation guidelines, and the data did not display a decreasing trend in concentrations over time. The available data indicates that pyrethroids are exceeding water quality standards in Hospital Creek and specific pollution control requirements must be established.

2.3.2.3 Ingram Creek (2 segments)

Ingram Creek is located on the west side of the San Joaquin Valley and flows from the Coast Range through rural and agricultural lands and into the San Joaquin River. Two reaches of Ingram Creek were 303(d)-listed for pyrethroids in 2006: (1) from the confluence with Hospital Creek to Highway 33 crossing and (2) from the confluence with the San Joaquin River to the confluence with Hospital Creek. The listings were based on sediment toxicity and toxicity identification evaluations that indicated pyrethroids were the likely cause of toxicity. The data used as the basis for these listings was collected in 2002-2004. An additional seven sediment samples were analyzed from the upper reach of Ingram Creek (from confluence with Hospital Creek to Highway 33 crossing) in 2009, 2010, 2011, 2012, and 2013. These sediment chemistry analyses were triggered by sediment toxicity testing. All seven samples contained pyrethroids, ranging from one to five compounds per sample. The sediment pyrethroid concentrations in five of the seven samples exceeded the evaluation guidelines, and the data did not display a decreasing trend in concentrations over time. The available data

indicate that pyrethroids are exceeding water quality standards in Ingram Creek and specific pollution control requirements must be established.

2.3.2.4 Mustang Creek

Mustang Creek is located on the east side of the San Joaquin River valley and flows through rural and agricultural lands into Highline Canal, which flows into the Merced River. Mustang Creek was 303(d)-listed for cis-permethrin in 2010 based on data collected in 2004. Subsequent data were collected in 2006, 2007, 2008, and 2013 for permethrin with a total of 11 samples. There were no detections of permethrin or the other five pyrethroids included in the analyses in any of the samples from 2006-2013. The reporting limit for permethrin was 20 ng/L and the method detection limit was 9 ng/L, both of which exceed the evaluation guidelines for permethrin (2 ng/L). Mustang Creek is currently under a management plan for the East San Joaquin Water Quality Coalition. The Coalition monitored for permethrin in 2006, 2007, and 2008, and then stopped monitoring for permethrin in October 2008 based on a change in their regulatory requirements. The Coalition resumed monitoring for permethrin in 2013 and only two of the ten monitoring events had water that could be sampled (January and February). In 2014, the Coalition began monitoring Mustang Creek for sediment toxicity, but did not monitor for permethrin in the water column. Based on the recent data, it is not clear whether permethrin concentrations are exceeding water quality standards in Mustang Creek because of the absence of data with detection limits at or below concentrations of concern and the dry conditions in Mustang Creek. Therefore specific pollution control requirements should be established for Mustang Creek.

2.4 Recent Developments Affecting Pyrethroid Use

Pesticide uses are regulated by the United States Environmental Protection Agency (USEPA), California Department of Pesticide Regulation (DPR) and the California County Agricultural Commissioners. Recent developments in pyrethroid label requirements in California are expected to reduce these pesticides in surface waters in urban areas. Several other relevant recent developments regarding the impacts of pesticides in surface water have resulted in, or will likely result in, additional restrictions and conditions on the use of pyrethroids, as well as other pesticides. These restrictions and conditions on pesticide use are, or will be, implemented through the regulation of pesticide uses. These restrictions and conditions on pesticide use have caused, or in the future should cause, reductions in the amounts of pyrethroids in surface waters.

2.4.1 **DPR Reevaluation of Pyrethroids**

In 2006, DPR placed 657 pyrethroid products into a special review status called reevaluation (California Notice 2006-13). The pyrethroids were separated into three groups based on the type of pyrethroid and if it has been detected in California

sediments. Group I contains active ingredients that are chrysanthemic acid ester pyrethroids; they are bioallethrin, d-allethrin, imiprothrin, phenothrin, prallethrin, resmethrin, and tetramethrin. Group II consists of just two active ingredients that are Type II pyrethroids that have not been detected in California sediments when reevaluation was initiated, tau-fluvalinate and tralomethrin. DPR waived additional study requirements for these compounds because of their low use, lack of evidence that they are contaminating surface waters, and based on a commitment by registrants to implement the same mitigation measures that will be developed for Group III pyrethroids.

The Group III active ingredients are all Type I or Type II pyrethroids that have been detected in surface waters: beta-cyfluthrin, bifenthrin, cyfluthrin, cypermethrin, deltamethrin, esfenvalerate, fenpropathrin, gamma-cyhalothrin, lambda-cyhalothrin, permethrin, and (S)-cypermethrin. Group III registrants have submitted the required data for environmental fate and 10-day sediment toxicity tests with *Hyalella azteca* and *Chironomus dilutus.* Chronic toxicity studies are also required for these two species, but this requirement has been deferred until USEPA finalizes their whole sediment life cycle toxicity test guidelines. Sediment half-life studies have been completed with a revised analytical method that follows recent USEPA study guidelines.

In 2009, registrants submitted reports about best management practices (BMPs) to reduce runoff losses from lawn irrigation and USEPA subsequently required label changes to address environmental hazards for non-agricultural outdoor pyrethroid products. In 2010, registrants completed a survey of urban pest control businesses and in 2012 they completed a pathway identification study for residential urban runoff. The results of the survey and the pathway identification study were used to develop surface water protection regulations for pyrethroids (section 2.4.2). In 2014, registrants completed a monitoring study on pyrethroids in publicly owned treatment works that examined concentrations in influent, effluent and biosolids at 32 WWTPs throughout California (Markle et al. 2014). The pyrethroids re-evaluation ended in July 2014 and the main regulatory outcome was the surface water protection regulations for pyrethroids. The data generated will also continue to be useful in risk assessments for these compounds.

2.4.2 California Surface Water Protection Regulations for Pyrethroids

DPR has recently adopted new restrictions on pyrethroid products in Title 3, California Code of Regulations, Sections 6970 and 6972. These additional requirements placed on the use of pyrethroids in outdoor non-agricultural settings are designed to reduce pyrethroid impacts on surface waters. These regulations went into effect on July 19, 2012 and apply to the following pyrethroids: bifenthrin, bioallethrin, S-bioallethrin,

cyfluthrin, beta-cyfluthrin, gamma-cyhalothrin, lambda-cyhalothrin, cypermethrin, deltamethrin, esfenvalerate, fenpropathrin, tau-fluvalinate, permethrin, phenothrin, prallethrin, resmethrin, and tetramethrin.

These regulations are expected to significantly decrease urban runoff of pyrethroids into surface waters by reducing applications to all surfaces, particularly horizontal impervious surfaces. Professional pest control applicators are required to follow these regulations, and it is estimated that they apply the majority of pyrethroids in urban areas, compared to nonprofessional homeowners and business owners. The following is the text of regulations added to the Food and Agriculture Code:

Section 6970

- Except when prohibited, applications to the soil surface, mulch, gravel, lawn, turf, or groundcover must be made using only the methods described below:
    - Spot treatment
    - Pin stream treatment of one-inch wide or less
    - Perimeter band treatment of three feet wide or less from the base of a building outward
    - Broadcast treatment but no within two feet from any horizontal impervious surface. Pin stream treatment of one-inch wide or less may be made within the two-foot area.
    - For broadcast treatment of termiticides to preconstruction sites, prior to precipitation, the treatment site must be covered with a waterproof covering, such as a polyethylene sheet, or a concrete slab must be poured over the treated soil.
- Except when prohibited, applications to horizontal impervious surfaces must be made using only the methods described below:
    - Spot treatment
    - Crack and crevice treatment
    - Pin stream treatment of one-inch wide or less
- Except when prohibited, applications to vertical structural surfaces, such as walls, foundations, windows, doors, and fencing, must be made using only the methods described below:
    - Spot treatment
    - Crack and crevice treatment
    - Pin stream treatment of one-inch wide or less
    - Perimeter band treatment up to a maximum height of two feet above the grade level
- Except when prohibited, for applications using granules to the soil surface, mulch, gravel, lawn, turf, or groundcover, the applicator shall sweep any granules that land on horizontal impervious surfaces on to the treatment site.
- The following applications are prohibited:
    - To any site during precipitation, except for applications made to the underside of eaves;

  - To the soil surface, mulch, gravel, lawn, turf, groundcover, or horizontal impervious surfaces with standing water, including puddles;
  - To sewer or storm drain, or curbside gutter;
  - To the following components of a constructed drainage system that drains to a sewer or storm drain, curbside gutter, or aquatic habitat:
    - Visible drainage grate connected to a drain pipe; or
    - Visible French drain, or a landscaped dry river bed, swale or trench filled with gravel or rock;
  - To the soil surface, including preconstruction termiticide sites, mulch, gravel, lawn, turf, groundcover, or horizontal impervious surfaces within 25 feet of aquatic habitat located downgradient from the application. The applicator shall measure the distance from the high water mark or intermittent streams that are dry from the top of the near bank; or
  - To the preconstruction termiticide site within 10 feet of a storm drain located downgradient from the application.
- Application to plants, shrubs, or trees where there is standing water in the dripline or perimeter of the plants, shrubs, or trees is prohibited.

NOTE: Authority cited: Section 11456, Food and Agricultural Code. Reference: Sections 11456 and 11501, Food and Agricultural Code.

Section 6972
The following applications are exempt from the provisions of 6970:

- Injection into soil or structural material, such as bricks, concrete, or wood.
- Post-construction rod or trench termiticide application methods
- Applications to below-ground insect nests or nests made of mud or paper combs
- Applications of baits in weather-proof stations or gel baits
- Pesticide applications to receiving water for which a permit has been issued under the Statewide General National Pollutant Discharge Elimination System (NPDES) for Pesticide Discharges to Waters of the U.S. from Spray Applications, and Vector Control Applications.
- Applications to the underside of the eaves
- Foggers or aerosol applications.

NOTE: Authority cited: Section 11456, Food and Agricultural Code. Reference: Sections 11456 and 11501, Food and Agricultural Code.

2.4.3 **Bifenthrin Label Changes**

Bifenthrin registrants signed a memorandum of agreement in 2011 that states manufacturers would voluntarily change bifenthrin professional product labels that would further limit outdoor residential, structural, industrial, and institutional bifenthrin use (MOA 2011). These restrictions prohibit applications of bifenthrin to horizontal impervious surfaces unless the surface is protected from rainfall and spray from sprinklers. Applications to vertical impervious surfaces that abut horizontal impervious

surfaces are also prohibited unless they are protected from rainfall or spray from sprinklers or the horizontal surfaces do not drain into sources of storm water. These label changes are occurring with the agreement that DPR will not pursue the incorporation of additional bifenthrin-specific restrictions into its surface water rulemaking, which was being developed at that time (CDPR 2011). These voluntary label changes for bifenthrin are more restrictive than the recently adopted DPR Surface Water Protection Regulations for pyrethroids (section 2.4.2). Bifenthrin registrants filed label amendments with USEPA by November 2011 and have all been reviewed by USEPA. As of November 2013, DPR received and accepted the label amendments reviewed by USEPA. DPR continues to monitor new bifenthrin product labeling to ensure compliance with the MOU. It is anticipated that these label changes will decrease bifenthrin runoff into surface waters. DPR continues to monitor for pyrethroids, including bifenthrin, in surface waters and sediments.

2.4.4 DPR Dormant Season Insecticide Spray Regulations

DPR adopted regulations for dormant season insecticide sprays in orchards. These regulations were adopted in 2007 in Title 3, California Code of Regulations, Sections 6960 and 6000. These regulations apply to pyrethroids as well as other insecticides used on orchards during the dormant season. The regulations adopt restrictions for dormant insecticide sprays unless 1) only dormant oils and/or biological control agents such as *Bacillus sp.* or spinosad are applied; 2) sprays are applied to a hydrologically isolated site; or 3) runoff is held for 72 hours before it is released. For the remaining dormant season insecticide applications, certain restrictions apply.

The restrictions limit ground and aerial applications of dormant insecticides to areas 100 feet from any surface water body, unless the water body resides exclusively on private property. They specify wind speeds in which dormant insecticides may be applied (3-10 miles per hour) and allow aerial application only if soil conditions do not allow field entry or approaching bloom conditions require aerial applications. The restrictions prohibit all dormant insecticide applications when soil is saturated with water or runoff is likely to occur when it rains, and a storm event is to occur within 48 hours following application. Dormant applications may be made only when insect scouting information (or a Pest Control Advisor) indicates pest populations have reached damaging levels.

Based on an analysis of seasonal pyrethroid use, it appears that the majority of pyrethroid use occurs in the irrigation season rather than the dormant season (see Figure 2-6). Many growers have decreased their use of dormant sprays overall because other management practices, such as orchard sanitation practices of removing empty nut shells, have proven equally or more effective than insecticide sprays.

2.4.5 USEPA Reevaluation of Pyrethrins, Pyrethroids and Synergists

In addition to the DPR reevaluation on pyrethroids, the USEPA is also reviewing this class of pesticides. The ten compounds in this group that were registered before November 1, 1984 went through re-registration, which was completed in 2008. These ten compounds are pyrethrins, allethrins, cypermethrin, tau-fluvalinate, permethrin, resmethrin, d-phenothrin, tetramethrin, MGK-264 (synergist), and piperonyl butoxide (synergist). This group of pesticides is also currently going through registration review, a USEPA program to systematically review all registered pesticides every 15 years to ensure that pesticides are not causing unreasonable adverse effects on human health or the environment. Individual compounds are reviewed separately in registration review, and will occur over several years for this group. Registration review was opened for esfenvalerate, cyphenothrin, allethrin stereoisomers, deltamethrin, tralomethrin, bifenthrin, fenpropathrin, and cyfluthrin in federal fiscal year 2010. Five more pyrethroid registration reviews began in fiscal year 2011: gamma-cyhalothrin, lambda-cyhalothrin, tau-fluvalinate, permethrin, and imiprothrin, as well as the synergist piperonyl butoxide. Phenothrin, tetramethrin, cypermethrin, prallethrin, resmethrin, metofluthrin and tefluthrin were opened for review in 2012, as well as the synergist MGK-264. Registration reviews take several years to complete as new data is requested and registrants typically have two years to submit the required data, which is then reviewed by USEPA and the public. Registration review could lead to changes in pyrethroid registrations if USEPA determines that the current uses are causing adverse effects for humans or aquatic life, but final decisions are not expected from USEPA until 2016-2018.

Central Valley Water Board staff, along with staff from other California Regional Water Quality Control Boards, certain municipalities, such as the city of Roseville, and the California Stormwater Quality Association has frequently provided comments to USEPA to help ensure that water quality concerns are addressed in the pyrethroid registration reviews. Continued engagement in USEPA registration reviews is a key element in the proposed implementation program, as discussed in Section 7 of this report.

2.4.6 USEPA Environmental Hazard and General Labeling for Pyrethroid Non-agricultural Outdoor Products

USEPA revised the “Environmental Hazard Statements” and general “Directions for Use” for pyrethroid products used in non-agricultural outdoor settings to reduce ecological exposures from residential uses. The label changes are directed at professional applicators and include direction to apply the pesticide in a manner that will not allow for runoff into surface waters. These label changes were required to be adopted on product labels by June 4, 2010.

2.4.7 USEPA Pyrethroids Spray Drift Initiative

In 2008, USEPA requested that registrants of agricultural pyrethroid products submit amended labels incorporating revised spray drift language. The revised language requires that there must be buffer zones between application areas and aquatic habitats, and specifies spray drift requirements (wind speed and direction, temperature inversion, droplet size, etc.) that will minimize drift.

2.4.8 Lawsuits Regarding Pesticides and Endangered Species

In response to lawsuits in recent years, courts have ruled that USEPA, in registering certain pesticides, failed to meet Endangered Species Act (ESA) requirements to consult with the US Fish and Wildlife Service (FWS) and/or National Marine Fisheries Service (NMFS) regarding potential impacts of certain pesticides to endangered species. These court decisions have resulted in new restrictions on use of certain pesticides, including several pyrethroids.

In response to these rulings, USEPA has been required to make “effects determinations” for the potential effects of each pesticide on each endangered species involved. The effects determinations state whether ESA consultation will be necessary. If ESA consultation is determined to be necessary in an effects determination, then USEPA initiates consultation with either FWS or NMFS, depending on the species affected. FWS or NMFS then issues a biological opinion, stating potential effects and prescribing measures for mitigating or preventing these effects. In response to the biological opinions, USEPA then modifies the pesticide labels to add measures to protect endangered species. These rulings have also resulted in injunctions on pesticide uses on or near endangered species habitat in the interim between the issuance of the ruling and the development of any needed label changes.

Once the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) label changes are finalized by USEPA, compliance with the new labels will be enforced through DPR and the agricultural commissioners through existing regulatory programs.

2.4.8.1 Red-Legged Frog

The Center for Biological Diversity filed suit against USEPA over lack of ESA consultation on the impacts of certain pesticides, including two pyrethroids (esfenvalerate and permethrin), on the California red-legged frog. The court issued a ruling in 2006 requiring USEPA to make effects determinations, resulting in ESA consultation when required, and potential label changes. An injunction was also put in place restricting use prior to the completion of any needed ESA consultation. The court’s injunction required buffer areas around certain habitats of the California red-legged frog, and disallowed use of certain pesticides, including esfenvalerate and

permethrin, within those habitats and buffer zones. Some of these habitat areas are in a small fraction of the area under consideration for this proposed amendment.

2.4.8.2 Lawsuit and Injunction Involving 74 Pesticides and 11 Threatened or Endangered Species in the San Francisco Bay Area

In 2007, the Center for Biological Diversity filed a lawsuit challenging the failure of USEPA to consult with FWS pursuant to the ESA regarding the effects of USEPA-registered pesticides on eleven species within the counties in the San Francisco Bay Area, which includes part of the Sacramento-San Joaquin Delta. Fifteen pyrethroids were listed among the 74 pesticides involved in the lawsuit: beta-cyfluthrin, bifenthrin, cyfluthrin, cyhalothrin (lambda), cypermethrin, deltamethrin, esfenvalerate, fenpropathrin, fluvalinate (tau), permethrin, phenothrin, resmethrin, tetramethrin, tralomethrin, and zeta-cypermethrin (S-cypermethrin). The 11 species include aquatic organisms such as delta smelt. As a result of that lawsuit, USEPA has agreed to consult with FWS regarding these potential impacts, which could result in additional pesticide use restrictions of these pesticides. Until a consultation process has been completed, an injunction is in place against use of the subject pesticides in occupied or designated critical habitat for the 11 species. Solano and Contra Costa Counties are affected by these developments and portions of them are within the area under consideration for this proposed Basin Plan amendment.

3 REGULATORY APPROACH AND APPLICABLE WATERS

There are thousands of water bodies within the Project Area, but only a small portion of these water bodies are currently 303(d)-listed for pyrethroids. Although many water bodies are not listed, this may be due to the fact that monitoring data for pyrethroids are only available for a small fraction of the water bodies in the Project Area and commonly used analytical techniques had detection limits higher than levels of concern. Due to the widespread use of these pesticides, many water bodies that are not currently monitored and/or 303(d)-listed likely receive pyrethroids discharges.

Due to the very low pyrethroid concentrations being considered, concern as to the feasibility of being able reduce loading sufficiently to meet pyrethroid concentration goals, and the corresponding potential regulatory implications, staff and stakeholders have spent significant time identifying and evaluating potential regulatory alternatives.

One primary concern is the feasibility of meeting concentration goals in urban environments since storm water and municipal wastewater dischargers do not have control over the use of pesticides by individuals in their service areas. In these areas, the primary means of source control is through the implementation of the authorities of agencies that regulate pesticide use: the California Department of Pesticide Regulation (DPR); County Agricultural Commissioners; and USEPA's Office of Pesticide Programs (OPP). The approach most likely to succeed in attaining adequate pyrethroid reductions would include a combination of dischargers implementing reasonable best management practices and the Board and/or dischargers coordinating with DPR and USEPA OPP to improve source control by addressing pesticide uses and products with high potential to impact surface water.

Considerable pro-active engagement by the Board and discharger community with DPR and USEPA OPP has occurred and is ongoing to address pyrethroid water quality concerns. There are multiple ongoing DPR and USEPA OPP pesticide use regulatory activities that are expected to reduce pyrethroid discharges. Most notably, in 2012 DPR adopted surface water protection regulations on non-agricultural professional pyrethroid applications. USEPA OPP currently has all the pyrethroids of concern in registration review, during which USEPA will determine whether these pyrethroid pesticides are expected to have unreasonable adverse effects, and if so take steps to mitigate those effects. DPR is following up on wastewater concerns, including conducting a study to characterize pesticide sources contributing to wastewater treatment plant influent.

3.1 Goals and Objectives

The overall goal for the proposed amendment is to establish clear requirements for the control of pyrethroid pesticide discharges that provide reasonable protection of beneficial uses in the Sacramento and San Joaquin River Watersheds, including the Delta. The proposed amendment is also designed to move toward water quality improvement as current uncertainty in analytical capabilities, bioavailability, and economic impacts are addressed. Project objectives include:

<u>Primary Objectives</u>

1. Establishing measurable pyrethroid concentration goals that provide reasonable protection of beneficial uses.
2. Addressing existing impairments from pyrethroid pesticides through total maximum daily loads (TMDLs) or other means.
3. Developing reasonable and attainable implementation provisions to achieve the pyrethroid concentration goals.

<u>Additional Objectives</u>

4. Efficient process to address future impairments.
5. Provisions for addressing alternative/replacement pesticides.
6. A phased program that:
    a. Includes monitoring and data gathering to resolve uncertainties and inform the Board's future actions;
    b. Avoids unintended regulatory consequences, and
    c. Significantly improves water quality while uncertainties are being addressed.

The 2014 Delta Strategic Plan highlighted the need for a control program to address both sediment and water column pyrethroid concentrations. Since there is currently not adequate sediment species toxicity data or an established method for deriving sediment criteria, the proposed Basin Plan amendment has focused on setting and achieving water column targets, however, proposed targets for TMDLs do identify no statistically significant toxicity to *Hyalella azteca* in benthic sediments.

3.2 Overall Regulatory Approach

While the overall regulatory approach may vary, there are several elements that would likely be proposed under any approach. The first element is numeric water quality targets to measure reasonable protection of aquatic life and progress toward meeting program goals. The second element is TMDLs or an equivalent for impaired water bodies specified in current listings that will fulfill 303(d) requirements. The last element is implementation provisions. The implementation provisions include a reasonable time for attainment, management practices to reduce pyrethroids for municipal storm water,

irrigated lands and wastewater dischargers, recommendations for DPR and USEPA Office of Pesticide Programs, follow-up actions for Central Valley Water Board to conduct with DPR & USEPA Office of Pesticide Programs to coordinate on use regulations and registration changes to protect water quality, measures to fill data gaps, monitoring, and a commitment for the Board to re-visit the targets or objectives before the final compliance date for meeting the objectives, targets, and/or allocations.

3.2.1 Potential Alternative Regulatory Approaches

3.2.1.1 Water Quality Objectives & TMDLs for listed urban streams & 4b for listed agricultural streams

Under this alternative, water quality objectives would be adopted for all water bodies with aquatic life uses within the Sacramento and San Joaquin River Basins. TMDLs would be adopted for urban streams currently 303(d)-listed as impaired. Agricultural streams with impairments would be listed as being addressed by existing regulatory requirements (Integrated Report category 4b) based on implementation through the Irrigated Lands Regulatory Program.

Preliminary draft Basin Plan amendment language based on this approach was circulated and discussed with stakeholders. This approach is similar to previous diazinon and chlorpyrifos Basin Plan amendments; however, the need for more significant reductions and presence of significant urban storm water and WWTP sources raises feasibility concerns for compliance. Once water quality objectives for pyrethroids are in place, federal regulations governing the NPDES program would likely require that permits for municipal and domestic wastewater contain numeric effluent limits for pyrethroids, and WWTP dischargers could be subject to mandatory minimum penalties for exceeding these effluent limits under State requirements. There are no known conventional technologies that will consistently achieve the potential pyrethroid concentration goals and POTWs and MS4s cannot control the use of pesticides in their service areas. Due to these factors, the feasibility of compliance with water quality objectives is unknown.

3.2.1.2 Numeric triggers, TMDLs for listed urban streams, and 4b for listed agricultural streams

This alternative is similar to the first alternative (section 3.2.1.1), except that instead of adopting water quality objectives, numeric triggers would apply to all water bodies with aquatic life uses within the Sacramento and San Joaquin River Basins. Numeric triggers may avoid any unintended regulatory consequences that may arise from adopting water quality objectives, particularly for POTWs.

TMDLs would be adopted for urban streams currently 303(d)-listed as impaired. Agricultural streams with impairments would be listed as being addressed by existing regulatory requirements (Integrated Report category 4b) based on implementation through the Irrigated Lands Regulatory Program.

3.2.1.3 Water quality objectives – adjusted for economic feasibility

Under this alternative, protective scientific criteria may be adjusted based on consideration of 13241 factors that include achievability and economic impacts to develop water quality objectives. Current performance data, management practices feasibility and effectiveness, and costs of practices would be considered to determine objectives that are reasonably protective of beneficial uses. One concern is that limited data exists on current performance and management practice effectiveness and there is insufficient information available to adjust water quality criteria based on economic feasibility at this time.

3.2.1.4 Basin-wide TMDL

This approach would set clear allocations for all discharges, including those to non-impaired waters, and allow compliance schedules of greater than ten years under the compliance schedule policy. This alternative would result in all agricultural, municipal storm water and municipal and domestic wastewater dischargers in the basin being subject to TMDL allocations. This requirement could have significant regulatory implications in terms of the monitoring and permitting requirements for all the dischargers subject to TMDL allocations.

3.2.1.5 Reduced geographic scope – TMDLs and 4b determinations for listed water bodies only. No basin-wide control program

This alternative would scale back the geographic scope for the establishment of water quality goals in this amendment. The geographic scope for which targets are being established could be scaled back to just the 303(d)-listed impaired waters, which are nine urban segments in the Sacramento/Roseville area and five agricultural streams in the San Joaquin Valley. The amendment could contain some implementation and monitoring for non-impaired water bodies to meet some project goals and fill data gaps, but future impairments would continue to be addressed individually through future Basin Plan amendments.

3.2.1.6 Conditional Prohibition

The Basin Plan amendment could include a conditional discharge prohibition, either as an alternative or as a complement to a water quality objective-focused approach. A conditional prohibition would likely (but not necessarily) be framed in terms of management actions known or anticipated to reduce pyrethroid loads rather than on specific water quality targets to be met. Thus, this approach could require certain

management practices/measures to be implemented but avoid compliance issues associated with toxicity-based effluent limits. Prohibitions are not a “water quality standard” under the Clean Water Act, and therefore would not trigger the requirement to include a numeric effluent limit in NPDES permits. If the Board included monitoring requirements with a conditional prohibition, it could gather data regarding the performance and feasibility of management practices, which may inform any future Basin Plan amendment and/or development of numeric objectives. The Board’s rice program provides an example of a successful conditional prohibition-based program.

While a conditional prohibition would result in management practice implementation and movement toward improved water quality, a conditional prohibition by itself might not meet requirements for addressing TMDL development requirements for impaired waters on the 303(d) list, which require a specific numeric target. However, a conditional prohibition could be combined with other regulatory approaches to meet these goals.

3.2.1.7 Phased Adoption of Targets or Objectives

The Board could consider the feasibility of adopting numeric targets or water quality objectives in a phased manner in combination with performance goals and triggers. This option would allow management based controls to be implemented while additional studies were conducted on economic feasibility. The option would include a reopener clause with a potential to adjust the numeric limits based on study results.

3.2.1.8 Combination of TMDLs and 4b determinations for impaired water bodies and a conditional prohibition

The Board could adopt TMDLs and other specific regulatory requirements for the water bodies currently listed as impaired in combination with a conditional prohibition, which could be applicable basin-wide. This alternative could contain implementation requirements via a conditional prohibition and monitoring for non-impaired water bodies to meet other project goals and fill data gaps to help the development and implementation of future control efforts. This alternative shares the advantages and disadvantages of the reduced geographic scope (section 3.2.1.5); however the inclusion of a conditional prohibition provides a tool to require broad implementation of management practices to control pyrethroids throughout the basin.

3.2.1.9 Combination of TMDLs and 4b determinations for impaired water bodies with a conditional prohibition and phased adoption of numeric limits

The Board could adopt TMDLs and other specific regulatory requirements for the water bodies currently listed as impaired in combination with a conditional prohibition that could be applicable basin-wide and phased adoption of numeric targets or triggers. This alternative may attain the goal of establishing clear concentration targets or triggers,

while supporting implementation of management practices to control pyrethroids and further investigations on economic feasibility of required load reductions.

Table 2: Summary of Potential Regulatory Approaches

Regulatory Approach[2]	Project Objectives Met[3]	Advantages[4]	Disadvantages
1. Water Quality Objectives & TMDLS for listed urban streams & 4b for listed for ag streams	☒1 ☒2 ☒3 (possibly not reasonable for WWTPs) ☒4 ☒5	Meets all objectives. Consistent with recent other pesticide Basin Plan amendments.	Wastewater treatment plants may be subject to mandatory minimum penalties due to the need to adopt water quality objectives as effluent limits. Compliance for ag and storm water will be through management practice implementation but data on effectiveness of management practices is limited.
2. Numeric Triggers & TMDLS for listed urban streams & 4b listed for ag streams	☒1 ☒2 ☒3 (possibly not reasonable for WWTPs) ☒4 ☒5	Meets all objectives – reduced potential for compliance issues relative to #1	Numeric interpretation of narrative objective may require incorporation as effluent limit potentially resulting in mandatory minimum penalties. Limited data on effectiveness of management practices for ag and storm water.

[2] These are not necessarily mutually exclusive

[3] Project objectives:

1. Establishing measurable limits on pyrethroid concentrations that provide reasonable protection of beneficial uses.
2. Addressing existing impairments from pyrethroid pesticides through TMDLs or other means.
3. Reasonable and attainable implementation provisions to achieve the target pyrethroid concentrations.
4. Efficient process to address future impairments
5. Provisions for addressing alternative pesticides

[4] Relative advantages and disadvantages to other options

Regulatory Approach[2]	**Project Objectives Met**[3]	**Advantages**[4]	**Disadvantages**
3. Water quality objectives – adjusted for economic feasibility of attainment	☒1 ☒2 ☒3 ☒4 ☒5	Avoids compliance issues and potentially detection limit issues. Should eliminate the need for a nonstandard WWTP approach	Data lacking to make robust feasibility calculations at this time.
4. Basin-Wide TMDL	☒1 ☒2 ☒3 ☒4 ☒5	Establishes allocations for all dischargers. Allows compliance schedules beyond 10 years.	All dischargers (including those to un-impaired waters) would have TMDL allocations & related monitoring requirements. Potential complexities with establishing agricultural allocations.
5. Reduced geographic scope – TMDLs and 4b determinations for listed water bodies only. No basin-wide WQOs	☐1 ☒2 ☒3 (partially) ☐4 ☒5	Avoids WWTP compliance issues since no WWTP receiving waters would have water quality objectives or triggers set. Allows for more informed decision in the future with regard to water bodies with WWTP discharges. Addresses requirements for currently listed water bodies.	Lack of certainty of targets or implementation requirements for waters not addressed. Would not address future listings. Would not address attainability issues of achieving the targets objectives.
6. Conditional Prohibition	☒1 ☒2 ☒3 ☒4 partially ☒5	Avoids feasibility issues, provides more flexibility. Allows the Board to craft discharge requirements and treat dischargers differently in terms of prohibition conditions. Allows a BMP-based approach to controlling pyrethroid pesticides for all dischargers.	May be difficult to coordinate with needs of a TMDL (which requires a specific numeric target) unless tied to specific discharge concentration(s).

Regulatory Approach[2]	**Project Objectives Met**[3]	**Advantages**[4]	**Disadvantages**
7. Phased adoption of numeric targets or objectives	☒1 delayed ☒2 ☒3 ☒4 ☒5	Establishes a clear end goal and focuses on management practice implementation while studies conducted on economic feasibility. Numeric limits may be adjusted based on new data prior to effective date. Could be used in conjunction with TMDLs and/or a conditional prohibition.	Numeric limit would rely on current assumptions/analysis. Phased numeric limit has potential conflict with 10-year limit in compliance time schedule. May require future Board actions.
8. (Combination of 5 and 6) – TMDLs and 4b determinations for impaired water bodies and a conditional prohibition	☒1 depending on prohibition d ☒2 ☒3 ☒4 partially ☒5	Avoids feasibility issues, provides more flexibility since no WWTP receiving waters would have water quality objectives or triggers set. Allows a BMP-based approach to controlling pyrethroid pesticides for all dischargers. Associated monitoring of BMP performance and cost may help close current data gaps and better inform future WQO.	If the prohibition is not tied to specific numeric limits, future listings may require separate TMDLs or other control methods.
9. (Combination of 5,6 & 7) TMDLs and 4b determinations for impaired water bodies with a conditional prohibition and phased adoption of numeric limits	☒1 ☒2 ☒3 ☒4 partially ☒5	Satisfies requirements for current listings. Establishes clear numeric limits and focuses on management practice implementation while studies conducted on economic feasibility for all water bodies including potential future listings. Numeric limits may be adjusted based on new data prior to effective date.	Numeric limit would rely on current assumptions/analysis. Phased numeric limit has potential conflict with 10-year limit in compliance time schedule. May require future Board actions.

3.2.2 **Proposed Regulatory Approach**

The proposed regulatory approach is alternative 8, a basin-wide conditional prohibition with TMDLs and 4b determinations for impaired water bodies. As discussed in section 5.6, currently the Board does not have adequate information to fully analyze Water Code section 13241 factors as required to develop new water quality objectives, in terms of attainability and costs. Nevertheless, the available data do indicate that pyrethroids are a significant risk to aquatic life, in both the waters currently listed as impaired and potentially in many other water bodies throughout the Basin. Therefore, staff is proposing an alternative that would be a phased approach requiring the implementation of reasonable management practices to move toward improved water quality, coordination with pesticide regulators for more effective source control, and data gathering to inform the Board on possible future actions.

This approach was presented to the board as a “strawman” regulatory approach in August 2016 and preliminary draft proposed amendment language based on this approach was distributed and discussed with stakeholders in August 2016.

3.3 Applicable Waters

This section evaluates different water bodies to which the Central Valley Water Board could apply the proposed control program for pyrethroids. The alternatives considered include:

1) All water bodies in the Sacramento River and San Joaquin River Basins;
2) All water bodies in the Sacramento River and San Joaquin River Basins with the warmwater or coldwater aquatic life habitat beneficial uses (WARM/COLD);

The following selection criteria were utilized to evaluate the alternatives:

- Appropriate protection of aquatic life and other beneficial uses
- Efficiently address current impairments and potential future impacts
    - Provide a clear and consistent numeric goal for pyrethroids
    - Encourage dischargers to prevent future impairments
    - Provide a regulatory framework if future impairments are identified
- Allow for potential future changes to beneficial uses.

3.3.1 **Alternative 1: All Water Bodies in the Sacramento and San Joaquin River Basins**

Under this alternative, the proposed control program for pyrethroids would apply to discharges to all surface waters in the Sacramento River and San Joaquin River basins that qualify as “waters of the state,” regardless of beneficial use or other considerations.

This alternative may result in applying pyrethroid concentration goals that are based on protection of aquatic life beneficial uses to waters to which those beneficial uses do not apply. This alternative would provide consistent pyrethroid concentration goals to all water bodies, so there would be no question as to whether or not the concentration goals apply in a given water body. Having pyrethroid concentration goals that apply in all waters would give dischargers a numeric goal for preventing future impairments and makes it clear that the regulatory framework applies to all waters in which the concentration goals are not achieved. The Board currently has several Basin Planning projects in development that may alter the beneficial use designations in some water bodies, and this alternative would not allow flexibility for the applicability of the pyrethroid concentration goals to change if beneficial uses are changed or altered in a water body. An additional Basin Plan amendment would be required to change the applicability of the pyrethroids control program if changes in water body applicability were desired in the future. In addition, this alternative would require the most extensive implementation, since the control program would apply to discharges to minor constructed conveyances and drains, which can be closer to sources and have less dilution. Thus, costs and potential impacts from alternative products would be the greatest under this alternative.

3.3.2 Alternative 2: Sacramento River and San Joaquin River Basin Water Bodies with a WARM and/or COLD Beneficial Use

Under alternative 2, the proposed control program would only apply to a subset of Sacramento River and San Joaquin River basin water bodies based on the most sensitive beneficial use of aquatic life habitat. The warm freshwater habitat (WARM) and cold freshwater habitat (COLD) beneficial uses apply to almost all water bodies named in Table II-1 of the Basin Plan, as well as their tributary streams.

This alternative would avoid the application of pyrethroid concentration goals that are based on protection of aquatic life beneficial uses to waters to which those beneficial uses do not apply. This alternative would still provide consistent pyrethroid concentration goals to many water bodies, because the WARM and COLD beneficial uses apply widely in the Basin. Like alternative 1, this alternative would still provide dischargers with a numeric goal for preventing future impairments and makes it clear that the regulatory framework applies to all waters in which the WARM and/or COLD beneficial uses apply. This alternative is would not require any changes if the Board adopts any changes to beneficial uses in the future, some of which are currently under development, since the applicability is linked to beneficial uses. This alternative would leave more flexibility for smaller constructed water bodies that may not have WARM or COLD beneficial uses. Thus the proposed pyrethroids control program would not apply to discharges to water bodies that do not have designated or existing WARM or COLD beneficial uses. This option could also lead to uncertainty for some water bodies because the proposed amendment does not attempt to determine exactly which water

bodies do have the WARM or COLD beneficial uses, and leaves that determination to future regulations or case-by-case determinations.

Under this alternative, covering most water bodies would be beneficial in terms of providing a clear, established goal for determining water quality standards attainment, and would enable the Central Valley Water Board to more readily respond to detections of pyrethroids. This alternative would be somewhat less expensive for dischargers compared to alternative 1 because the control program would not apply to discharges to water bodies without WARM or COLD beneficial uses.

3.3.3 Proposed Water Bodies Alternative

Alternative 2 is the proposed alternative. This alternative will provide broad coverage in terms of having a clearly established pyrethroids control program for water bodies throughout the Sacramento River and San Joaquin River basins, and will include provisions to control pyrethroid discharges to hundreds of water bodies that could potentially be 303(d)-listed for pyrethroids in the future. This alternative provides a clear regulatory framework for the protection of water quality from pyrethroids in aquatic ecosystems, and will allow the Central Valley Water Board to address potential future impairments more efficiently. Establishing a pyrethroids control program for multiple water bodies, both 303(d)-listed and not, will provide a clear numeric goal for control of discharges of these pesticides. This should help to prevent water quality impairments and allow for future impairments to be promptly addressed.

In addition, this alternative would leave the Board flexibility in terms of appropriate beneficial use designations and water quality objectives in constructed water bodies. The Central Valley Water Board has initiated a process for evaluation of beneficial use designations for agriculturally dominated water bodies (CRWQCB-CVR 2012); the proposed alternative would allow that process to determine which water bodies are considered constructed and which beneficial uses apply to them. If this process determines that there are water bodies in which the WARM/COLD beneficial uses do not apply, then the pyrethroids control program would not apply to discharges to those water bodies.

4 BENEFICIAL USES

No changes to the beneficial use designations are recommended for the pyrethroid pesticides Basin Plan amendment. 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 beneficial uses and designates one or more of these beneficial uses for specific water bodies in the Sacramento River and San Joaquin River basins. The Basin Plan also states that “the beneficial uses of any specifically identified water body generally apply to its tributary streams” and that “[for] unidentified water bodies, the beneficial uses will be evaluated on a case-by-case basis.” Section 303(c) of the Clean Water Act also discusses beneficial uses. This section 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, water quality criteria designed to protect those uses, and antidegradation policies to maintain and protect water quality.

Existing designated beneficial uses were evaluated in the development of TMDLs and Basin Plan amendments addressing diazinon and chlorpyrifos in the Sacramento and Feather Rivers (Hann et al. 2007), the Sacramento-San Joaquin Delta Waterways (McClure et al. 2006), the Lower San Joaquin River (Beaulaurier et al. 2005), and Sacramento County Urban Creeks (Spector et al. 2004) and found to be appropriate in regards to the regulation of pesticide discharges. Beneficial uses for these water bodies include warm and cold freshwater habitat (WARM and COLD, respectively), and some or all of the following: domestic supply (MUN); agricultural irrigation and stock watering (AGR); industry service supply (IND); hydropower generation (PWR); contact recreation (REC-1); non-contact recreation (REC-2); warm and cold migration and spawning (MIGR and SPWN, respectively); wildlife habitat (WILD); and navigation (NAV) (see Table II-I in the Basin Plan).

This Basin Plan amendment proposes to establish specific provisions for pyrethroid pesticides in all water bodies in the Sacramento River and San Joaquin River basins that have designated or existing WARM and/or COLD beneficial uses. This proposal does not seek to designate or de-designate beneficial uses in any water bodies, but instead relies on designations in the Basin Plan and the Basin Plan’s tributary statement described above to determine where the provisions are applicable. Nearly all natural streams in the Sacramento River and San Joaquin River basins either have WARM and/or COLD beneficial uses, or are tributary to water bodies with WARM and/or COLD beneficial uses. Thus these beneficial uses generally apply to natural streams throughout the entire basin. The WARM/COLD beneficial uses are the most sensitive to pyrethroids and provide an appropriate basis for establishment of Basin Plan provisions.

Therefore pyrethroids Basin Plan provisions that would protect the WARM/COLD beneficial uses should be protective of all other beneficial uses.

Warm and cold migration and spawning (MIGR and SPWN) also have the potential to be sensitive beneficial uses, but less information is available about the effects of pyrethroids on these beneficial uses. However, all waters where MIGR and SPWN are designated also have WARM and COLD beneficial uses designated, so all waters with MIGR and SPWN beneficial uses will be subject to the pyrethroid pesticides provisions under the proposed Basin Plan amendment.

Existing information confirms the widespread existence of the warm water and/or cold water freshwater habitat beneficial uses for the Sacramento River and San Joaquin River basin water bodies, and indicates that these uses are the most sensitive to pyrethroids based on available information. Therefore, additional designations are not necessary at this time, and the beneficial uses currently designated in the Basin Plan support the establishment of appropriate provisions for pyrethroids.

Board staff does not recommend any changes to the beneficial use designations. Existing information indicates that the WARM/COLD beneficial use(s) are the most sensitive to pyrethroid pesticides; therefore, modifications to beneficial use designation(s) are not necessary to support the proposed amendment. Board staff also notes that the proposed amendment would not preclude the Board from developing subcategories for the WARM/COLD beneficial uses (e.g., “LIMITED WARM” or “LIMITED COLD” beneficial use subcategories) at a later date. During the development of such subcategories, the Board could evaluate whether the proposed pyrethroid provisions should also apply to those beneficial use subcategories.

5 PYRETHROID CONCENTRATION GOALS

According to section 303(c) of the Clean Water Act, individual states are responsible for reviewing, establishing, and revising water quality standards. Those water quality standards are then submitted to USEPA for approval. Federal standards are a combination of beneficial uses and the criteria to protect those uses. In California, the State Water Resources Control Board (State Water Board) and the Regional Water Quality Control Boards are responsible for developing water quality standards. Upon approval by the Central Valley Water Board, State Water Board, State Office of Administrative Law, and USEPA, water quality standards are incorporated into the appropriate Basin Plan.

Water quality criteria must protect designated beneficial uses and if a water body has multiple beneficial uses, it must protect the most sensitive use. (40 C.F.R. §131.11(a)). Based on our current body of knowledge, aquatic life habitat uses (WARM and/or COLD) is the beneficial use that is most sensitive to pyrethroids. The definition of freshwater habitat beneficial uses contained in the Basin Plan (page II-2.00) is: “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.”

If water quality objectives were to be adopted by the Central Valley Water Board, they must ensure reasonable protection of the beneficial uses designated for the applicable water bodies, and be consistent with state and federal regulations. Section 13241 of Porter-Cologne states that the Regional Board shall consider the following factors in establishing water quality objectives: 1) past, present, and probable future beneficial uses of water, 2) environmental characteristics of hydrographic unit, including quality of water available to it, 3) water quality conditions reasonably achievable through coordinated control of all factors that affect water quality in the area, 4) economic considerations, 5) the need for developing housing within the region, and 6) the need to develop and use recycled water. After considering these and possibly other factors, the Regional Board may adjust appropriate water quality criteria for use as water quality objectives.

5.1 Pesticides Water Quality Objectives Currently in the Basin Plan

Water quality objectives can be either numeric or narrative. The Basin Plan currently does not include specific numeric water quality objectives for pyrethroids, but contains the following narrative water quality objectives that are applicable to pyrethroid pesticides (page III-6.00):

> "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 also contains a narrative water quality objective for toxicity that applies to toxicity caused by pesticides, specifying the following (pages III-8.01-9.00):

> "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 Regional Water Board.
>
> The Regional Water Board will also consider all material and relevant information submitted by the discharger and other interested parties and numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.S. Food and Drug Administration, the National Academy of Sciences, the U.S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective."

The Implementation chapter of the Basin Plan includes the following policies for evaluating pesticides relative to narrative water quality objectives (page IV-35.00):

> "For most pesticides, numerical water quality objectives have not been adopted. USEPA 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."

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 "antidegradation" 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.

Consistent with the Basin Plan, the Board can utilize criteria to interpret narrative water quality objectives. The Board may also develop numeric water quality objectives based on criteria as long as it considers six factors identified in section 13241 of Porter-Cologne:

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

As described in section 5.6, the Board does not have adequate information to conduct a robust review of 13241 factors at this time in order to establish numeric water quality objectives for pyrethroids. In particular, quantitative data is limited on effectiveness of available controls and cost. However, there is a need to develop goals in order to move toward improvements as more information is developed. Therefore, this section examines values, referred to as "concentration goals" which could be used for the purpose of establishing TMDL numeric targets as well as numeric triggers for discharges that have the potential to cause or contribute to pyrethroid impairments in order to implement activities to reduce pyrethroid concentrations while developing information on effectiveness and cost.

Pyrethroids have been identified as causing impairments in the water column as well as in sediments. These two matrices are separated when evaluating data and they will also be considered separately for examination of possible alternatives for pyrethroid concentration goals. The pyrethroid concentration goal alternatives are described in section 5.3 for aqueous concentrations and section 5.4 for sediment concentrations.

Pyrethroid concentration goals could be proposed for neither, one, or both of the matrices.

5.2 Factors to Consider when Developing Pyrethroid Concentration Goals

Several factors have the ability to affect pyrethroid toxicity. The following factors were considered when developing concentration goals: additive toxicity of pyrethroids, bioavailability, temperature effects, aquatic species sensitivity, and the development of pyrethroid-resistance in aquatic organisms. Two of the factors, additivity and bioavailability, are discussed in detail with staff recommendation for inclusion as part of the pyrethroid concentration goals. The remaining factors are discussed for context, but insufficient quantifiable data is available to include them as part of the pyrethroid concentration goals at this time.

5.2.1 **Additive Toxicity**

Pyrethroids can co-occur in the environment and appear to have approximately additive toxic effects (Trimble et al. 2009, Werner and Moran 2008). All pyrethroids have the same general toxicological mode of action, which is that they bind to and prolong the opening of voltage-dependent ion channels, causing convulsions, paralysis, and death (Brander et al. 2009). There are some variations in the specific symptoms of toxicity among the pyrethroids, particularly between the type I pyrethroids (i.e., those lacking an alpha-cyano group, e.g., permethrin and bifenthrin) and type II pyrethroids (i.e., those with an alpha-cyano group, e.g., cyfluthrin, cypermethrin, esfenvalerate, and lambda-cyhalothrin).

Mixtures of pesticides with the same or similar toxicological mode of action are generally considered to follow the concentration addition model of joint toxicity (Lydy et al. 2004, Olmstead and LeBlanc 2005, PapeLindstrom and Lydy 1997). In the concentration addition model, the concentrations of each pesticide in a given mixture are normalized so that they can be added together (Lydy et al. 2004). Typically the concentrations are normalized to a toxicity reference value, such as an LC_{50} or EC_{50}. The normalized concentrations are added together to result in the total toxicity of the mixture relative to the reference values. The toxic unit approach is the most common way to express the concentration addition model:

Equation 1

$$\sum_{n}^{i=1} \frac{C_i}{ECx_i} = TU$$

where:
C_i = concentration of the ith chemical in the mixture;
EC_{xi} = concentration of the ith chemical that elicits the same response (x) as the full mixture;
TU = toxic unit.

Several studies have demonstrated that the toxicity of pyrethroid mixtures is approximately additive, as predicted by the concentration addition model. Barata et al. (2006) tested mixtures of λ-cyhalothrin and deltamethrin with *Daphnia magna.* Most of the observed effects for survival were within a factor of two of the effects predicted by the concentration addition model. The researchers observed slight antagonism in several of the mixtures and they attributed this to a few unexpected extreme values for joint survival effects. Antagonism means that the combination was less toxic than expected based on the concentration addition model prediction.

Brander et al. (2009) tested mixtures of cyfluthrin and permethrin with *Hyalella azteca* and reported that mortality predicted by the concentration addition model was within a factor of 1.5 or less compared to the toxicity test results. The concentration addition model predicted higher toxicity than was observed, indicating slight antagonism for the binary mixture. When the pyrethroid synergist piperonyl butoxide (PBO) was added, the model predictions were not significantly different from the observed effects. Brander et al. (2009) offered several explanations for the observed antagonism between the two pyrethroids. Permethrin is a type I pyrethroid, and cyfluthrin is a type II pyrethroid, and type II pyrethroids may be able to outcompete type I pyrethroids for binding sites, which is known as competitive agonism; or binding sites may be saturated, so that complete additivity is not observed. They also note that cyfluthrin is metabolized more slowly than permethrin, so cyfluthrin can bind longer. PBO may remove this effect because the rate of metabolism of both pyrethroids is reduced in its presence.

Callinan et al. (2012) tested pyrethroid mixtures with *Hyalella azteca* in aqueous exposures in the following binary combinations: type I-type I (bifenthrin-permethrin), type I-type II (bifenthrin-cyfluthrin, bifenthrin-lambda-cyhalothrin, permethrin-cyfluthrin, and permethrin-lambda-cyhalothrin) and type II-type II (cyfluthrin-lambda-cyhalothrin). These combinations were tested in 4-day exposures, and two of the combinations were also tested in 10-day chronic exposures. Both the concentration addition and the independent action models were fit to the observed toxicity data and the fits were compared with several statistical analyses. One way of comparing the fits indicated that all combinations of pyrethroids were additive following the concentration addition model.

Another way of comparing the results indicated that there was slight antagonism in two of the pyrethroid combinations (bifenthrin-cyfluthrin and permethrin-cyfluthrin), but only in the 4-day tests, not in the 10-day tests.

Trimble et al. (2009) performed sediment toxicity tests with *Hyalella azteca* in three binary combinations: type I-type I (permethrin-bifenthrin), type II-type II (cypermethrin-λ-cyhalothrin), and type I-type II (bifenthrin-cypermethrin) in order to test differences in pyrethroid mixture toxicity based on pyrethroid type. The toxicity of these combinations was predicted with the concentration addition model, with model deviations within a factor of two. Trimble et al. also fit the mixture toxicity results to the independent action model, which does not assume that the pesticides have the same toxicological mode of action, and this model actually fit the observed toxicity data better than the concentration addition model in two of three cases – for the type I-type I combination and the type II-type II combination. The type I-type II combination was better fit by the concentration addition model even though the modes of action are expected to be the least similar in this case. While the best model to fit joint toxicity of pyrethroids varies by study and by pyrethroid combination, Trimble et al. (2009) concluded that the data in this study indicate that pyrethroid mixture toxicity is likely additive and that the deviations from the concentration addition model reasonably encompass expected intra- and interlaboratory variability.

In all of the studies on pyrethroid mixtures, the mixtures were more toxic than a single pyrethroid tested alone. Several tests indicated some antagonism in pyrethroid mixtures, meaning that the combination was less toxic than expected based on the concentration addition model prediction. However, even in the cases of slight antagonism, the mixture toxicity results fit the concentration addition model within a factor of 2 or less.

The six pyrethroids under consideration for this proposed amendment are either Type I or Type II pyrethroids. The Type I and Type II pyrethroids have the same general mechanism of toxic action, and have been shown to exhibit additive toxicity to aquatic invertebrates when they co-occur (Barata et al. 2006; Brander et al. 2009; Trimble et al. 2009). 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 pyrethroids needs to be assessed, even when the individual concentrations would otherwise be below thresholds of concern.

The Basin Plan (p. IV-18.00) provides an additivity formula for toxic substances that applies to pyrethroids because it has been determined that they exhibit additive toxicity. The additivity formula in the Basin Plan is as follows:

Equation 2

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

In this equation, the toxicologic limit would be equal to a pyrethroid concentration goal. Additive toxicity of pyrethroids can be addressed by using the above additivity formula when evaluating attainment of applicable water quality objectives. Addressing additive toxicity will ensure that the cumulative toxic potential of these pesticides is addressed.

Additivity was investigated with recent monitoring data to examine how many samples had multiple pyrethroids detected. The percentage of samples with multiple pyrethroids detected varies significantly by water body type. The incidence of multiple detections in a sample was very low for agricultural water bodies (0.4%), whereas wastewater treatment plant effluents and urban water bodies had higher incidences of multiple pyrethroids per sample (75% and 20%, respectively). It should be noted that the sample size for agricultural water bodies is much larger than for all other water body categories and this may influence the data. However, in agricultural areas it is more likely that only one or two particular products are being used at a given time based on cropping patterns in watersheds, whereas in urban areas, the range of products used at any given time may be much larger. These differing use patterns in urban and agricultural areas may account for the higher likelihood of detecting multiple pyrethroids in a sample in urban water bodies and WWTP effluents.

Combinations of pyrethroids and other chemicals likely to be present in Central Valley waters may have additive, synergistic, or antagonistic effects on toxicity to aquatic organisms. Interactions between pyrethroids and various pesticides and other chemicals were reviewed by Fojut et al. (2012), and the authors concluded that there is currently not sufficient data to quantify any of these interactions. Other chemicals identified as having additive or synergistic toxicity with pyrethroids in some circumstances include metals (cadmium), fungicides, and various insecticides (a carbamate, organophosphates and a benzamide) (Fojut et al. 2012). Fojut et al. (2012) did note that the lack of sufficient data to quantify the mixture effects of pyrethroids and piperonyl butoxide (PBO), a known synergist, was a significant data gap. PBO is often in pesticide formulations with pyrethrins, which are the naturally occurring pesticides from which the synthetic pyrethroids were developed. However, due to the lack of data to quantify impacts, quantitative limits to account for these interactions are not recommended for inclusion in the Basin Plan at this time.

5.2.2 **Bioavailability**

Pyrethroid pesticides are hydrophobic organic chemicals, meaning that they have a higher tendency to bind to solids or dissolved organic matter (DOM) than to be

dissolved in water. Although pyrethroids are primarily bound to solids and DOM in aquatic environments, toxicity does occur. Pyrethroids have been identified as the cause of toxicity in surface waters and sediment in the Central Valley (Phillips et al. 2007, 2014a; Weston et al. 2009; Weston and Lydy 2010). The fraction of a chemical that an organism is exposed to via intake of the chemical in water, ingestion of the chemical bound to food sources, or direct uptake through membranes is referred to as the bioavailable fraction of the chemical (You et al. 2011). In typical aquatic environments, some fraction of pyrethroid pesticides is bioavailable to the organism, and the remaining fraction is bound to solids and the organism does not interact with and is not exposed to the bound fraction. Over time, pyrethroids may be released from the bound state and become bioavailable to aquatic organisms depending on environmental conditions and the half-life of the specific constituent (You et al. 2011).

Many researchers have investigated the bioavailability of pyrethroid pesticides and what factors influence bioavailability. These studies have demonstrated that uptake and toxicity of pyrethroids are reduced when sediment, DOM or other natural sorbents are present (Day 1991, DeLorenzo et al. 2006, Lajmanovich et al. 2003, Muir et al. 1985, 1994, Smith and Lizotte 2007, Xu et al. 2007, Yang et al. 2006a, b, c, 2007). In aquatic environments, the amount of suspended solids and other factors that may affect bioavailability may vary greatly by season or when storm or irrigation events occur, and the bioavailability of pyrethroids will also vary with those changes. For benthic organisms, the bioavailability of pyrethroid residues in bed sediments is dependent on the physicochemical properties of the sediment (e.g., organic carbon content, grain size), as well as organism behavior.

The bioavailable fraction of a chemical is the true amount that an organism is exposed to, and for that reason, it would be ideal to use the bioavailable concentration to determine whether the pyrethroid concentration goals are achieved. The only way to truly measure the bioavailable concentration of a chemical is to measure the amount taken up by an organism in its tissue (tissue residue analysis). Typical analytical chemistry techniques do not distinguish between the bioavailable fraction and the total pyrethroid concentration occurring in either a water or sediment sample. However, there are several ways to estimate the bioavailable fraction in water and sediment samples.

Many researchers have demonstrated that the freely dissolved concentration of pyrethroids correlates well with bioavailability to aquatic organisms (Bondarenko et al. 2007, Bondarenko and Gan 2009, Hunter et al. 2008, Xu et al. 2007, Yang et al. 2006a, 2006b, 2007). The freely dissolved concentration of a chemical is that which is not bound to DOC, nor bound to suspended particles, but is truly dissolved in the aqueous phase. The bioavailable concentration is not directly equivalent to the freely dissolved concentration, because the freely dissolved concentration neglects exposure via ingestion of chemicals bound to food sources, or absorption directly through exterior

membranes. However, many studies have demonstrated that the freely dissolved concentration is highly correlated with the bioavailable fraction and is a good predictor of bioavailability. The freely dissolved concentration is typically 1-30% of the whole water concentration (see section 5.6.3), indicating that using whole water concentrations may significantly overestimate the toxicity of water samples.

A strong correlation between freely dissolved aqueous concentrations and toxicity has been demonstrated in the literature and there are practical ways to measure or estimate the freely dissolved concentration. Using freely dissolved concentrations may require further development for analytical methods with appropriate quality control and quality assurances or the collection of additional data (e.g., dissolved and particulate organic carbon). Approaches for estimating or measuring the freely dissolved concentration in aqueous samples are discussed further in sections 5.2.2.1 and 5.2.2.2.

To account for bioavailability in sediment samples, contaminant concentrations are often normalized to the organic carbon content of sediments and this is the approach the Water Boards have taken for interpreting sediment chemistry data for pyrethroids (SWRCB 2010, 2015). Other approaches could include using dry weight sediment concentrations, normalizing to the fraction of fine particles, or measuring the freely dissolved concentration in interstitial water (also referred to as porewater). Normalizing to organic carbon content has been widely used for pyrethroids (Amweg et al. 2005, 2006, Weston et al. 2004, 2005, 2008), although it has been demonstrated that this normalization does not entirely account for variations in bioavailability across sediments (Xu et al. 2007). All of the alternatives considered for pyrethroid concentration goals in sediment are based on OC-normalized sediment concentrations. Because this approach is widely accepted and incorporated into all of the alternatives, other options for accounting for bioavailability in sediments are not explored further.

For determining whether pyrethroid concentration goals are achieved, staff recommends including some means of accounting for bioavailability. Accounting for bioavailability of pyrethroids in environmental samples will result in a more accurate predication of potential toxicity to aquatic organisms in aquatic ecosystems. This is a reasonable approach that protects aquatic life, while accounting for environmental characteristics and reducing the likelihood that samples that would not cause harm to aquatic organisms would be determined to exceed the pyrethroid concentration goals. A discussion of utilizing freely dissolved concentrations to account for bioavailability follows.

5.2.2.1 Measuring freely dissolved concentrations

The most widely used technique for measuring the freely dissolved concentration is solid-phase microextraction (SPME). This technique involves using a polymer fiber to extract a negligible amount of chemical from the water so that equilibrium is not

disturbed in the sample. SPME has been demonstrated to provide good results for freely dissolved concentrations (Bondarenko et al. 2007, Bondarenko and Gan 2009, Hunter et al. 2008, Xu et al. 2007, Yang et al. 2006b, 2007). SPME methods have not yet been adopted widely by commercial laboratories and standard methods are not available from U.S. EPA, ASTM or other standardization organizations. The SPME technique could provide more accurate measurements of freely dissolved concentrations compared to estimating the concentration with partitioning coefficients, particularly if site-specific partition coefficients are not used.

Researchers have also filtered water samples prior to chemical analysis to remove suspended solids and/or dissolved organic matter to measure dissolved pyrethroids. Typical syringe filters are not recommended for use when analyzing for pyrethroids because studies have demonstrated that a fraction of the dissolved compounds can adsorb to the filters instead of passing through (Gomez-Gutierrez et al. 2007, House and Ou 1992). These losses to the filter may be important when measuring low environmental concentrations of pyrethroids. However, the U.S. Geological Survey (USGS) has developed a filtration sample handling method specifically for pyrethroids (Hladik et al. 2009). This method involves filtering water through a diaphragm pump, with equipment made from specified materials and flow rates, and for the least losses samples should be filtered in the field. Approximately 3-5% of pyrethroids were lost to surface association in the filtration apparatus, which is considered minimal and acceptable by USGS. The USGS filtration method only removes suspended solids, it does not filter DOC, so the resulting pyrethroid concentration is the sum of the freely dissolved concentration and the concentration bound to DOC. Using this method, the freely dissolved concentration could be calculated if the DOC concentration is measured.

5.2.2.2 Estimating freely dissolved concentrations

The freely dissolved concentration can also be estimated, rather than directly measured, by calculating the amount of binding to suspended solids and DOM. The amount of binding to these phases is typically normalized to the organic carbon content of the materials, because it is presumed that pyrethroid pesticides, like other hydrophobic organic chemicals, primarily bind to the organic carbon (OC) found in solids and DOM. The following equation can be used to estimate the freely dissolved concentration of pyrethroids:

Equation 3

$$C_{dissolved} = \frac{C_{total}}{1 + ((K_{OC}[POC]) + (K_{DOC}[DOC])}$$

where: $C_{dissolved}$ = concentration of chemical in dissolved phase (μg/L);
C_{total} = total concentration of chemical in water (μg/L);
K_{OC} = organic carbon-water partition coefficient (L/kg);
[POC] = concentration of particulate organic carbon (kg/L);
K_{DOC} = organic carbon-water partition coefficient (L/kg) for DOC;
[*DOC*] = concentration of dissolved organic carbon in water (kg/L).

To calculate the freely dissolved concentration with this equation, water samples must be analyzed for the total concentration of each pyrethroid pesticide (C_{total}), the concentration of total organic carbon ([TOC]), and the concentration of dissolved organic carbon ([DOC]). The concentration of particulate organic carbon ([POC]) can then be calculated as: [POC] = [TOC]-[DOC]. Site-specific partition coefficients are recommended for these calculations because organic carbon occurring in the environment can vary widely in their binding properties depending on the physical-chemical properties of the organic matter, which primarily develop based on the source and aging of the material. Site-specific partition coefficients may also vary with season and timing of sample collection because aquatic ecosystems are not static and new sources of material may be introduced due to changes in the surrounding environment. The accuracy of the estimation of the freely dissolved concentration will be improved if site-specific partition coefficients are used, but if site-specific partition coefficients are not available, partition coefficients available in the literature could also be used for this calculation.

Estimating the freely dissolved concentration via partition coefficients may over- or underestimate bioavailability, but one study demonstrated that using site-specific partition coefficients were comparable to direct measurement via SPME. Yang et al. (2006b) measured partition coefficients for four suspended sediments and then used those values to predict LC_{50}'s for *Ceriodaphnia dubia* at various levels of suspended solids for four pyrethroids. They compared these estimated LC_{50}'s to the LC_{50}'s measured by SPME and found that 95% of estimated LC_{50}'s fall within a factor of two of the LC_{50} measured by SPME, indicating that direct measurement by SPME and estimation via partition coefficients are comparable. It is unlikely that site-specific partition coefficients will be available for most monitoring sites because determining these values is not a standard procedure performed by commercial laboratories. Partition coefficients have primarily been reported by academic research laboratories and pesticide registrants.

Because site-specific partition coefficients will likely not be available, default partition coefficients are proposed in order to use Equation 3 to estimate the freely dissolved concentration of a sample. A literature review of existing partition coefficients was conducted and data acceptability criteria were:

- Study followed a standard batch equilibrium experimental design
- The freely dissolved aqueous concentrations were measured using SPME with time-staggered standard preparation to reduce calibration errors due to sorption to container walls
- Natural sediments were used (not formulated)
- Low solids-to-solution ratios (≤ 2:100)

Only one study was identified that met all of the above criteria (Chickering 2014) and these partition coefficients are presented in Table 5-1. Two studies met the criteria except that time-staggered standard preparation was not utilized, and therefore it is more likely that the partition coefficients from these studies are overestimated, these partition coefficients are presented in Table 5-2 for informational value. Some data processing was completed to result in the partition coefficients reported in Table 5-1 and Table 5-2. The K_{OC} and K_{DOC} data for permethrin were reported separately for the two diastereomers of permethrin (cis-permethrin and trans-permethrin) by Cui and Gan (2013). Because most formulations of permethrin are approximately 50% cis-permethrin and 50% trans-permethrin, the mean of the values for the two diastereomers was used as the permethrin K_{OC} and K_{DOC} for those data. K_{DOC} values were not explicitly reported by Chickering (2014), but the data necessary to calculate K_{DOC} values were reported. The total aqueous pyrethroid concentration, the freely dissolved aqueous pyrethroid concentration, and the concentration of DOC were used to calculate K_{DOC} using the following equation (Bondarenko and Gan 2009):

Equation 4

$$K_{DOC} = \frac{(C_{total} - C_{dissolved}) / [DOC]}{C_{dissolved}}$$

where: K_{DOC} = organic carbon-water partition coefficient (L/kg) for DOC;
C_{total} = total concentration of chemical in water (μg/L);
$C_{dissolved}$ = concentration of chemical in dissolved phase (μg/L);
[*DOC*] = concentration of dissolved organic carbon in water (kg/L).

Table 5-1 Organic carbon-water partition coefficients (K_{OC}) and dissolved organic carbon-water partition coefficients (K_{DOC}) for pyrethroids that met all data acceptability criteria.

	%OC[a]	Bif (L/kg)	Cyf (L/kg)	Cyp (L/kg)	Esf (L/kg)	L-cy (L/kg)	Per (L/kg)	Reference
K_{OC}	4	4,049,394	3,983,720	3,105,712	6,365,689	2,077,949	6,329,845	Chickering 2014
		3,682,730	3,449,806	3,484,084	7,851,870	2,160,946	3,719,214	
		4,952,213	4,176,779	2,726,695	7,442,352	1,929,773	8,174,471	
Mean K_{OC}	Mean ± Std Dev	4,228,000 ± 653,000	3,870,000 ± 377,000	3,105,000 ± 379,000	7,220,000± 768,000	2,056,000 ± 117,000	6,075,000 ± 2,239,000	
	[DOC][a] ppm							
K_{DOC}	1.66	1,737,127	2,432,071	762,765	1,733,158[b]	952,809	957,703	Chickering 2014

[a] Calculated as the mean %OC or mean [DOC] measured in all tests across chemicals.
[b] K_{DOC} for esfenvalerate was calculated with the mean [DOC] for the five other pyrethroids because [DOC] data were not available for the esfenvalerate samples.

Table 5-2 Organic carbon-water partition coefficients (K_{OC}) and dissolved organic carbon-water partition coefficients (K_{DOC}) for pyrethroids that met all but one data acceptability criteria.

	%OC	Bif (L/kg)	Cyf (L/kg)	Cyp (L/kg)	Esf (L/kg)	L-cy (L/kg)	Per (L/kg)	Ref.
K_{OC}	5.1	1,330,000	3,330,000	--	14,200,000	2,300,000	4,700,000	Cui & Gan 2013
	2.6	1,200,000	2,430,000	--	5,240,000	2,140,000	2,545,000	
	4.9	990,000	3,260,000	--	5,300,000	1,860,000	2,955,000	
	11.3	98,000	560,000	--	570,000	370,000	1,235,000	
	0.5	5,470,000	6,450,000	--	20,900,000	12,130,000	6,075,000	
	0.5	1,720,000	--	1,920,000	3,240,000	--	4,540,000	Yang et al. 2006b
	2.45	628,571	--	1,122,449	910,204	--	697,959	
	0.07	11,571,429	--	21,857,143	14,714,286	--	8,714,286	
	1.36	1,794,118	--	2,132,353	1,860,294	--	1,301,471	
K_{DOC}	**Sed. Name**							
	SC	600,000	610,000	--	2,060,000	1,320,000	1,215,000	Cui & Gan 2013
	GCP	2,690,000	12,890,000	--	13,300,000	6,550,000	17,460,000	
	EMP73	180,000	410,000	--	2,140,000	450,000	1,750,000	
	LHB	7,150,000	20,930,000	--	19,260,000	7,600,000	17,855,000	
	EMP37	43,440,000	26,660,000	--	301,540,000	59,180,000	122,520,000	

The sorptive properties of sediments and DOC can vary widely, and the goal is to result in the most accurate prediction of the freely dissolved concentration, therefore only the partition coefficients that meet all of the data acceptability criteria are recommended. These partition coefficients could be used in Equation 3 to estimate the freely dissolved concentrations of pyrethroids. When the Basin Plan amendment is reviewed in the future, any new data on partition coefficients, particularly site-specific values in the Central Valley, should be evaluated.

It should be noted that the recommended default partition coefficients (Table 5-3) are appropriate to use for ambient water samples, and they may not be representative of unique matrices, such as municipal or domestic wastewater treatment plant effluents, or sediment exposures. Partition coefficients for wastewater effluents are needed to assess the effects of pyrethroids in effluents on ambient waters. One study has determined partition coefficients for four pyrethroids using wastewater effluents and these values can be used for estimating the freely dissolved pyrethroid concentration in effluents. Parry and Young (2013) determined both K_{OC} and K_{DOC} for bifenthrin, lambda-cyhalothrin, cypermethrin, and permethrin based on six samples from the Sacramento Regional Wastewater Treatment Plant. As recommended above, the 50th percentile of K_{OC} values is used as the default K_{OC} for effluents for each pyrethroid. Only a single K_{DOC} value was reported for each chemical (Parry and Young 2013), and those are the recommended K_{DOC} values for wastewater effluents. Because partition coefficients for wastewater effluents are not available for cyfluthrin and esfenvalerate, the default partition coefficients for ambient waters may be used in cases when these pyrethroids are detected wastewater effluents. However, if partition coefficients specific to municipal and domestic wastewater effluents become available for these compounds in the future, it is recommended that those values are used for assessing pyrethroids in effluents. Recommended partition coefficients for both ambient waters and wastewater effluents are summarized in Table 5-3.

Table 5-3 Recommended default partition coefficients for pyrethroids (L/kg)

	Ambient Waters		**Wastewater Effluents[a]**	
Pyrethroid	**K_{OC}**	**K_{DOC}**	**K_{OC}**	**K_{DOC}**
Bifenthrin	4,228,000	1,737,127	15,848,932	800,000
Cyfluthrin	3,870,000	2,432,071	--	--
Cypermethrin	3,105,000	762,765	6,309,573	200,000
Esfenvalerate	7,220,000	1,733,158	--	--
Lambda-cyhalothrin	2,056,000	952,809	7,126,428	200,000
Permethrin	6,075,000	957,703	10,000,000	200,000

[a]All data from Parry and Young (2013)

5.2.3 Temperature Effects on Pyrethroid Toxicity

Pyrethroids have been demonstrated to be more toxic at lower temperatures (Weston et al. 2009, Harwood et al. 2009). Most of the toxicity test data from which the criteria are derived are based on laboratory tests at 20-25ºC. Ambient water temperatures in Central Valley waterways are closer to 15ºC in winter and can range above 30 ºC in some water bodies during the summer. Pyrethroids have been demonstrated to be 2 to 3 times more toxic at 15ºC compared to the standard test temperature of 23 ºC. It is not known whether temperatures higher than 23 ºC would decrease pyrethroid toxicity since

impacts of temperatures above 23 ºC have not been tested or quantified. The State Board Stream Pollution Trends Program has recommended that toxicity tests should be conducted at 15ºC to better reflect ambient temperatures during their spring sample collections (Phillips et al. 2016).

5.2.4 Pyrethroid-resistant Aquatic Organisms

The aquatic invertebrate *Hyalella azteca* is known to be particularly sensitive to pyrethroids. Among species tested in the laboratory, *Hyalella azteca* is the most sensitive of all aquatic organisms to all pyrethroids tested. *Hyalella azteca* are also used in ambient toxicity testing and are known to be a sensitive indicator of pyrethroids in surface waters and sediments. While *Hyalella azteca* is typically referred to as a single species, it is actually known to be a species complex, meaning that different populations may vary in size, life-history characteristics, and genetic diversity (Major et al. 2013). Two recent studies have demonstrated that field populations of *Hyalella azteca* have variable sensitivities to pyrethroids and these results are described below (Weston et al. 2013b, Clark et al. 2015). Some field populations tested had equivalent sensitivities to pyrethroids as laboratory-reared organisms, whereas other field populations were up to 550 times more tolerant of pyrethroids compared to laboratory-reared populations (Weston et al. 2013b).

Weston et al. (2013b) collected *Hyalella azteca* from seven sites in California with varying land use, including undeveloped grasslands, commercial and residential sites, and agricultural sites. The researchers performed genetic analysis on the field populations and determined that they belonged to three different groups (called clades). They also analyzed three populations of laboratory-reared organisms and found all of them belonged to a fourth clade. The researchers noted that sensitivity to pyrethroids varied by clade and was also correlated to land use. The populations from sites with few pyrethroid inputs and little or no detected pyrethroids in stream sediments were equally sensitive to pyrethroids as laboratory-reared cultures. In contrast, the populations from sites with higher pyrethroid sediment concentrations demonstrated the highest degree of resistance to pyrethroids; they were up to 550 times more tolerant to pyrethroids compared to laboratory-reared populations.

The researchers did genetic analysis on the populations to investigate mechanisms of resistance and found multiple genetic mutations in the resistant field populations. These same mutations have also been identified in pesticide-resistant agricultural pests, indicating that the mutated *Hyalella azteca* were likely exposed to pyrethroids or other similarly acting chemicals over multiple generations. The individuals with the mutations that allow these organisms to tolerate high concentrations of pyrethroids survived and passed on the mutations to the following generations, while those without the mutations did not survive to pass on their genes, potentially reducing the overall genetic and biological diversity of the populations. Weston et al. state that the consequences of

these evolutionary changes in *Hyalella azteca* populations are unknown for the species and for aquatic ecosystems, but reduced genetic diversity can result in populations that do not have genetic variations to tolerate other stressors. The authors also highlight the importance of knowing the genetic group and sensitivity of the laboratory cultures used in ambient toxicity testing so that results from different labs are truly comparable.

Clark et al. (2015) identified several field populations of *Hyalella azteca* that were significantly more tolerant of the pyrethroids bifenthrin and cypermethrin compared to laboratory-reared cultures. Field populations in drainages with agricultural and urban influences were more likely to be resistant to pyrethroids compared to those from undeveloped drainages. Organisms from urban drainages were consistently the least sensitive to pyrethroids. This may be a reflection of exposure to pyrethroids because urban drainages are known to have consistently high loads of pyrethroids. Field populations from undeveloped areas had approximately equal sensitivity to pyrethroids as laboratory cultures.

Seasonal variations were also identified at sites where organisms were collected and tested at different times of year. In urban drainages, organisms collected in October were more sensitive to pyrethroids than those collected the following May. Organisms are exposed to many contaminants in winter and spring storm water runoff and exposure to contaminants is known to induce detoxification enzymes. Increased activity of detoxification enzymes would allow an organism to metabolize contaminants more efficiently, which would lead to greater tolerance of contaminants among surviving organisms. *Hyalella azteca* collected from agricultural drainages were more sensitive in January than those collected in June and May. Again, it is possible that organisms are exposed to a flush of contaminants in winter and spring due to storm water runoff, and by May and June they have decreased sensitivity to pyrethroids due to induction of detoxification enzymes. Under this scenario, organisms would be most sensitive to contaminants when first flush storm events occur.

Clark et al. also looked at changes in sensitivity over successive generations of field-collected *H. azteca.* The field-collected organisms were cultured in the laboratory in pyrethroid-free conditions and subsequent generations were tested for pyrethroid sensitivity. The F3 generations of two of the most resistant populations were tested and the cypermethrin LC_{50} for each population decreased approximately an order of magnitude compared to the field-collected F0 generations. However, the F3 generations from these populations were still less sensitive than populations from undeveloped areas or laboratory cultures by approximately a factor of 5-10. The declining tolerance indicates that it is unlikely that a permanent genetic adaptation has occurred, although genetic analysis was not performed so that cannot be confirmed for these populations. The authors point out that there are likely multiple factors that could lead field populations to be resistant to pyrethroids compared to laboratory cultures, including the

ability to acclimate to the presence of contaminants by induction of detoxification enzymes, variations in pyrethroids tolerance among *H. azteca* subpopulations, and genetic adaptations.

Based on the two available studies that have identified pyrethroid-resistant field populations in the Project Area, it appears that multiple factors likely account for the development of resistance to pyrethroids in these field populations (Weston et al. 2013b, Clark et al. 2015). Genetic mutations are passed on from one generation to the next and are an indication that the populations have been exposed to high levels of chemicals for long periods of time, and are a sign of population-level effects of contaminants (Weston et al. 2013b). There is not information about potential adverse effects caused by these genetic mutations, however there is potential for adverse effects due to potential reductions in genetic diversity. The populations with genetic mutations all occurred in areas expected to have a history of high contaminant loads, such as urban storm drains and agricultural drainages. Metabolic acclimation may only occur in the presence of pyrethroids or other contaminants and are not permanent traits passed on to subsequent generations (Clark et al. 2015).

In order to be protective of the various populations of *Hyalella azteca* and other species with similar sensitivity to pyrethroids that may not develop the same genetic resistance to these pesticides as has been demonstrated in some populations of *Hyalella azteca* staff recommends that the more conservative laboratory species is utilized when deriving pyrethroid concentration goals until more information is available on the resistant populations and the population-level effects of the development of pyrethroid resistance.

5.2.5 **Aquatic Species Sensitivity**

Pyrethroid toxicity data are only available for a small fraction of the aquatic species found in Central Valley waters. Aquatic life criteria derivation typically relies on statistical tools like species sensitivity distributions to use existing toxicity data to derive concentrations that should be protective of all species. *Hyalella azteca* is the most sensitive to pyrethroids of species that have been tested. There are other species resident in the Project Area that are known to be similarly sensitive to pyrethroids as the amphipod *Hyalella azteca*.

Estuarine mysid shrimp, such as *Americamysis bahia*, reside in the Delta, but were not included in criteria derivation because the data for these species are from saltwater toxicity testing and only freshwater toxicity tests were included for criteria derivation. Acute toxicity values (LC_{50}s) for mysids are a factor of 3 to 13 higher than those of *Hyalella azteca*, but it is possible that inclusion in criteria derivation could have altered the statistical outcome of the overall criteria because they are the next most sensitive species after *Hyalella azteca*. Potential impacts to mysid shrimp are also a

consideration as the available data indicate they are relatively sensitive to pyrethroids, though not as sensitive as *Hyalella azteca* and can play an important role in aquatic food webs (Burris 2017).

Sublethal effects on resident fish have been demonstrated at very low levels. Brander et al. (2016) reported reproductive effects on inland silverside (*Menidia beryllina*), which reside in the Delta, at 0.5 ng/L bifenthrin, which is equal to the lowest *H. azteca* LC_{50} for bifenthrin. Brander et al. (2016) was published after the UC Davis criteria were derived for pyrethroids, and thus were not included. However, the chronic UC Davis bifenthrin criterion is below this effect level, so it is unlikely that inclusion of this toxicity value would significantly affect the resulting criterion. Other sublethal effects have been documented in resident fish (Fong et al. 2016), but if effects were not directly linked to survival, growth or reproduction they were not included in criteria derivation.

Studies on some non-resident species such as the amphipod *Gammarus* species and Atlantic salmon have documented sublethal effects at low concentrations, but these effects were not included in criteria derivation in several cases if they were not directly linked to survival, growth or reproduction or if effect concentrations were not quantified due to detection limits.

5.3 Aqueous Pyrethroid Concentration Goal Alternatives

Pyrethroid concentration goal alternatives for aqueous concentrations of pyrethroids are evaluated in this section. Available water quality criteria (WQC) and guidelines for pyrethroids are presented in Table 5-4 for the protection of aquatic life and human health (drinking water and recreational purposes). Based on the available values, the aquatic life freshwater habitat beneficial uses (WARM/COLD) are far more sensitive to pyrethroids than the drinking water and recreational uses. The available criteria and guidelines to protect the aquatic life beneficial use are further evaluated in this section. The values for drinking water and recreational uses are not further evaluated because they are orders of magnitude larger than the aquatic life values and surface water monitoring data indicates that ambient concentrations are far below these values.

There are twelve alternatives considered for establishing pyrethroid concentration goals:

1. No change – Use of existing Basin Plan guidance;
2. California Department of Fish and Wildlife (CDFW) interim water quality criteria;
3. 2010/11 University of California Davis method water quality criteria;
4. 1st percentile 2015 UC Davis water quality criteria;
5. 5th percentile 2015 UC Davis water quality criteria;
6. 2.5 percentile 2015 UC Davis water quality criteria;
7. 2015 water quality criteria derived via USEPA method;
8. Pyrethroid Working Group (PWG) combined species sensitivity distribution for acute toxicity of pyrethroids to arthropods;

9. Australia/New Zealand trigger;
10. Canadian interim freshwater quality guidelines;
11. Dutch maximum permissible concentrations;
12. USEPA Office of Pesticide Programs aquatic life benchmarks.

First, these alternatives were evaluated based on the five factors, listed below, to determine whether they should be further considered as potential pyrethroid concentration goals. An evaluation of each of the alternatives and these factors is shown in Table 5-5.

- Data sources and calculation method were clearly identified so that sources can be checked for quality and errors
- Availability of both acute and chronic criteria to ensure protection from both short-term and longer exposures
- Availability for the six pyrethroids of interest
- Comparison of values to toxicity values for the most sensitive species in the data sets (*Hyalella azteca,* toxicity values shown in Table 2-2)
- Consistency across the basin, with the project goals, with other regulations, and criteria derivation methodologies.

The human right to water was also considered in this evaluation. Alternatives that are determined to be protective of aquatic life beneficial uses will also be protective of human consumption beneficial uses because aquatic life has been demonstrated to be a more sensitive beneficial use. None of the alternatives considered will affect the affordability or accessibility of water for human consumption, thus all of the alternatives are consistent with the goal of the Human Right to Water law of securing universal access to safe drinking water.

Table 5-5 summarizes the evaluation of each alternative based on the five factors described above. Appendix A discusses the nine alternatives that were not selected for further evaluation based initial scoring. Four alternatives were further considered as pyrethroid concentration goals because they scored well overall on the initial evaluation factors. The four alternatives that are further considered are:

1. 1st percentile 2015 UC Davis water quality criteria;
2. 5th percentile 2015 UC Davis water quality criteria;
3. 2.5 percentile 2015 UC Davis water quality criteria;
4. 2015 water quality criteria derived via USEPA method.

These four alternatives are discussed below. The alternatives were then further evaluated based on 13241 Porter-Cologne considerations and other applicable laws and policies in section 5.6.

Table 5-4 Available water quality criteria and guidelines for pyrethroids.

	Bifenthrin (ng/L)	Cyfluthrin (ng/L)	Cypermethrin (ng/L)	Esfenvalerate (ng/L)	Lambda-cyhalothrin (ng/L)	Permethrin (ng/L)
Aquatic life criteria and guidelines for freshwater surface waters						
CDFW interim acute[a]	NA	NA	2	NA	NA	30
2010/11 UCD acute[b] 2010/11 UCD chronic[b]	4 0.6	0.3 0.05	1 0.2	NA NA	1 0.5	10 2
1st percentile 2015 acute via UCD method 1st percentile 2015 chronic via UCD method	0.06[c] 0.01[c]	0.07[d] 0.01[d]	0.04[e] 0.01[e]	0.2[f] 0.03[f]	0.03[g] 0.01[g]	6[h] 1[h]
5th percentile 2015 acute via UCD method 5th percentile 2015 chronic via UCD method	0.8[c] 0.1[c]	0.8[d] 0.2[d]	1[e] 0.3[e]	2[f] 0.3[f]	0.7[g] 0.3[g]	6[h] 1[h]
2.5 percentile 2015 acute via UCD method 2.5 percentile 2015 chronic via UCD method	0.3 [c] 0.05 [c]	0.3 [d] 0.06 [d]	0.3 [e] 0.07 [e]	0.7 [f] 0.1 [f]	0.2 [g] 0.08 [g]	6[h] 1[h]
2015 acute via USEPA method 2015 chronic via USEPA method	0.059[c] NA	NA NA	0.25[e] NA	NA NA	0.21[g] 0.087[g]	4[h] NA
PWG SSD acute[i]	1.3	1.5	3.0	2.3	0.8	19
Australia/New Zealand trigger[j]	NA	NA	NA	1	NA	NA
Canadian interim guideline (chronic)[k]	NA	NA	NA	NA	NA	4
Dutch maximum permissible conc. (chronic)[l]	1.1	NA	0.09	NA	NA	0.2
USEPA OPP aquatic life benchmark – invertebrates[m] (acute; chronic)	800; 1.3	12.5; 7	210; 69	25; 17	3.5; 2	10; 1.4
USEPA OPP aquatic life benchmark – fish[m] (acute; chronic)	75; 40	34; 10	195; 140	35; 35	105; 31	395; 51.5
1/10th lowest LC_{50}	0.05[n]	0.055[o]	0.056 [p]	0.085 [q]	0.03 [r]	0.7[s]
Human health guidelines for drinking water						
USEPA human health benchmark – acute (1d-children)[t]	3,300,000	200,000	1,000,000	18,000	50,000 (γ-cyh: 25,000)	2,500,000
USEPA human health benchmark – chronic (lifetime)[t]	91,000	168,000	420,000	13,000	7,000	1,750,000
Water quality guidelines for recreational purposes						
Australia/New Zealand maximum conc.[j]	NA	NA	NA	Fenvalerate 40,000	NA	300,000

[a]Siepmann and Holm 2000; [b]Fojut et al. 2012; [c]Fojut 2015a; [d]Fojut 2015b; [e]Fojut 2015c; [f]Fojut 2015d; [g]Fojut 2015e; [h]Fojut 2015f; [i]Giddings et al. 2014; [j]ANZECC/ARMCANZ 2000; [k]CCME 2006; [l]Crommentuijn et al. 2000; [m]USEPA 2012b; [n]Bradley 2013a; [o]Bradley 2013b; [p]Bradley 2013c; [q]Bradley 2013d; [r]Bradley 2013e; [s]Bradley 2013f; [t]USEPA 2013.

Table 5-5 Aqueous pyrethroid concentration goal alternatives and evaluation factors

Alternative	Transparent data source and calculation	Acute and chronic values available	Values available for all 6 pyrethroids	Chronic values are below *H. azteca* LC_{50}s	Consistency in basin, with project goals, etc.
No change - Basin Plan guidance	Yes	No	Yes	Yes	No
No pyrethroids	Yes	No	Yes	Yes	No
CDFW interim criteria	Yes	Yes	No	No	Yes
2010/11 UCD criteria	Yes	Yes	No	Yes for 3, no for 2 pyrethroids	Yes
1st percentile 2015 UCD criteria	Yes	Yes	Yes	Yes	Yes
5th percentile 2015 UCD criteria	Yes	Yes	Yes	Yes for 5, equal for 1 pyrethroid	Yes
2.5 percentile 2015 UCD criteria	Yes	Yes	Yes	Yes	Yes
2015 via USEPA method	Yes	Yes for 1, no for 5 pyrethroids	No	Yes for the 1 chronic criterion available	Yes
PWG SSD values	No	No	Yes	No	Yes
Australia/New Zealand trigger	No	No	No	No	No
Canadian interim guideline (chronic)	Yes	No	No	Yes	No
Dutch maximum permissible conc. (chronic)	No	No	No	Yes for 2, no for 1 pyrethroid	No
USEPA OPP aquatic life benchmarks	Yes	Yes	Yes	No	No

5.3.1 UC Davis Method Criteria

The Central Valley Water Board contracted with UC Davis to develop a new methodology to establish water quality criteria for the protection of aquatic life based on findings from a review of current methodologies (TenBrook et al. 2009). The methodology developed by UC Davis incorporates procedures that could improve criteria generation. Similar to the USEPA method, the goal of the UC Davis method is to extrapolate from available pesticide toxicity data for a limited number of species to a concentration that should not produce detrimental physiological effects in aquatic life (TenBrook et al. 2010).

The UC Davis method provides an approach to review available toxicity data for a water quality constituent and to derive two values, an acute criterion and a chronic criterion. The UC Davis methodology has the ability to handle data sets that do not meet the eight taxa requirements of the USEPA method (USEPA 1985), and can use as few as one

datum. Toxicity data for all of the taxa required by the USEPA methodology are seldom available for pesticides, thus it is often not possible to generate criteria using the USEPA methodology with existing data. The UC Davis method uses a species sensitivity distribution (SSD) to derive criteria that is similar to the SSD in the USEPA method. Unlike the eight taxa requirements of the USEPA method, the UC Davis SSD method requires a minimum of five taxa to derive a criterion, which are 1) the family Salmonidae, 2) a warm water fish, 3) a planktonic crustacean, of which one must be in the family Daphniidae in the genus *Ceriodaphnia, Daphnia,* or *Simocephalus,* 4) a benthic crustacean, and 5) an insect (aquatic exposure).

In addition, the UC Davis method can be used to derive acute and chronic criteria when the five SSD taxa requirements are not met. For acute criteria, the method uses an assessment factor with a minimum of one datum from the family Daphniidae in the genus *Ceriodaphnia, Daphnia,* or *Simocephalus*. For acute criterion derivation, the method outlines data requirements if more than one datum is available, but less than the five required species (TenBrook et al. 2010). When fewer than five toxicity values are available to derive a chronic criterion, the UC Davis method uses acute-to-chronic ratios (ACRs) to extrapolate from the acute data to a chronic criterion. An ACR is calculated by dividing an acute LC/EC_{50} value by a chronic value, such as a maximum acceptable toxicant concentration (MATC), from the same or similar tests. ACRs are calculated using data for three sensitive species, but when data are not available for three species, a default ACR is used to derive a chronic criterion. A default ACR of 12.4, based on the 80th percentile of ACRs for eight pesticides, was given in the original methodology (TenBrook et al. 2010), although this value has been updated to 11.4 with the addition of more recent criteria data (Fojut et al. 2014).

Criteria developed using the UC Davis method aim to protect all species in the aquatic ecosystem and several conservative choices are included in the method to ensure protection of sensitive species that are not included in available toxicity data sets. One conservative assumption in the UC Davis method is that the averaging periods for the acute and chronic criteria are considerably shorter than the toxicity test durations they are derived from. The acute criteria averaging period is 1-hour, while acute toxicity tests are 96-hours long. The chronic criteria averaging period is 4-days, while the chronic toxicity tests are typically at least 7-day exposures. Toxic effects are typically seen at lower concentrations with longer exposure times, so having shorter averaging periods than the toxicity test exposures is a conservative assumption of the UC Davis method and helps account for limited data sets.

The UC Davis method also includes an exceedance frequency of not more than once every 3 years. This means that if there are two or more exceedances of the concentration goal in a 3 year period, then the concentration goals would not be achieved. The exceedance frequency was chosen because some populations may take

up to 3 years to recover from the toxic effects of pesticides; however, many populations may recover more quickly from excursions, particularly invertebrate species with short lifecycles, which are most likely to exhibit effects from acute exposures of pyrethroids. The 3 year exceedance frequency of the UC Davis method was chosen based on a literature review of ecosystem recovery studies. Several studies involving pyrethroids showed affected populations recovered from short pulse exposures in several weeks, but one pyrethroid study showed that populations had not fully recovered over 240 days after a short exposure. Most studies showed that recovery occurred in 3 years or less, so the 3 year exceedance frequency is conservative. However, for threatened or endangered species, recovery from excursions of the criteria may be difficult if the populations are already stressed and lack resiliency. The acute and chronic averaging periods and the exceedance frequency of the UC Davis are the same as those given in the USEPA guidelines for deriving aquatic life criteria.

All of the UC Davis pyrethroids water quality criteria are recommended to be compared to freely dissolved concentrations (vs. whole water) because binding to suspended solids and dissolved organic matter, which are found in ambient waters at varying levels, reduces the bioavailability and toxicity of these compounds. This concept is consistent with other criteria, such as USEPA criteria for toxic metals such as copper, which explicitly include hardness effects on bioavailability in the criteria. There is uncertainty in the calculation or measurement of what fraction of a pyrethroid is freely dissolved, which may under or overestimate actual concentrations. However, the use of freely dissolved concentrations is recommended in the UC Davis pyrethroid criteria because the freely dissolved concentration provides the best characterization of pyrethroids' toxic potential.

According to the UC Davis method, the pyrethroids water quality criteria are intended to be considered additively because all of the compounds have the same or similar mode of toxic action. As discussed in section 0, several tests indicated some antagonism in pyrethroid mixtures, meaning that the combination was less toxic than expected based on the concentration addition model prediction, so there is conservatism in the assumption of direct additivity. Consideration of additive toxicity is only possible for the six pyrethroids for which criteria are available, and additive toxicity with other pyrethroids is not accounted for because water quality criteria are not available for these pesticides. Pyrethroids also have additive effects with other pesticides and toxicants, such as metals and commonly used pesticides like organophosphates as well as piperonyl butoxide (PBO) a pesticide formulation additive. These effects were considered in criteria derivation, but could not be included in the criteria since the effects could not be quantified across multiple species.

The UC Davis criteria also do not account for temperature effects of pyrethroids because insufficient data were available for multiple species for each compound to

numerically account for this effect and develop temperature-dependent criteria. As discussed in section 5.2.3, pyrethroids can be more toxic at lower temperatures, therefore the criteria are likely less conservative during winter storms, when temperatures are lower than those used during laboratory analyses, but conversely may be more conservative when ambient temperatures are higher.

The UC Davis method outlines procedures to evaluate derived criteria to ensure that they are set at levels that will protect against adverse effects to 1) sensitive species, 2) species in the ecosystem, and 3) threatened or endangered species (TenBrook et al. 2010). In cases when such data show toxicity can occur at a lower concentration than the acute or chronic criteria derived with the 5th percentile value, the method guidance is to ensure protection by adjusting the criteria downward to the 1st percentile (or lower 95% confidence interval of the 5th percentile, whichever is higher). This guidance is specific to the UC Davis Methodology. The adjustment to the 1st percentile is not required by USEPA policy or guidance. The USEPA aquatic life criteria methodology (USEPA 1985) utilizes the 5th percentile for calculation of criteria to estimate a level that would be protective of aquatic life beneficial uses. The USEPA methodology specifies that important species with toxicity values near or below the criteria should be considered, but does not specify a method of adjusting the criteria for these toxicity values.

5.3.1.1 1st percentile 2015 UC Davis Water Quality Criteria

Since UC Davis water quality criteria for five pyrethroids were originally derived in 2010 and 2011 (section 5.3.1), additional toxicity data has been generated for these pesticides. In 2015, staff of the Central Valley Regional Board derived updated water quality criteria using the UC Davis methodology and the information gathered in the original criteria reports, as well as recently generated or identified toxicity data.

There were several factors that led staff to conclude that it was important to calculate updated criteria. One factor is that recent toxicity data for the sensitive species *Hyalella azteca* were available from high quality consistent tests that were not included in any of the original criteria reports. Another factor was that a draft water quality criteria for esfenvalerate was derived in 2014 (Trunnelle et al. 2014), and had not yet been finalized. In addition, the default acute-to-chronic ratio of the UC Davis method was updated in 2014 to include ACRs for two pyrethroids (cyfluthrin and lambda-cyhalothrin), and thus would be more appropriate and representative of these compounds compared to the original default ACR that did not include data for any pyrethroids. The updated default ACR is 11.4 and is the 80th percentile of ACRs for ten pesticides (Fojut et al. 2014). The original ACR in the UC Davis method was 12.4 (TenBrook et al. 2010).

Central Valley Regional Board staff began with the information gathered in the 2010/11 UC Davis water quality criteria reports and added recently generated or identified toxicity data to derive water quality criteria for six pyrethroids following the UC Davis method, which are summarized below. This alternative will be further considered because acute and chronic criteria are available for all six pyrethroids of interest and relevant current data has been incorporated. The UC Davis methodology is distinct from USEPA guidance in that the criteria were calculated using the 1st percentile of the distribution when the criteria based on the 5th percentile were not protective of the most sensitive species in the data set.

- Bifenthrin (Fojut 2015a): The acceptable acute data set contained eight species mean acute values, which were used to calculate an acute freshwater criterion of 0.6 ng/L using a log-logistic SSD. Acute values for *Ceriodaphnia dubia* and *Hyalella azteca* were updated in the 2015 acute data set compared to the 2010 data set; all other acute values remained the same. The 2015 acceptable chronic data set contained four species mean chronic values, but none could be paired with appropriate acute data. Chronic values for *Ceriodaphnia dubia* and *Hyalella azteca* were available for the 2015 acute data that were not in the 2010 data set. The 2015 chronic criterion was calculated with the updated default acute-to-chronic ratio of 11.4, which resulted in a chronic freshwater criterion of 0.01 ng/L for bifenthrin. The criteria were calculated using the 1st percentile of the log-logistic distribution because the criteria based on the 5th percentile may not be protective of the most sensitive species in the data set based on a conservative comparison of acute 1-hour criteria with 96-hour LC_{50}s.

- Cyfluthrin (Fojut 2015b): Eight species mean acute values were available to calculate an acute freshwater criterion of 0.07 ng/L using a log-logistic SSD. The acute value for *Hyalella azteca* was updated in the 2015 acute data set compared to the 2010 data set; all other acute values remained the same. As in the 2010 criteria, there were three species mean chronic values, which were paired with corresponding acute data to calculate a cyfluthrin ACR of 10.27. This ACR was used to calculate a chronic freshwater criterion of 0.01 ng/L. The criteria were calculated using the 1st percentile of the log-logistic distribution because the criteria based on the 5th percentile may not be protective of the most sensitive species in the data set based on a conservative comparison of acute 1-hour criteria with 96-hour LC_{50}s.

- Cypermethrin (Fojut 2015c): The acceptable acute data set contained 18 species mean acute values, which were used to derive a freshwater acute criterion of 0.04 ng/L with a Burr Type III SSD. Acute values for *Hyalella azteca* and *Oncorhynchus mykiss* were updated and acute values for *Baetis rhodani, Chironomus dilutes, Lepomis macrochirus,* and *Orconectes spp.* were added to

the 2015 acute data set compared to the 2010 data set; all other acute values remained the same. Two freshwater species mean chronic value available, but neither could be paired with corresponding acute data to calculate ACRs. *Daphnia magna* was added to the 2015 chronic data set compared to the 2010 data set. However, paired acute and chronic values were available for one saltwater species, and this ACR was combined with two default ACRs resulting in a cypermethrin ACR of 9.2. This ACR was used to calculate a freshwater chronic criterion of 0.01 ng/L. The criteria were calculated using the 1st percentile of the log-logistic distribution because the criteria based on the 5th percentile may not be protective of the most sensitive species in the data set based on a conservative comparison of acute 1-hour criteria with 96-hour LC_{50}s.

- Esfenvalerate (Fojut 2015d): The acceptable data set contained eight species mean acute values, which were used to derive a freshwater acute criterion of 0.2 ng/L with a log-logistic SSD. There were three species mean chronic values available, and one could be paired with a corresponding acute value to calculate an ACR. This ACR was combined with two default ACRs resulting in a esfenvalerate ACR of 12.2. This ACR was used to calculate a freshwater chronic criterion of 0.03 ng/L. The criteria were calculated using the 1st percentile of the log-logistic distribution because the criteria based on the 5th percentile may not be protective of the most sensitive species in the data set based on a conservative comparison of acute 1-hour criteria with 96-hour LC_{50}s.

- Lambda-cyhalothrin (Fojut 2015e): There were 20 species mean acute values in the acceptable data set, which resulted in an acute freshwater criterion of 0.03 ng/L using a Burr Type III SSD. The only change in the acute data set between the 2010 and 2015 data sets was that the acute value for *Hyalella azteca* was updated. As in the 2010 criteria, there were two species mean chronic freshwater values and a saltwater chronic value that were paired with corresponding acute data to calculate a lambda-cyhalothrin ACR of 4.73. This ACR was used to calculate a freshwater chronic criterion of 0.01 ng/L. The criteria were calculated using the 1st percentile of the log-logistic distribution because the criteria based on the 5th percentile may not be protective of the most sensitive species in the data set based on a conservative comparison of acute 1-hour criteria with 96-hour LC_{50}s.

- Permethrin (Fojut 2015f): There were 20 species mean acute values and an acute freshwater criterion of 6 ng/L was derived using the 5th percentile of a Burr Type III SSD. The acute value for *Hyalella azteca* was updated and an acute value for *Hexagenia bilineata* was added to the 2015 acute data set compared to the 2011 data set; all other acute values remained the same. There were three species mean chronic values in the acceptable data set, but none could be

paired with appropriate acute data to calculate ACRs. As in the 2011 criteria, one saltwater chronic value was paired with corresponding acute data. The saltwater ACR was combined with two default ACRs to result in an ACR of 8.5. This ACR was used to calculate a chronic freshwater criterion of 1 ng/L.

5.3.1.2 5th percentile 2015 UC Davis Water Quality Criteria

The UC Davis methodology recommends that criteria should first be calculated with the 5th percentile value of the species sensitivity distribution, but then those criteria should be compared to the most sensitive values in the data set, toxicity values for threatened and endangered species, and data from ecosystem level studies to ensure that sensitive species are protected. If the criteria derived with the 5th percentile of the distribution do not appear to be protective of all species in the data set, then the guidance in the UC Davis method is to adjust the criteria downward using the next lowest estimate from the distribution. Five of the six 2015 water quality criteria derived using the UC Davis method were adjusted based on data for sensitive species. In these five criteria, the 1st percentile of the distribution was used to calculate the acute and chronic criteria instead of the 5th percentile of the distribution. In many criteria derivation methodologies from around the world, including the USEPA guidelines, the 5th percentile is the recommended distributional estimate for criteria derivation as being reasonably protective of the overall population.

This alternative provides acute and chronic criteria for all six pyrethroids of interest, includes current data, and is more consistent with other criteria derivation methodologies such as USEPA, which uses the 5th percentile, thus this alternative will be further considered.

- Bifenthrin (Fojut 2015a): The acceptable acute data set containing eight species mean acute values was used to calculate an acute freshwater criterion of 0.8 ng/L using the 5th percentile of a log-logistic SSD. The 2015 acceptable chronic data set contained four species mean chronic values, but none could be paired with appropriate acute data. The chronic criterion of 0.1 ng/L was calculated with the updated default acute-to-chronic ratio of 11.4 and the acute 5th percentile value.

- Cyfluthrin (Fojut 2015b): Eight species mean acute values were available to calculate an acute freshwater criterion of 0.8 ng/L using the 5th percentile of a log-logistic SSD. The three species mean chronic values were paired with corresponding acute data to calculate a cyfluthrin ACR of 10.27. The chronic criterion of 0.2 ng/L was calculated with the cyfluthrin ACR and the acute 5th percentile value.

- Cypermethrin (Fojut 2015c): The acceptable acute data set containing 18 species mean acute values was used to calculate a freshwater acute criterion of

1 ng/L with the 5th percentile of a Burr Type III SSD. Two freshwater species mean chronic value available, but neither could be paired with corresponding acute data to calculate ACRs. However, paired acute and chronic values were available for one saltwater species, and this ACR was combined with two default ACRs resulting in a cypermethrin ACR of 9.2. The chronic criterion of 0.3 ng/L was calculated with the cypermethrin ACR and the acute 5th percentile value.

- Esfenvalerate (Fojut 2015d): The acceptable data set containing eight species mean acute values was used to derive a freshwater acute criterion of 2 ng/L with the 5th percentile of a log-logistic SSD. There were three species mean chronic values available, and one could be paired with a corresponding acute value to calculate an ACR. This ACR was combined with two default ACRs resulting in a esfenvalerate ACR of 12.2. The chronic criterion of 0.3 ng/L was calculated with the esfenvalerate ACR and the acute 5th percentile value.

- Lambda-cyhalothrin (Fojut 2015e): There were 20 species mean acute values in the acceptable data set, which resulted in an acute freshwater criterion of 0.7 ng/L using the 5th percentile of a Burr Type III SSD. As in the 2010 criteria, there were two species mean chronic freshwater values and a saltwater chronic value that were paired with corresponding acute data to calculate a lambda-cyhalothrin ACR of 4.73. This ACR was used with the acute 5th percentile value to calculate a freshwater chronic criterion of 0.3 ng/L.

- Permethrin (Fojut 2015f): There were 20 species mean acute values and an acute freshwater criterion of 6 ng/L was derived using the 5th percentile of a Burr Type III SSD. There were three species mean chronic values in the acceptable data set, but none could be paired with appropriate acute data to calculate ACRs. As in the 2011 criteria, one saltwater chronic value was paired with corresponding acute data. The saltwater ACR was combined with two default ACRs to result in an ACR of 8.5. This ACR was used with the acute 5th percentile value to calculate a chronic freshwater criterion of 1 ng/L.

5.3.1.3 2.5 percentile UC Davis Water Quality Criteria

As described above in sections 5.3.1.1 and 5.3.1.2, criteria derived using both the 1st and 5th percentiles of the species sensitivity distributions as calculated with the UC Davis methodology are considered as alternatives. The 1st and 5th percentile alternatives were both reviewed when the scientific basis of the proposed amendment underwent external peer review in accordance with Health and Safety Code Section 57004 in 2015. There were three peer reviewers and two of them concluded that the 1st percentile criteria may be overly conservative based on the fact that the calculated values were significantly lower (up to 56-fold) than the LC_{50} of the most sensitive species in the data sets. One of the two reviewers also noted the consistency of the 5th percentile with historic use. In response to the peer review, staff developed an

additional alternative of the 2.5 percentile UC Davis criteria in an effort to strike the balance for the five pyrethroids for which the 1st percentile criteria were derived with the peer review findings (see section 5.3.1.1). The UC Davis method recommends using the lower 95% confidence interval of the 5th percentile or the 1st percentile when adjusting downward for protection of sensitive species, but the use of the 2.5 percentile would be based on use of best professional judgement, which is also included in the UC Davis method guidance. In these five criteria, the 2.5 percentile of the distributions were used to calculate the acute and chronic criteria instead of the 5th or 1st percentile of the distributions. The 2.5 percentile criteria are all below acute (LC_{50}) and chronic toxicity values for *Hyalella azteca*, which is the most sensitive species in each data set and is resident in the project area water bodies.

This alternative provides acute and chronic criteria for all six pyrethroids of interest, includes current data, and falls within the range of values considered during independent scientific peer review. For these reasons, this alternative will be further considered.

- Bifenthrin (Fojut 2015a): The acceptable acute data set containing eight species mean acute values was used to calculate an acute freshwater criterion of 0.3 ng/L using the 2.5 percentile of a log-logistic SSD. The 2015 acceptable chronic data set contained four species mean chronic values, but none could be paired with appropriate acute data. The chronic criterion of 0.05 ng/L was calculated with the updated default acute-to-chronic ratio of 11.4 and the acute 2.5 percentile value.

- Cyfluthrin (Fojut 2015b): Eight species mean acute values were available to calculate an acute freshwater criterion of 0.3 ng/L using the 2.5 percentile of a log-logistic SSD. The three species mean chronic values were paired with corresponding acute data to calculate a cyfluthrin ACR of 10.27. The chronic criterion of 0.06 ng/L was calculated with the cyfluthrin ACR and the acute 2.5 percentile value.

- Cypermethrin (Fojut 2015c): The acceptable acute data set containing 18 species mean acute values was used to calculate a freshwater acute criterion of 0.3 ng/L with the 2.5 percentile of a Burr Type III SSD. Two freshwater species mean chronic value available, but neither could be paired with corresponding acute data to calculate ACRs. However, paired acute and chronic values were available for one saltwater species, and this ACR was combined with two default ACRs resulting in a cypermethrin ACR of 9.2. The chronic criterion of 0.07 ng/L was calculated with the cypermethrin ACR and the acute 2.5 percentile value.

- Esfenvalerate (Fojut 2015d): The acceptable data set containing eight species mean acute values was used to derive a freshwater acute criterion of 0.7 ng/L

with the 2.5 percentile of a log-logistic SSD. There were three species mean chronic values available, and one could be paired with a corresponding acute value to calculate an ACR. This ACR was combined with two default ACRs resulting in an esfenvalerate ACR of 12.2. The chronic criterion of 0.1 ng/L was calculated with the esfenvalerate ACR and the acute 2.5 percentile value.

- Lambda-cyhalothrin (Fojut 2015e): There were 20 species mean acute values in the acceptable data set, which resulted in an acute freshwater criterion of 0.2 ng/L using the 2.5 percentile of a Burr Type III SSD. There were two species mean chronic freshwater values and a saltwater chronic value that were paired with corresponding acute data to calculate a lambda-cyhalothrin ACR of 4.73. This ACR was used with the acute 2.5 percentile value to calculate a freshwater chronic criterion of 0.08 ng/L.

- Permethrin (Fojut 2015f): There were 20 species mean acute values and an acute freshwater criterion of 6 ng/L was derived using the 5th percentile of a Burr Type III SSD. There were three species mean chronic values in the acceptable data set, but none could be paired with appropriate acute data to calculate ACRs. As in the 2011 criteria, one saltwater chronic value was paired with corresponding acute data. The saltwater ACR was combined with two default ACRs to result in an ACR of 8.5. This ACR was used with the acute 5th percentile value to calculate a chronic freshwater criterion of 1 ng/L.

5.3.2 **2015 water quality criteria derived via USEPA method**

In the UC-Davis criteria reports for pyrethroids, the authors used the data sets gathered according to the UC Davis method to derive criteria according to the USEPA method (Table 5-6). These criteria were not issued or reviewed by the USEPA, but did follow the USEPA 1985 Guidelines (USEPA 1985) as described above in section A.3. There were sufficient data to derive acute criteria for bifenthrin, cypermethrin, lambda-cyhalothrin, and permethrin. The acute data sets for these four pyrethroids met seven of eight taxa requirements, but an exception was made because the missing taxon (a phylum not already represented, e.g., a mollusk) is known to be insensitive to pyrethroids, which was also done in the CDFW hazard assessment (section A.3). There were sufficient data to calculate an acute-to-chronic ratio and a chronic criterion for lambda-cyhalothrin, but chronic criteria could not be calculated for any other pyrethroids.

Table 5-6 Water quality criteria derived following the USEPA guidelines (USEPA 1985) All concentrations in ng/L.

Pesticide	Criterion maximum concentration (acute)	Criterion continuous concentration (chronic)
Bifenthrin[a]	0.059	Not calculable
Cyfluthrin	Not calculable	Not calculable
Cypermethrin[b]	0.25	Not calculable
Esfenvalerate	Not calculable	Not calculable
Lambda-cyhalothrin[c]	0.21	0.087
Permethrin[d]	4	Not calculable

[a]Fojut 2015a; [b]Fojut 2015c; [c]Fojut 2015e; [d]Fojut 2015f.

The criteria derived using the USEPA method are lower than the water quality criteria derived using the 5th percentile of the SSD in the UC Davis method (section 5.3.1.2), higher than the 1st percentile UC Davis criteria, except for bifenthrin, which is approximately equal to the criterion maximum concentration (section 5.3.1.1), and they are lower or approximately equal to the 2.5 percentile UC Davis criteria (section 5.3.1.3).

The available values are below LC_{50}s for the sensitive species *Hyalella azteca* and use the USEPA methodology, which would be consistent with Clean Water Act guidance for developing water quality standards. While chronic criteria are not available for five of the six pyrethroids, and acute criteria are available for four of the six pyrethroids, this alternative will be further considered because they could be used in combination with values from another method to cover acute and chronic criteria for all six pyrethroids of interest.

5.4 Sediment Pyrethroid Concentration Goal Alternatives

Sediment quality criteria for the protection of aquatic life have not been derived for many current-use pesticides, and in fact, there are very few jurisdictions that even have a methodology to derive sediment quality criteria (Fojut et al. 2011, 2013). Because there is uncertainty in the science of deriving sediment concentration goals, flexibility rather than consistency is preferred for sediment concentration goals. Humans have little contact with sediments and we have no information regarding human health effects from contact with pyrethroid-contaminated sediments, therefore staff assumes that the freshwater habitat beneficial uses (WARM/COLD) are the most sensitive to pyrethroids in sediments.

There are eight alternatives considered for establishing concentration goals for pyrethroids in sediment (Table 5-7):

1. No change - continue to interpret narrative objectives (evaluation guidelines);
2. No pyrethroids in sediments;

3. Maximum acceptable toxicant concentration (MATC) for the most sensitive species available (chronic toxicity value);
4. Dutch maximum permissible concentration;
5. Equilibrium partitioning sediment guidelines (ESG_{OC})
    a. Based on chronic 1st percentile UC Davis water quality criteria
    b. Based on chronic 2.5 percentile UC Davis water quality criteria
    c. Based on chronic 5th percentile UC Davis water quality criteria
    d. Based on chronic USEPA water quality criteria.

Table 5-7 Available sediment quality criteria and guidelines for pyrethroids

	Bifenthrin	Cyfluthrin	Lambda-Cyhalothrin	Cypermethrin	Esfenvalerate	Permethrin
Aquatic life criteria for freshwater sediments						
Evaluation guidelines used in 2010 update of 303(d) list – Central Valley Region[a]	0.52 µg/g OC	1.08 µg/g OC	0.45 µg/g OC	0.38 µg/g OC	1.54 µg/g OC	10.83 µg/g OC
Evaluation guidelines proposed for 2012 update of 303(d) list[b]	0.43 µg/g OC	1.1 µg/g OC	0.44 µg/g OC	0.3 µg/g OC	1.5 µg/g OC	8.9 µg/g OC
10-day *Hyalella azteca* MATC	0.03 µg/g OC	0.015 µg/g OC	0.054 µg/g OC	0.25 µg/g OC	0.24 µg/g OC	0.43 µg/g OC
Dutch maximum permissible concentration[f] (chronic criterion)	4.8 µg/kg DW (0.048 µg/g OC)	NA	NA	0.39 µg/kg DW (0.0039 µg/g OC)	NA	0.87 µg/kg DW (0.0087 µg/g OC)
ESG_{OC} based on chronic 1st percentile UCD chronic WQC	0.01 µg/g OC	0.01 µg/g OC	0.01 µg/g OC	0.01 µg/g OC	0.03 µg/g OC	0.9 µg/g OC
ESG_{OC} based on chronic 2.5 percentile UCD chronic WQC	0.05 µg/ g OC	0.04 µg/g OC	0.06 µg/g OC	0.04 µg/g OC	0.1 µg/g OC	0.9 µg/g OC
ESG_{OC} based on chronic 5th percentile UCD chronic WQC	0.1 µg/g OC	0.1 µg/g OC	0.2 µg/g OC	0.2 µg/g OC	0.3 µg/g OC	0.9 µg/g OC
ESG_{OC} based on chronic USEPA WQC (CCC)	NA	NA	0.06 µg/g OC	NA	NA	NA

NA: not available; OC: organic carbon; DW: dry weight; ESGOC: OC-normalized equilibrium sediment guideline. Sources: [a]10-day sediment LC_{50} for *Hyalella azteca* (SWRCB 2010); [b]10-day sediment LC_{50} for *Hyalella azteca* (CRRWQCB 2014); [c]Amweg et al. 2005, [d]Amweg and Weston 2007; [e]Maund et al. 2002; [f]Crommentuijn et al. 2000.

First, these alternatives were evaluated based on the four factors, listed below, to determine whether they should be further considered as potential pyrethroid concentration goals. An evaluation of each of the alternatives and these factors is shown in Table 5-8 and the following sections describe the alternatives and their evaluation in more detail.

- Data sources and calculation method were clearly identified so that sources can be checked for quality and errors
- Availability for the six pyrethroids of interest
- Comparison of values with toxicity values of appropriate duration for the most sensitive species in the data sets (*Hyalella azteca*)
- Flexibility to change as technical information becomes available.

Six alternatives scored well overall on the initial evaluation factors and these six alternatives were then further considered to determine whether to adjust criteria into water quality objectives based on Porter-Cologne considerations and other applicable laws and policies in section 5.6. The six alternatives that are further considered are:

1. No change - continue to interpret narrative objectives;
2. No pyrethroids in sediments;
3. Maximum acceptable toxicant concentration (MATC) for the most sensitive species available (chronic toxicity value);
4. Equilibrium partitioning sediment guidelines (ESG_{OC})
    a. Based on chronic 1st percentile UC Davis water quality criteria
    b. Based on chronic 2.5 percentile UC Davis water quality criteria
    c. Based on chronic 5th percentile UC Davis water quality criteria.

Table 5-8 Sediment pyrethroid concentration goal alternatives and evaluation factors

Alternative	Transparent data source and calculation	Values available for all 6 pyrethroids	Values are below *H. azteca* LC_{50}s	Flexibility
No change – interpret with evaluation guidelines	Yes	Yes	No for current evaluation guidelines	Yes
No pyrethroids	Yes	Yes	Yes	No
MATCs	Yes	Yes	Yes	No
Dutch maximum permissible concentration	No	No	Yes	No
ESG_{OC} based on chronic 1st percentile UCD chronic WQC	Yes	Yes	Yes	No
ESG_{OC} based on chronic 2.5 percentile UCD chronic WQC	Yes	Yes	Yes	No
ESG_{OC} based on chronic 5th percentile UCD chronic WQC	Yes	Yes	Yes	No
ESG_{OC} based on chronic USEPA WQC (CCC)	Yes	No	Yes	No

5.4.1 No Change – continue to interpret narrative objectives

The Basin Plan currently contains narrative water quality objectives regarding pesticides and toxicity. The Central Valley Water Board uses available guidelines and criteria to interpret existing narrative water quality objectives. The Central Valley Water Board has not established criteria specifically for pyrethroids to interpret compliance with its narrative water quality objectives for toxicity and pesticides.

In the past, such as on the 2010 update to the 303(d) list, sediment toxicity due to pyrethroids has been identified as impairing water bodies. In these cases, demonstration of statistically significant toxicity compared to controls was used to interpret the narrative toxicity water quality objective (i.e., “no toxics in toxic amounts”). Sediment chemistry data have been interpreted using a toxicity unit analysis, in which sediment concentrations normalized to organic carbon content of the sediment were compared to OC-normalized LC_{50}s for sediment-bound pyrethroids. The evaluation guidelines used to interpret pyrethroid sediment concentrations may change as new toxicity information becomes available, so the LC_{50}s used in the past may not always be the numeric evaluation guidelines in the future. This alternative would not provide consistent values to be used across the Basin over time, because the numbers may change as new technical information becomes available.

The “no change” alternative will be further considered for pyrethroids because it would apply if numeric objectives for sediments are not established and allows flexibility in the values used to interpret the narrative objectives.

5.4.2 No Pyrethroids in Sediments

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 that detectable levels of pyrethroids in sediments would not be allowed. California’s antidegradation policies allow for the presence of pyrethroids if that presence is consistent with maximum benefit to the people of the state, and does not unreasonably affect present and anticipated beneficial uses, and does not result in water quality less than that prescribed in existing policies (State Water Board Resolution 68-16 and 40 CFR 131.12).

The Central Valley Water Board could make a determination that allowing the presence of any pyrethroids in sediments is not to the maximum benefit of the people of the state, which would serve as the basis for a no pyrethroids objective for sediment. Alternatively, the Central Valley Water Board could determine that allowing the presence of some pyrethroids in sediments is consistent with the maximum benefit to the people of the state, but that the concentration consistent with the maximum benefit is less than the highest concentration that would be protective of beneficial uses.

However, as long as pyrethroids remain registered for widespread use, completely eliminating all detections of pyrethroids in sediment would require cessation or an unfeasible level of treatment of all MS4 and POTW discharges and either cessation or an infeasible level of treatment for agricultural discharges or cessation agricultural pyrethroid uses. Therefore, this alternative does not meet the overall project goal of reasonable protection of beneficial uses, so it will not be further considered.

5.4.3 Maximum Acceptable Toxicant Concentrations (MATC)

Maximum acceptable toxicant concentrations are chronic toxicity values from single-species laboratory toxicity tests. MATCs are typically calculated as the geometric mean of the no-observed effect concentration and the lowest-observed effect concentration. The MATC is an approximation of a no-effect level for the tested species, but is not necessarily the no-effect level for all species in an aquatic ecosystem. If the test species is the most sensitive species in an ecosystem, then the MATC should be protective of the entire ecosystem. MATCs are available for the priority pyrethroids for at least two species (Table 5-9). When more than one MATC is available, the value for the most sensitive species is used for this evaluation. This alternative will be further considered because these values would likely be more protective of aquatic ecosystems than those used to interpret the narrative objectives in the recent past, which were LC_{50}s, and they are available for sensitive species for all six priority pyrethroids.

Table 5-9 Sediment-based MATCs available for the priority pyrethroids

Chemical	Species	Endpoint	OC-normal MATC (µg/g OC)[a]	Reference
Bifenthrin	*Hyalella azteca*	10 d Growth	**0.03***	Picard 2010a
	H. azteca	10 d Survival	0.12	Picard 2010a
	Chironomus dilutus	10 d Survival	6.45	Picard 2010b
Cyfluthrin	*H. azteca*	10 d Growth	**0.015***	Picard 2010c
	H. azteca	10 d Survival	0.063	Picard 2010c
	C. dilutus	10 d Survival	0.85	Picard 2010d
Cypermethrin	*H. azteca*	10 d Growth	0.12	Picard 2009a
			0.40	Picard 2009c
			0.61	Picard 2009d
			0.13	Picard 2009e
			0.25*	Geometric Mean
	H. azteca	10 d Survival	0.21	Picard 2009a
			0.79	Picard 2009b
			0.75	Picard 2009c
			1.18	Picard 2009d
			0.65	Picard 2009e
			0.080	Picard 2010f
			0.44	Geometric Mean
	C. dilutus	10 d Survival	2.03	Picard 2010g
Esfenvalerate	*H. azteca*	10 d Survival	**0.24***	Picard 2010h
	C. dilutus	10 d Survival	7.69	Picard 2010i
Lambda-cyhalothrin	*H. azteca*	10 d Survival	**0.054***	Picard 2010j
	C. dilutus	10 d Growth	1.09	Picard 2010k
	C. dilutus	10 d Survival	2.10	Picard 2010k
Permethrin	*H. azteca*	10 d Growth	**0.43***	Picard 2010l
	H. azteca	10 d Survival	1.61	Picard 2010l
	C. dilutus	10 d Survival	7.74	Picard 2010m

[a] Calculated as the geometric mean of the reported NOEC and LOEC divided by the reported OC content.
* Indicates the MATC for the most sensitive species-endpoint for each chemical.

5.4.4 Sediment Quality Criteria

Sediment quality criteria are analogous to water quality criteria. For both types of criteria the goal is to approximate a no-effect level for all species in an ecosystem using data from multiple species, if they are available. Using sediment quality criteria as objectives would be preferable to using MATCs because SQC are designed to be protective of the entire ecosystem, whereas MATCs are only known to be protective of a single species.

UC Davis developed a draft methodology for derivation of sediment quality criteria (Fojut et al. 2014), but the methodology has not been finalized. To test the method, UC Davis used the methodology to derive sediment quality criteria for three pyrethroids (bifenthrin, permethrin, and esfenvalerate), and in this process found that so little sediment toxicity data were available for these compounds that the methodology could not be fully vetted. Thus, the sediment quality criteria for these compounds are termed interim values to indicate that it is not yet clear whether the method produces criteria that are likely to be protective of all species in aquatic ecosystems. The UC Davis methodology and interim criteria will not be further considered because of the high level of uncertainty in the interim criteria and the draft methodology.

5.4.4.1 Dutch maximum permissible concentrations

There are sediment quality criteria available from the Dutch National Institute of Public Health and the Environment, termed maximum permissible concentrations ($MPC_{sediment}$), which are analogous to chronic criteria (Crommentuijn et al. 2000). These values are available for three of the priority pyrethroids: bifenthrin, cypermethrin, and permethrin (Table 5-7). These values were calculated using the equilibrium partitioning approach, which is determined using the water quality criteria (termed MPC_{water} in the Dutch documents) and the solid-water partition coefficient (K_d). In the Dutch report, the following equation was used to calculate MPCs in sediment:

Equation 5

$$MPC_{sediment} = MPC_{water} * K_d$$

The specific toxicity values used to calculate the MPC_{water} values were not reported (section A.8), and the individual values and sources are not reported for the solid-water partition coefficients used to calculate the $MPC_{sediment}$ values. Because it is not possible to review these data sources, the Dutch $MPC_{sediment}$ values will not be further considered.

5.4.4.2 Equilibrium partitioning sediment guidelines

The US EPA proposed a similar equilibrium partitioning approach as used in the Dutch method (USEPA 2002); however values were normalized to the organic carbon content of the sediment as follows:

Equation 6

$$ESG_{OC} = FCV * K_{OC}$$

Where:
ESG_{OC} = organic carbon-normalized equilibrium sediment guideline
FCV = final chronic value from the US EPA water criteria method (USEPA 1985; FCV is typically equivalent to the chronic water quality criterion)
K_{OC} = organic carbon-normalized sediment-water partition coefficient

Equation 6 was used to calculate sediment criteria (or guidelines) based on equilibrium partitioning. The ESG_{OC} values were calculated with the 1st, 2.5, and 5th percentile UC Davis chronic water quality criteria (sections 5.3.1.1, 5.3.1.3, 5.3.1.2) and the lambda-cyhalothrin chronic criterion calculated using the USEPA method (section 5.3.2). The K_{OC} values used to calculate the ESG_{OC} values were determined for the conditions used in sediment toxicity tests (i.e., a sediment:solution ratio of 1:2) provided in Table 5-10.

The ESG_{OC} values can be compared to sediment LC_{50} values (also given in Table 2-2) and MATCs (Table 5-9) to assess whether the ESG_{OC} values would likely be protective of aquatic organisms. This comparison is important because the ESG_{OC} values are calculated based on water column toxicity data, and comparing the values to known sediment data provides a way to ensure that the overall calculation approach is valid for these data sets. All of the ESG_{OC} values based on criteria derived with the UC-Davis and USEPA methods are lower than the sediment LC_{50} values, indicating that the ESG_{OC} values would likely be protective of acute effects to a known sensitive species.

The ESG_{OC} values derived using the 1st percentile UC Davis chronic criteria for five of the pyrethroids are below the lowest MATCs, indicating that the ESG_{OC} values would likely be protective of chronic effects to a known sensitive species for these compounds. Only the ESG_{OC} value derived using the chronic criteria from the UC Davis method for permethrin was above the lowest MATC, by approximately a factor of 2, indicating that the ESG_{OC} may not be protective of sediment species for this compound. Four of six of the ESG_{OC} values calculated using the 2.5 percentile and 5th percentile criteria from the UC Davis method are above the MATCs. Based on this data comparison, it appears that the ESG_{OC} based on the 2.5 or 5th percentile UC Davis water quality criteria may not be protective of sensitive aquatic organisms in sediment in all conditions, but that ESG_{OC} based on the 1st percentile UC Davis water quality criteria would likely be protective of sensitive aquatic organisms in sediment. The is ESG_{OC} alternatives based on the 1st, 2.5 and 5th percentile UC Davis chronic criteria will be further considered because these values would likely be more protective of aquatic ecosystems than those used to interpret the narrative objectives in the recent past, which were LC_{50}s, and they are available for sensitive species for all six priority pyrethroids.

Table 5-10 Equilibrium sediment guidelines normalized to organic carbon (ESG_{OC}) for six pyrethroids

	Bifenthrin	Cyfluthrin	Cypermethrin	Esfenvalerate	Lambda-cyhalothrin	Permethrin
K_{OC}[a]	1,030,000	670,000	588,000	1,133,000	740,000	850,000
1st percentile UCD chronic criteria (ng/L)[b]	0.01	0.01	0.01	0.03	0.01	1
2.5 percentile UCD chronic criteria (ng/L)[b]	0.05	0.06	0.07	0.1	0.08	1
5th percentile UCD chronic criteria (ng/L) [b]	0.1	0.2	0.3	0.3	0.3	1
2015 chronic criteria via USEPA (ng/L)[b]					0.087	
ESG_{OC} based on 1st percentile UCD criteria (μg/g OC)	0.01	0.01	0.01	0.03	0.01	0.9
ESG_{OC} based on 2.5 percentile UCD criteria (μg/g OC)	0.05	0.04	0.04	0.1	0.06	0.9
ESG_{OC} based on 5th percentile UCD criteria (μg/g OC)	0.1	0.1	0.2	0.3	0.2	0.9
ESG_{OC} based on USEPA criteria (μg/g OC)					0.06	
Hyalella azteca LC_{50} (μg/g OC)[c]	0.43	1.08	0.34	1.53	0.45	8.68
Lowest MATC (μg/g OC)[d]	0.03	0.015	0.25	0.054	0.24	0.43

[a]Chickering 2015. [b]See Table 5-4, [c]See Table 2-2, [d]See Table 5-9.

5.5 Summary of Potential Pyrethroid Concentration Goals Derived by Alternate Methods

The alternatives that are further considered as potential pyrethroid concentration goals are summarized below. In the following section, these remaining alternatives are evaluated with respect to Porter-Cologne requirements and other applicable laws and policies. The alternative potential pyrethroid concentration goals are summarized in Table 5-11 and Table 5-12 for the aqueous pyrethroids and sediment-bound pyrethroids, respectively.

5.5.1 **Aqueous concentrations alternatives**

Water quality criteria based on the 1st, 2.5 or 5th percentile derived via University of California Davis method alternative would establish pyrethroid concentrations goals including the six pyrethroids of interest (bifenthrin, cyfluthrin, cypermethrin,

esfenvalerate, lambda-cyhalothrin, and permethrin) (section 5.3.1.1, 5.3.1.2, or 5.3.1.3). Under this alternative, the six pyrethroids would be considered additively and measured or estimated freely dissolved concentrations could be used to determine whether the concentration goals are achieved.

Under the 2015 water quality criteria derived via USEPA method alternative, the acute concentration for bifenthrin, cypermethrin, lambda-cyhalothrin, and permethrin would be the criteria calculated using the USEPA method and the 2015 data sets (section 5.3.2). Criteria are not available for cyfluthrin and esfenvalerate under this alternative, so values from a different alternative would be needed for the concentration goals for these compounds. Chronic criteria are not available for five of the six pyrethroids under this alternative, thus only the lambda-cyhalothrin chronic criterion could be used in a chronic concentration goal under this alternative and values from another alternative would be needed for the other five pyrethroids. Under this alternative, staff recommends that the six pyrethroids would be considered additively and measured or estimated freely dissolved concentrations could be used to determine whether the concentration goals are achieved, although these recommendations are not part of USEPA guidance.

Table 5-11 Summary of pyrethroid concentration goals alternatives – Aqueous concentrations (ng/L) and water column toxicity values for *Hyalella azteca*

Alternative	1st percentile 2015 UC Davis criteria		5th percentile 2015 UC Davis criteria		2.5 percentile 2015 UC Davis criteria		2015 criteria via USEPA method		*Hyalella azteca* 96-hour LC_{50}[a]
	Acute	Chronic	Acute	Chronic	Acute	Chronic	Acute	Chronic	
Bifenthrin	0.06	0.01	0.8	0.1	0.3	0.05	0.059	--	0.5
Cyfluthrin	0.07	0.01	0.8	0.2	0.3	0.06	--	--	0.55
Cypermethrin	0.04	0.01	1	0.3	0.3	0.07	0.25	0.087	0.56
Esfenvalerate	0.2	0.03	2	0.3	0.7	0.1	--	--	0.85
Lambda-cyhalothrin	0.03	0.01	0.7	0.3	0.2	0.08	0.21	--	0.3
Permethrin	6	1	6	1	6	1	4	--	7

[a]LC_{50}: concentration lethal to 50% of test organisms

5.5.2 Sediment concentrations alternatives

The “No change” alternative for sediment concentrations would not establish numeric concentration goals for sediment-bound pyrethroids in the Sacramento and San Joaquin River basin water bodies. Under this alternative, the best available technical information would continue to be used to interpret the narrative water quality objectives.

The MATC alternative for sediment would establish concentration goals for the six pyrethroids in sediment (section 5.4.3). Under this alternative, the six pyrethroids would be considered additively.

The sediment quality criteria (ESG_{OC}) alternative for sediment would establish concentration goals for the six pyrethroids in sediment based on the 1st, 2.5, or 5th percentile chronic UC Davis water quality criteria (section 5.4.4). Under this alternative, the six pyrethroids would be considered additively.

Table 5-12 Summary of pyrethroid concentration goal alternatives – Sediment concentrations (μg/g OC) and sediment toxicity values for *Hyalella azteca*

Alternative	No Change	MATC (μg/g OC)	ESG_{OC} based on 1st percentile UCD criteria (μg/g OC)	ESG_{OC} based on 2.5 percentile UCD criteria (μg/g OC)	ESG_{OC} based on 5th percentile UCD criteria (μg/g OC)	*Hyalella azteca* sediment LC_{50}[a] (μg/g OC)
Bifenthrin	Best available technical value	0.03	0.01	0.05	0.1	0.43
Cyfluthrin		0.015	0.01	0.04	0.1	1.08
Cypermethrin		0.25	0.01	0.04	0.2	0.34
Esfenvalerate		0.24	0.03	0.1	0.3	1.5
Lambda-cyhalothrin		0.054	0.1	0.06	0.2	0.45
Permethrin		0.43	0.9	0.9	0.9	8.7

[a]LC_{50}: concentration lethal to 50% of test organisms

5.6 Evaluation of Pyrethroid Concentration Goal Alternatives

This section evaluates the alternatives for establishing pyrethroid concentration goals with respect to the Porter-Cologne Water Quality Control Act and other applicable state and federal laws and policies. Section 13241 of Porter-Cologne specifies the following considerations in establishing water quality objectives:

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

Based on limitations on available information on the achievability and economics of achieving different alternatives, staff has determined that a robust analysis of all of the above factors could not be conducted. Adopting pyrethroid water quality objectives is not recommended at this time because: 1) there is insufficient information available to evaluate the extent of implementation of management practices that would be required to attain pyrethroid water quality objectives and to complete the economic analysis of implementing practices to that extent (sections 5.6.3 and 0.), and there is potential for significant regulatory consequences should an inappropriate water quality objective be adopted. Staff is recommending the use of numeric triggers and targets based on scientific criteria to move toward water quality improvement while additional information is developed on achievability and costs of implementation measures. In the following sections, the available information is utilized to evaluate potential pyrethroid concentration goals relative to the Porter Cologne section 13241 factors, consistency with State and Federal laws and policies, and meeting the overall project goal and objectives. While a full analysis of the 13241 factors cannot be performed at this time, these are important considerations in establishing concentration goals, and discussion of these factors will better describe the information that will need to be gathered for future Board consideration.

5.6.1 **Beneficial Uses**

Federal law requires that states adopt criteria that protect the beneficial uses and that the most sensitive uses are protected. (40 C.F.R. § 131.11(a).) In addition, state law requires the reasonable protection of beneficial uses. (Wat. Code, § 13241, et seq.) In this section, each potential pyrethroid concentration goal is evaluated for the requirement to protect beneficial uses.

5.6.1.1 Aqueous concentrations

For aqueous concentrations, there were three considerations for evaluating whether the potential pyrethroid concentration goal is consistent with protection of beneficial uses:

- Protection of known sensitive species (e.g. *Hyalella azteca)*
    - Table 5-11 shows the aquatic concentration goal alternatives and the 96-hour LC_{50} for *Hyalella azteca.*
- Expected sediment concentrations if potential aqueous pyrethroid concentration goal is achieved
    - Table 5-13 shows calculated maximum sediment concentrations and sediment toxicity thresholds for *Hyalella azteca*
- Consideration of conservative assumptions and issues that are not accounted for with the potential aqueous pyrethroid concentration goals.

5.6.1.1.1 *1st percentile 2015 UC Davis Water Quality Criteria*

Similar to the USEPA criteria method, the UC Davis method uses acute and chronic toxicity data for a wide range of species. The criteria derived using the UC Davis

method are expressed in the same averaging period (hourly and 4-day) and allowable exceedance frequency (once every three years) as is used in the USEPA method.

The 1st percentile 2015 UC Davis criteria would be protective of *Hyalella azteca* and other sensitive species based on a comparison of these criteria to current toxicity data (see Table 5-14).

The estimated maximum sediment concentrations if the 1st percentile UC Davis criteria were achieved in the water column are all below sediment LC_{50} values for *Hyalella azteca*, the most sensitive species in the sediment data sets (Table 5-13). Therefore attaining the 1st percentile criteria in the water column would be expected to resolve the sediment toxicity that was the basis for most of the pyrethroid listings. Four of the six pyrethroids calculated maximum expected sediment concentrations exceeded the *Hyalella azteca* sediment chronic toxicity values, which are estimates of no-effect levels for this species. All calculations are based on the conservative assumption that all of the bed sediment an organism is exposed to would contain pyrethroids at the expected levels, but it is likely that it is mixed with sediments that do not contain pyrethroids.

Because the 1st percentile chronic criteria are a factor of 28-56 below the 96-hour *Hyalella azteca* LC_{50}s it would be expected that sensitive species would be protected even at lower temperatures, and have more protection from additive or synergistic effects with other chemicals. It is also possible that in some cases, the 1st percentile UC Davis criteria may be lower than necessary to provide protection of beneficial uses, based on the exceedance frequency and averaging periods for the criteria and the fact that they are 28-56 times lower than the toxicity values for the most sensitive tested species. Based on this overall evaluation, the UC Davis criteria are expected to be protective of all freshwater habitat beneficial uses in the Sacramento and San Joaquin River basin water bodies, but may be overprotective in some circumstances.

5.6.1.1.2 *5th percentile UC Davis Water Quality Criteria*

The chronic water quality criteria derived using the UC Davis method based on the 5th percentile of the species sensitivity distributions were below the 96-hour LC_{50} for the sensitive species *Hyalella azteca* for five of six pyrethroids (see Table 5-14), and one was equal to it.

For three pyrethroids, the estimated maximum sediment concentrations if the 5th percentile criteria are met in the water column exceed sediment LC_{50} values for *Hyalella azteca*, the most sensitive species in the sediment data sets (Table 5-13). Therefore, waters attaining the 5th percentile criteria could exhibit toxicity to *H. azteca* in sediments, which has been determined by the Board to be an exceedance of water quality standards. For the remaining three pyrethroids, the calculated maximum expected sediment concentrations if the 5th percentile UC Davis criteria were achieved are less

than a factor of 2 below sediment LC_{50} values for *Hyalella azteca*. The calculated maximum expected sediment concentrations for all six pyrethroids exceeded the *Hyalella azteca* sediment chronic toxicity values, which are estimates of no-effect levels for this species. All calculations are based on the conservative assumption that all of the bed sediment an organism is exposed to would contain pyrethroids at the expected levels, but it is likely that it is mixed with sediments that do not contain pyrethroids.

Concentration goals based on the 5th percentile UC Davis criteria are just below or at the thresholds of potential toxic effects on the most sensitive aquatic species, *H. azteca*. Additionally, the 5th percentile is consistent with the level of protection for aquatic life beneficial uses in USEPA's aquatic life criteria derivation methodology and is in line with recommendations from two of the three independent scientific peer reviewers as reasonable protection of aquatic life.

5.6.1.1.3 *2.5 percentile 2015 UC Davis Water Quality Criteria*

There is concern from some stakeholders and two of the peer reviewers that the 1st percentile criteria may be overprotective of beneficial uses and concern from other stakeholders that the 5th percentile criteria may be underprotective of beneficial uses, so criteria were also calculated with the 2.5 percentile of the species sensitivity distribution. The acute and chronic water quality criteria based on the 2.5 percentile are all below the LC_{50}s for *Hyalella azteca,* the most sensitive species in the data sets (see Table 5-11), and therefore these criteria are expected to be protective of this species and other similarly sensitive species.

The calculated maximum sediment concentrations if the 2.5 percentile UC Davis criteria were achieved are all below sediment LC_{50} values for *Hyalella azteca*, the most sensitive species in the sediment data sets (Table 5-13). Therefore, attaining the 2.5 percentile criteria in the water column would be expected to resolve the sediment toxicity that was the basis for most of the pyrethroid listings. Five of the six pyrethroids calculated maximum expected sediment concentrations exceeded the *Hyalella azteca* sediment chronic toxicity values, which are estimates of no-effect levels for this species. All calculations are based on the conservative assumption that all of the bed sediment an organism is exposed to would contain pyrethroids at the expected levels, but it is likely that it is mixed with sediments that do not contain pyrethroids.

The 2.5 percentile chronic criteria are a factor of 4 to 10 below the *Hyalella azteca* LC_{50}s. Based on this overall evaluation, the UC Davis criteria based on the 2.5 percentile are expected to provide protection of freshwater habitat beneficial uses.

5.6.1.1.4 *2015 Criteria via USEPA method*

Criteria were derived using the USEPA method and the acute and chronic toxicity data sets gathered as part of the derivation of 2015 criteria using the UC Davis method. 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. Acute water quality criteria derived with the USEPA method could only be derived for four of the six pyrethroids of interest (bifenthrin, cypermethrin, lambda-cyhalothrin, and permethrin). In addition, a chronic criterion could only be derived for lambda-cyhalothrin. These values are not approved or promulgated by USEPA, but were derived by following the USEPA method with the exception that the data sets used to derive them were incomplete. The criteria were derived with incomplete data sets because the only missing taxon is known to be particularly insensitive to pyrethroids, and the lack of the taxon would not lead to an underestimation of toxic effects. This practice was consistent with the CDFW interim criteria that were derived for several pyrethroids. These criteria would be protective of *Hyalella azteca* and other sensitive species based on current toxicity data (see Table 5-11).

The calculated maximum expected sediment concentration could only be calculated for lambda-cyhalothrin, the only compound for which there is a chronic criterion available. The lambda-cyhalothrin calculated maximum expected sediment concentration of 0.18 µg/g OC is below the sediment LC_{50} value for *Hyalella azteca*, but is above the *Hyalella azteca* chronic toxicity value (Table 5-13), indicating that while acute effects may not be expected, sublethal effects may occur. This calculation is based on the conservative assumption that all of the bed sediment an organism is exposed to would contain pyrethroids at the expected levels, but it is likely that it is mixed with sediments that do not contain pyrethroids.

These criteria are expected to be protective of all freshwater habitat uses in the Sacramento and San Joaquin River basin water bodies for the compounds and averaging periods for which they are available. Acute values from a different alternative would be needed for the remaining two pyrethroids and for chronic averaging periods for the remaining five pyrethroids to protect aquatic life beneficial uses from all six pyrethroids.

Table 5-13 Calculated maximum sediment concentration ($C_{sediment}$) if potential pyrethroid concentration goals are achieved and acute (LC_{50}) and chronic (maximum acceptable toxicant concentration [MATC]) toxicity values for *Hyalella azteca*. $C_{sediment}$ was calculated as the product of the organic carbon-normalized partition coefficient (Koc) and the chronic water quality criteria (WQC).

	Bifenthrin	Cyfluthrin	Cypermethrin	Esfenvalerate	Lambda-cyhalothrin	Permethrin
Koc (L/kg OC)	4,228,000	3,870,000	3,105,000	7,220,000	2,056,000	6,075,000
1st Chronic WQC (ng/L)	0.01	0.01	0.01	0.01	0.03	1
2.5 Chronic WQC (ng/L)	0.05	0.06	0.07	0.1	0.08	1
5th Chronic WQC (ng/L)	0.1	0.2	0.3	0.3	0.3	1
1st - $C_{sediment}$ (µg/g OC)	0.042	0.039	0.031	0.072	0.062	6.1
2.5 - $C_{sediment}$ (µg/g OC)	0.21	0.23	0.22	0.72	0.16	6.1
5th - $C_{sediment}$ (µg/g OC)	0.42	0.77	0.932	2.2	0.62	6.1
Sediment LC_{50} (µg/g OC)	0.43	1.08	0.34	1.5	0.45	8.7
Sediment MATC (µg/g OC)	0.03	0.015	0.25	0.24	0.054	0.43

5.6.1.2 Sediment

Table 5-15 shows the sediment concentration goal alternatives and toxicity thresholds for *Hyalella azteca*.

5.6.1.2.1 *No Sediment Concentration Goal*

There were 14 listings for sediment toxicity caused by pyrethroids on the 2010 update to the 303(d) list. The evaluation guideline used for these listings was a statistically significant difference between the sample and control sediments using Dunnett's test in 10-day *Hyalella azteca* sediment toxicity tests. To evaluate sediment chemistry data, laboratory sediment toxicity values (LC_{50}s) for *Hyalella azteca* were used. With no numeric concentration goal established for sediment, numeric evaluation guidelines protective of the most sensitive beneficial use would continue to be used to interpret the narrative water quality objectives. WARM/COLD beneficial uses are the most sensitive to pyrethroids, thus, the evaluation guidelines should be at a level expected to be protective of freshwater habitat uses. Toxicity values are available for all six pyrethroids for *Hyalella azteca*, which is known to be particularly sensitive to pyrethroids, and if these toxicity values are used as the evaluation guidelines, then they should be protective of acute effects on benthic species. If sediment toxicity test data is available, data would be evaluated based on significant statistical difference from the control. The "no change" option would be fully protective of beneficial uses because the most current

toxicity data would be used for assessing attainment with the narrative objectives as well as toxicity test results that would demonstrate whether these data are predictive of ambient toxicity.

5.6.1.2.2 *Maximum Acceptable Toxicant Concentration (MATC)*

MATCs are likely to be protective of the WARM/COLD beneficial uses if the available values are for sensitive species, such as *Hyalella azteca.* MATCs are available for the six priority pyrethroids from tests with *H. azteca*, thus it is likely that these values would be protective of all aquatic life in the Sacramento and San Joaquin River basin water bodies.

5.6.1.2.3 *Sediment quality criteria - ESG_{OC}*

Sediment quality criteria in the form of organic carbon-normalized equilibrium sediment guidelines (ESG_{OC}) are likely to be protective of the WARM/COLD beneficial uses if they appear to be protective of sensitive species, such as *Hyalella azteca.* Organic carbon-normalized equilibrium sediment guidelines were calculated for the six priority pyrethroids based on chronic criteria derived by the UC Davis method based on the 1st, 2.5, and 5th percentile of the species sensitivity distributions. The ESG_{OC} were compared to sediment LC_{50}s and MATCs for *H. azteca*, and the ESG_{OC}'s based on the 1st percentile chronic criterion were at or below MATCs for a majority of pyrethroids, thus it is likely that these values would be protective of all aquatic life in the Sacramento and San Joaquin River basin water bodies. It is less clear if ESG_{OC} values based on the 2.5 or 5th percentile chronic criteria would be protective of aquatic life beneficial uses because for these two alternatives, the values exceeded MATCs for four of the six priority pyrethroids. However, ESG_{OC} values for all of the percentile alternatives were below *H. azteca* LC_{50} values, indicating that all of the ESG_{OC} alternatives are likely to provide some level of protection of the WARM/COLD beneficial uses.

5.6.2 **Environmental Characteristics and Quality of Water Available**

Environmental characteristics of the water available, such as temperature and dissolved and particulate organic matter may alter the toxic potential or bioavailability of pyrethroids. Many water bodies also contain other pesticides and toxic pollutants that can have additive or synergistic toxicity with pyrethroids. The proposed concentration goals would account for the effect of organic matter on the toxic potential of pyrethroids by allowing the use of freely dissolved concentrations. It was not possible at this time to explicitly include temperature effects or additive and synergistic effects with other pesticides in the development of concentration goals.

5.6.3 **Water Quality Conditions Reasonably Achievable**

Pyrethroid water column concentrations detected in the Sacramento River and San Joaquin River basin water bodies are the result of current-year applications of these pesticides, however pyrethroids in sediments may persist over months or years. Pyrethroids are considered moderately persistent in the aqueous environment, unlike

DDT or certain other chlorinated pesticides that can persist for decades. But similarly to chlorinated pesticides, they are sequestered in sediments. Unlike some naturally occurring compounds such as selenium, there are no natural sources of pyrethroids, and there are no natural, or "background" concentrations. If these pesticides were prevented from entering surface waters, then concentrations of pyrethroids in surface waters and sediments would decline in a moderate timeframe because for most pyrethroids degradation half-lives are 1-4 months, although they can be up to 2 years or even stable (section 2.2.2.2). Notably, bifenthrin has longer degradation half-lives than the other pyrethroids – ranging from 3 months to over 2 years, and stable in some conditions. Thus, more time may be needed for the environmental levels of this compound to be reduced to levels that are protective of aquatic life.

The difficulty and cost of preventing pyrethroids from entering surface waters are key elements in attaining any water quality goals for these pesticides. Options for reducing the amount of pesticides entering the water bodies in the Sacramento River and San Joaquin River basin are discussed in section 7. Table 5-14 and Table 5-15 compare pyrethroids monitoring data (available as whole water concentrations) to the for acute and chronic water quality criteria for aqueous concentrations being considered for concentration goals. Based on the available monitoring data, significant reductions in pyrethroid discharges are needed in all water body types to attain water quality criteria derived by either the UC Davis or USEPA method (Table 5-14 and Table 5-15). All of the monitoring data used to compare to the water quality criteria are based on whole water concentrations. The reductions needed to attain these water quality criteria would be much lower, although still significant, if they were compared to freely dissolved concentrations.

For water bodies receiving urban storm water discharges, the recently adopted DPR surface water regulations (section 2.4.2) are expected to result in significant reductions in pyrethroids entering surface waters. One study modeled the effects of the DPR surface water regulations in the urban watershed of the lower American River in Sacramento (Jorgenson et al. 2013). The model predicted that if the surface water regulations are fully implemented, there would be an 84% reduction in pyrethroid levels in this watershed (reported as pyrethroid toxic units). The average reductions needed to attain the chronic 1st percentile UC Davis criteria in urban or mixed watersheds during storm-related exceedances range from 86-99.9%, depending on the pyrethroid (Table 5-15). For the chronic criteria based on the 2.5 or 5th percentile, average reductions needed range from 86-99% or 82-98%, respectively, depending on the pyrethroid. Jorgenson et al. (2013) state that the majority (~70%) of pyrethroid toxic units in the watershed are associated with bifenthrin and cyfluthrin; for these two compounds, reductions of greater than 99% are needed in urban watersheds to attain the 1st percentile UC Davis chronic criteria. Reductions of 99% are needed for bifenthrin and cyfluthrin to attain the 2.5 percentile chronic criteria in urban watersheds, and reductions

of 96-98% are needed to attain the 5th percentile chronic criteria. While the 84% reduction expected as a result of the DPR surface water regulations may not completely eliminate exceedances of these water quality criteria, they are expected to make a significant impact in reducing toxicity related to pyrethroids.

If bioavailability is accounted for by comparing the freely dissolved pyrethroid concentrations to the potential concentration goals, the necessary reductions to attain these levels in surface waters would be smaller. In urban creeks dissolved organic carbon and particulate organic carbon levels can vary greatly. In the American River, DOC and TOC have been measured in the range of 1.04-2.61 mg/L and 1.18-3.27 mg/L, respectively, whereas in Pleasant Grove Creek, DOC and TOC were measured at 10.3 mg/L and 41.1 mg/L, respectively. Peak whole water concentrations of bifenthrin and cyfluthrin have been recorded at 106 ng/L and 20 ng/L in urban watersheds (Table 2-5). The freely dissolved concentrations of bifenthrin and cyfluthrin were estimated for the American River and Pleasant Grove Creek using Equation 3 with the above data, summarized in Table 5-16. Particulate organic carbon (POC) was calculated as follows: POC=TOC-DOC.

In this example, if the whole concentration were at these peak urban concentrations the calculated freely dissolved bifenthrin and cyfluthrin concentrations in the American River would range from 11-31 ng/L and 1.8-5 ng/L, respectively. For the Pleasant Grove Creek example, if the whole water concentrations were at these peak urban concentrations, freely dissolved bifenthrin and cyfluthrin concentrations would be 0.7 ng/L and 0.1 ng/L, respectively. In these examples the freely dissolved concentrations are 71-99% lower than the total concentrations. At these peak concentrations, bifenthrin reductions of 99.91-99.99% would be needed based on whole water concentrations, whereas reductions of 85-99.9% would be needed based on the freely dissolved concentrations, depending on whether the 1st, 2.5, and 5th percentile UC Davis criteria were used. When TOC and/or DOC are particularly high, such as in the Pleasant Grove Creek example, a higher fraction of pyrethroids are bound, so reductions needed to attain freely dissolved concentrations would be lower in these situations.

Water bodies in agricultural areas require large reductions to meet any of the potential concentration goals (Table 5-14, Table 5-15). In several watersheds, agricultural dischargers have completed successful management plans for sediment toxicity related to pyrethroids, meaning that following the detection of toxicity management practices were implemented by growers and afterwards no toxicity was detected in three years of sampling. Similar large reductions were needed to attain the chlorpyrifos and diazinon water quality objectives adopted in previous Basin Plan amendments, and excellent progress has been made on reducing the levels of those pesticides in surface waters and attaining the water quality objectives, as evidenced by completed Management Plans under the Irrigated Lands Regulatory Program and recommended de-listings

(McClure et al. 2014). Based on these previous successes requiring similar large reductions in water bodies in agricultural areas, pyrethroids numeric concentrations may also be reasonably achievable in these waters using the management practices discussed in section 7.2.3, which have been successfully implemented to achieve the control of chlorpyrifos and diazinon discharges.

For wastewater discharges, 94-99.8% average reductions in pyrethroid levels are needed when comparing whole water pyrethroid concentrations to the 1st percentile UC Davis chronic criteria (Table 5-15). Average reductions of 95-98% are needed in wastewater effluents to attain the water quality criteria based on the 2.5 percentile based on whole water concentrations, and 52-94% reductions are needed to attain the 5th percentile UC Davis chronic criteria based on whole water concentrations (Table 5-15).

Needed reductions for wastewater discharges were also calculated based on freely dissolved pyrethroid concentrations, which were available for facilities in Sacramento, Vacaville, and Stockton (Parry and Young 2013, RBI 2012, data from Weston displayed in Appendix B). As expected, average reductions needed to attain the water quality criteria are significantly lower when effluent concentrations are compared to dissolved pyrethroid concentrations than when compared to whole water pyrethroid concentrations. For wastewater discharges, 40-87% average reductions in pyrethroid levels are needed when comparing dissolved pyrethroid concentrations to the 1st percentile UC Davis chronic criteria (Table 5-17). Average reductions of 0-45% are needed in wastewater effluents to attain the water quality criteria based on the 2.5 percentile based on dissolved concentrations, and 0-78% reductions are needed to attain the 5th percentile UC Davis chronic criteria based on dissolved concentrations (Table 5-17).

Parry & Young (2013) measured whole water concentrations of several pyrethroids in effluent from the Sacramento Regional Wastewater Treatment Plant, and they also calculated the freely dissolved concentrations using site-specific partition coefficients and the measured concentrations of suspended solids and DOC (analogous to Equation 3). For these samples, the freely dissolved concentrations ranged from 1-6% of the whole water concentrations. While the whole water concentrations exceed the chronic 1st percentile criteria by factors ranging from 100-300, the freely dissolved concentrations exceed the chronic 1st percentile criteria by factors ranging from 10-25. Comparing these samples to the criteria based on the 5th percentile, the freely dissolved concentrations exceed the chronic criteria in only one of six samples by a factor of 1.2. There are no known technologies that would result in an additional 90-99% reduction in pyrethroids in wastewater effluents, thus, it is uncertain if these reductions are reasonably achievable for municipal and domestic wastewater dischargers. It is possible that source control could help in attaining pyrethroid concentration goals in effluents,

particularly those based on higher concentrations (5th and 2.5^{th}) using freely dissolved concentrations, by reducing influent concentrations through a combination of public education and/or changes in registered pesticide uses.

Table 5-14 Reductions needed to attain acute criteria during exceedances (based on whole water concentrations)

Bif: bifenthrin, cyf: cyfluthrin, cyp: cypermethrin, esf: esfenvalerate, λ-cy: lambda-cyhalothrin, per: permethrin. All calculations based on whole water concentrations.

				1st percentile UCD acute criteria	Reduction needed to meet 1st percentile UCD acute criteria during exceedances		2.5 percentile UCD acute criteria	Reduction needed to meet 2.5 percentile UCD acute criteria during exceedances		5th percentile UCD criteria	Reduction needed to meet 5th percentile UCD acute criteria during exceedances		Criteria derived by EPA method	Reduction needed to meet acute criteria - EPA method during exceedances	
	Water Body Type	# of samples	# of detects (%)	# exceeding acute crit. (%)	Avg	Max	# exceeding acute crit. (%)	Avg	Max	# exceeding acute crit. (%)	Avg	Max	# exceeding acute crit. (%)	Avg	Max
Bif	Ag	1,240	19 (2%)	19 (2%)	98%	99%	18 (1%)	98%	99.9%	18 (1%)	94%	99.8%	19 (2%)	99%	99.9%
	Urban	88	43 (49%)	43 (49%)	99%	99.9%	43 (49%)	99%	99.7%	43 (49%)	89%	99%	43 (49%)	99%	99.9%
	Mixed	108	23 (21%)	23 (21%)	98%	99.9%	23 (21%)	90%	99.9%	23 (21%)	75%	99.7%	23 (21%)	98%	99.9%
	WWTP	30	16 (53%)	16 (53%)	98%	99%	16 (53%)	88%	95%	16 (53%)	69%	87%	16 (53%)	98%	99%
Cyf	Ag	1,236	7 (0.6%)	7 (0.6%)	99%	99%	7 (0.6%)	95%	98%	7 (0.6%)	88%	93%	Not available		
	Urban	88	12 (14%)	12 (14%)	99%	99.7%	12 (14%)	95%	99%	12 (14%)	86%	96%			
	Mixed	108	7 (6%)	7 (6%)	98%	99.7%	7 (6%)	79%	99%	7 (6%)	78%	97%			
	WWTP	24	1 (4%)	1 (4%)	96%	96%	1 (4%)	82%	82%	1 (4%)	53%	53%			
Cyp	Ag	1,403	4 (0.3%)	4 (0.3%)	99.7%	99.9%	4 (0.3%)	98%	99.6%	4 (0.3%)	93%	99%	4 (0.3%)	98%	99.7%
	Urban	88	5 (6%)	5 (6%)	99%	99.6%	5 (6%)	94%	97%	5 (6%)	79%	90%	5 (6%)	95%	98%
	Mixed	108	7 (6%)	7 (6%)	99%	99.9%	7 (6%)	92%	99.6%	7 (6%)	72%	99%	7 (6%)	93%	99.7%
	WWTP	30	7 (23%)	7 (23%)	99%	99.8%	7 (23%)	93%	98%	7 (23%)	75%	94%	7 (23%)	94%	99%
Esf	Ag	1,418	24 (2%)	24 (2%)	96%	99.9%	23 (2%)	97%	99.7%	22 (2%)	90%	99%	Not available		
	Urban	88	0 (0%)	0 (0%)	0%	0%	0 (0%)	0%	0%	0 (0%)	0%	0%			
	Mixed	130	19 (15%)	18 (14%)	85%	98%	16 (12%)	62%	93%	7 (5%)	57%	80%			
	WWTP	18	1 (6%)	1 (6%)	95%	95%	1 (6%)	81%	81%	1 (6%)	52%	87%			
λ-cy	Ag	1,306	20 (2%)	20 (2%)	99%	99.7%	20 (2%)	95%	99.8%	20 (2%)	82%	99%	20 (2%)	95%	99.8%
	Urban	88	7 (8%)	7 (8%)	99%	99.8%	7 (8%)	94%	99%	7 (8%)	80%	95%	7 (8%)	94%	98%
	Mixed	108	14 (13%)	14 (13%)	98%	99.8%	14 (13%)	88%	99%	13 (12%)	72%	96%	14 (13%)	87%	99%
	WWTP	30	10 (33%)	10 (33%)	88%	99%	10 (33%)	86%	96%	9 (30%)	46%	46%	10 (33%)	86%	98%
Per	Ag	1,406	8 (0.6%)	Same as 5th percentile			Same as 5th percentile			7 (0.5%)	83%	99%	8 (0.6%)	82%	99%
	Urban	88	13 (15%)							10 (11%)	58%	95%	12 (14%)	65%	96%
	Mixed	108	12 (11%)							9 (8%)	48%	77%	11 (10%)	77%	98%
	WWTP	30	18 (60%)							17 (57%)	58%	87%	18 (60%)	70%	91%

Table 5-15 Reductions needed to attain chronic criteria during exceedances (based on whole water concentrations)

Bif: bifenthrin, cyf: cyfluthrin, cyp: cypermethrin, esf: esfenvalerate, λ-cy: lambda-cyhalothrin, per: permethrin. All calculations based on whole water concentrations.

				1st percentile UCD chronic criteria	Reduction needed to meet 1st percentile UCD chronic criteria during exceedances		2.5 percentile UCD chronic criteria	Reduction needed to meet 2.5 percentile UCD chronic criteria during exceedances		5th percentile criteria derived by UCD method	Reduction needed to meet 5th percentile UCD chronic criteria during exceedances		Criteria derived by EPA method	Reduction needed to meet chronic criteria - EPA method during exceedances	
	Water Body Type	# of 4-day averages	# of detections (%)	# exceeding chronic crit. (%)	Avg	Max	# exceeding chronic crit. (%)	Avg	Max	# exceeding chronic crit. (%)	Avg	Max	# exceeding chronic crit. (%)	Avg	Max
Bif	Ag	1,123	19 (2%)	19 (2%)	99.8%	99.9%	19 (2%)	99%	99.9%	19 (2%)	97%	99.9%	Not available		
	Urban	52	30 (58%)	30 (58%)	99.9%	99.99%	30 (58%)	99%	99.9%	30 (58%)	98%	99.9%			
	Mixed	107	22 (21%)	22 (21%)	99.6%	99.9%	22 (21%)	98%	99.9%	22 (21%)	97%	99.9%			
	WWTP	30	16 (53%)	16 (53%)	99.6%	99.8%	16 (53%)	98%	99%	16 (53%)	92%	98%			
Cyf	Ag	1,122	7 (0.6%)	7 (0.6%)	99.8%	99.9%	7 (0.6%)	99%	99.5%	7 (0.6%)	97%	98%	Not available		
	Urban	53	10 (19%)	10 (19%)	99.8%	99.9%	10 (19%)	99%	99.7%	10 (19%)	96%	99%			
	Mixed	107	6 (6%)	6 (6%)	99.7%	99.9%	6 (6%)	98%	99.6%	6 (6%)	94%	98%			
	WWTP	24	1 (4%)	1 (4%)	99%	99%	1 (4%)	96%	96%	1 (4%)	88%	88%			
Cyp	Ag	1,289	4 (0.3%)	4 (0.3%)	99.9%	99.99%	4 (0.3%)	99.5%	99.9%	4 (0.3%)	98%	99.6%	Not available		
	Urban	52	4 (8%)	4 (8%)	99.8%	99.9%	4 (8%)	98%	99%	4 (8%)	93%	97%			
	Mixed	107	6 (6%)	6 (6%)	99.7%	99.9%	6 (6%)	98%	99.9%	6 (6%)	92%	99.6%			
	WWTP	30	7 (23%)	7 (23%)	99.8%	99.9%	7 (23%)	98%	99.6%	7 (23%)	93%	98%			
Esf	Ag	1,292	13 (1%)	13 (1%)	91%	99.9%	13 (1%)	99%	99.9%	12 (1%)	90%	99.9%	Not available		
	Urban	52	0 (0%)	0 (0%)	0%	0%	0 (0%)	0%	0%	0 (0%)	0%	0%			
	Mixed	123	15 (12%)	15 (12%)	97%	99.7%	15 (12%)	91%	99%	14 (11%)	82%	99.6%			
	WWTP	18	1 (6%)	1 (6%)	99.7%	99.7%	1 (6%)	97%	97%	1 (6%)	92%	92%			
λ-cy	Ag	1,191	20 (2%)	20 (2%)	99.7%	99.9%	20 (2%)	98%	99.9%	20 (2%)	92%	99.8%	20 (2%)	98%	99.9%
	Urban	52	7 (13%)	7 (13%)	99.7%	99.9%	7 (13%)	98%	99%	7 (13%)	91%	98%	7 (13%)	97%	99%
	Mixed	107	13 (12%)	13 (12%)	99.6%	99.9%	13 (12%)	96%	99.5%	13 (12%)	83%	98%	13 (12%)	95%	99.5%
	WWTP	30	10 (33%)	10 (33%)	99%	99.6%	10 (33%)	95%	99%	10 (33%)	52%	87%	10 (33%)	94%	98%
Per	Ag	1,292	8 (0.6%)	Same as 5th percentile			Same as 5th percentile			8 (0.6%)	96%	99.8%	Not available		
	Urban	52	11 (21%)							11 (21%)	91%	97%			
	Mixed	107	11 (10%)							11 (10%)	86%	95%			
	WWTP	30	18 (60%)							18 (60%)	94%	96%			

There is currently no data available that reports the expected reductions in aqueous pyrethroid concentrations based on the management practices expected to be used by dischargers (sections 7.1, 7.2.3, 7.3). Significant reductions of pyrethroids are needed in all types of discharges and at this time insufficient data is available to evaluate the attainability of any of the pyrethroid concentration goals considered.

Since sediment concentrations will be related to the concentrations in discharges and in-stream concentrations, insufficient data is available to evaluate the attainability of the sediment concentration goals considered, although calculations indicate attaining the concentration goals will result in attainment of concentrations in sediment within the range considered for sediment concentration goals (See table 5-16).

It is reasonable to assume that lower pyrethroid concentration goals will be more difficult to achieve and would require more resources. Some of the practices for mitigating pyrethroid impairments 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.

Table 5-16 Data and results of freely dissolved pyrethroid calculations for storm water examples

Parameter		Value	
K_{OC} bifenthrin (L/kg)[a]		4,228,000	
K_{DOC} bifenthrin (L/kg)[a]		1,737,127	
K_{OC} cyfluthrin (L/kg)[a]		3, 870,000	
K_{DOC} cyfluthrin (L/kg)[a]		2,432,071	
American River low	TOC (mg/L)[c]	1.18	
	DOC (mg/L)[c]	1.04	
	POC (mg/L)[c]	0.14	
American River high	TOC (mg/L)[d]	3.27	
	DOC (mg/L)[d]	1.93	
	POC (mg/L)[d]	1.34	
Pleasant Grove Creek	TOC (mg/L)[e]	41.1	
	DOC (mg/L)[e]	10.3	
	POC (mg/L)[e]	30.8	
		C_{total}[b] (ng/L)	$C_{dissolved}$[f] (ng/L)
American River low	bifenthrin	106	31
	cyfluthrin	20	5
American River high	bifenthrin	106	11
	cyfluthrin	20	1.8
Pleasant Grove Creek	bifenthrin	106	0.7
	cyfluthrin	20	0.1

[a]Table 5-3 [b] Table 2-5, [c]Data from 11/8/11 (CEDEN database), [d]Data from 8/4/09 (CEDEN database), [e]Data from 9/28/10 (CEDEN database), [f] Calculated using Equation 3.

Table 5-17 Reductions needed to attain acute and chronic criteria for wastewater treatment plants during exceedances (based on dissolved concentrations)

Bif: bifenthrin, cyf: cyfluthrin, cyp: cypermethrin, esf: esfenvalerate, λ-cy: lambda-cyhalothrin, per: permethrin. All calculations based on dissolved concentrations.

				1st percentile UCD criteria	Reduction needed to meet 1st percentile UCD criteria during exceedances		2.5 percentile UCD criteria	Reduction needed to meet 2.5 percentile UCD criteria during exceedances		5th percentile UCD criteria	Reduction needed to meet 5th percentile UCD criteria during exceedances		Criteria derived by EPA method	Reduction needed to meet criteria - EPA method during exceedances	
		# of samples	# of detects (%)	# exceeding crit. (%)	Avg	Max	# exceeding crit. (%)	Avg	Max	# exceeding crit. (%)	Avg	Max	# exceeding crit. (%)	Avg	Max
Bif	Acute	30	15 (50%)	6 (20%)	56%	83%	1 (3%)	16%	16%	0 (0%)	0%	0%	6 (20%)	57%	83%
	Chronic			14 (47%)	83%	97%	7 (23%)	45%	86%	4 (13%)	41%	72%	Not available		
Cyf	Acute	30	1 (3%)	0 (0%)	0%	0%	0 (0%)	0%	0%	0 (0%)	0%	0%	Not available		
	Chronic			1 (3%)	67%	99%	0 (0%)	0%	0%	0 (0%)	0%	0%			
Cyp	Acute	30	12 (40%)	10 (33%)	54%	97%	1 (3%)	78%	78%	0 (0%)	0%	0%	1 (3%)	82%	82%
	Chronic			12 (40%)	87%	99%	9 (30%)	32%	95%	1 (3%)	78%	78%	Not available		
Esf	Acute	30	2 (7%)	0 (0%)	0%	0%	0 (0%)	0%	0%	0 (0%)	0%	0%	Not available		
	Chronic			2 (7%)	68%	73%	0 (0%)	0%	0%	0 (0%)	0%	0%			
λ-cy	Acute	30	5 (17%)	2 (7%)	62%	84%	0 (0%)	0%	0%	0 (0%)	0%	0%	0 (0%)	0%	0%
	Chronic			4 (13%)	65%	95%	0 (0%)	0%	0%	0 (0%)	0%	0%	1 (3%)	54%	54%
Per	Acute	30	16 (53%)	Same as 5th percentile			Same as 5th percentile			0 (0%)	0%	0%	0 (0%)	0%	0%
	Chronic									4 (13%)	40%	64%	Not available		

5.6.4 Economic Considerations

Agricultural Dischargers

It is likely that changes in agricultural practices will be necessary to reduce pyrethroid concentrations in the Sacramento and San Joaquin Valley water bodies. These practices and their potential costs are discussed in greater detail in sections 7 and 8.4 of this report. The practices are generally the same practices that would be expected to be implemented under the Irrigated Lands Regulatory Program for the general control of pesticides and sediment. The costs for agricultural dischargers to attain water quality objectives were estimated as part of the Environmental Impact Report for the Long-term Irrigated Lands Regulatory Program (ICF International 2010, 2011). Thus, the costs of implementing the types of management practices that would be used to control pyrethroid discharges for the proposed amendment are consistent with the existing estimated costs of the ILRP. However, the overall cost of implementing practices to control pyrethroids to attain the concentration goals is not known since the reductions needed and effectiveness of practices is unknown. The potential need for additional management practices with significant costs could be re-visited in future phases, if the Board considers updating pyrethroid-related Basin Plan requirements and more data and information are available. Additional costs for monitoring pyrethroids in the water column may be incurred, but the costs of monitoring were also estimated as part of the overall program costs for agricultural dischargers. Under the Irrigated Lands Regulatory Program, monitoring requirements are determined on an annual basis and the pesticides monitored at a given site may shift from year to year as crops and pesticide use change. Overall implementation costs of the proposed amendment for agricultural discharges are discussed in section 9.2.

Municipal Storm Water MS4 Dischargers

Pyrethroids continue to be detected in municipal storm water discharges, but it is likely that these concentrations will decrease as a result of recent label changes on bifenthrin products and new surface water regulations promulgated by DPR. The surface water regulations went into effect in July 2012. Conclusive monitoring results since the regulations went into effect are not yet available from DPR; however DPR is conducting further education and outreach, as well as enforcement, on the regulations. The bifenthrin label changes have been implemented and currently appear on bifenthrin products. If pyrethroid concentrations do not significantly decline in the water column as a result of DPR's surface water regulations and the label changes, municipal dischargers may have costs associated with attaining the concentration goals. The costs for implementation could vary depending on which concentration goals are adopted, since attaining the lower concentration goals could require more extensive management practice implementation by more dischargers. However, because effectiveness of the management practices and actions to reduce pyrethroids in MS4

discharges (as discussed in section 5.6.3) is not known, a thorough economic analysis of the costs for attaining the different concentration goals is not possible at this time. The types of practices MS4s could implement to control pyrethroids are discussed in Section 7.1 and potential implementation costs are discussed in section 9.1.

Municipal or Domestic Wastewater Dischargers

Pyrethroids have been detected in wastewater effluents when they have been monitored, but have not currently been identified as a source of pyrethroids impairment in any water bodies in the Project Area. There is no known treatment alternative for wastewater discharges on which to base a cost estimate. The proposed implementation program for wastewater dischargers also includes implementation of BMPs as well as monitoring. Overall costs of the proposed amendment for municipal wastewater dischargers are discussed in section 9.3 and the practices are discussed in section 7.1. Because it is unclear if implementing the identified management practices will lead to attainment of the potential pyrethroid concentration goals, a thorough economic analysis of attaining pyrethroid concentration goals is not possible for municipal and domestic wastewater dischargers at this time. Practice effectiveness and cost could be re-visited in future phases, if the Board considers updating pyrethroid-related Basin Plan requirements and more data and information are available.

Economic Consideration of the Alternative Concentration Goals

Due to the uncertainty in the extent of reductions needed and uncertainty about the effectiveness of management practices and other actions to reduce concentrations, there is significant uncertainty as to the overall costs of attainment of any of the concentration goals considered. The proposed regulatory approach was designed to meet the goal of reasonable and attainable implementation requirements, but, as indicated in Section 9, the costs to implement practices to control pyrethroids are likely to be significant with any of the concentration goals considered. All of the pyrethroid concentration goals considered would be significant water quality improvements. While it was not possible to perform a detailed analysis of the costs of attaining the different concentration goals, it is reasonable to assume that attaining lower concentrations (such as those based on the 1st or 2.5th percentile criteria) would likely be significantly more costly, as larger reductions would be needed and more dischargers would need to implement practices to reduce concentrations.

5.6.5 The Need to Develop Housing

Pyrethroids are used extensively as termiticides in new home foundations, and it is not clear if these treatments are a significant source of pyrethroid runoff. These products are typically applied to the subsoil before a concrete foundation is poured. If the foundation site is not properly covered in the interim between pyrethroid application and

pouring of the concrete, runoff could occur due to a storm event. Construction sites are issued National Pollution Discharge Elimination System permits and must implement measures to reduce runoff and erosion from worksites, and these same management practices would also be effective for controlling discharges of pyrethroids from housing development sites.

While pyrethroids are used in the development of new housing, the discharge of pyrethroids is not necessary for the development of new housing or to maintain existing housing supply or values, and can be avoided with implementation of BMPs that are currently required for construction sites. Therefore, none of the alternate concentration goals are expected to affect housing.

5.6.6 The Need to Develop and Use Recycled Water

Pyrethroids are not known to be a limiting factor for the development or use of recycled water. Therefore, none of the alternate concentration goals are expected to affect the development or use of recycled water. Decreasing pyrethroid concentrations in surface waters should improve the quality of water available for recycling. Adopting controls on pyrethroid discharges may encourage some dischargers to recycle water to avoid discharging pyrethroids (and other pollutants) to surface waters. If pyrethroids remain in recycled water, they would not likely be problematic because the main uses for recycled water in the Central Valley, agricultural reuse and landscape and golf course irrigation (SWRCB 2011), would not likely be harmed by the expected levels of pyrethroids in recycled water.

5.6.7 Consistency with State and Federal Laws and Policies

5.6.7.1 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 C.F.R. § 131.11 (b) et seq.).

Aqueous Concentrations

TMDLs are required to contain numeric targets that are consistent with attainment of the applicable water quality standards, in this case the narrative toxicity and pesticides water quality objectives. Concentration goals based on the 1st, 2.5, or 5th percentile UC Davis criteria would be consistent with the Clean Water Act, since the UC Davis methodology has protection goals consistent with the Basin Plan and Clean Water Act. Concentration goals based on the UC Davis criteria provide overall protection of aquatic life beneficial uses as discussed in section 5.6.1. Concentration goals based on criteria derived using the USEPA methodology would also be consistent with the Clean Water Act, because these values appear to be protective of the most sensitive resident species, but only for the four pyrethroids for which acute criteria could be derived. The

USEPA derived goals would need to be used in combination with other criteria to be fully protective. Criteria based on the USEPA method relies on 304(a) guidance, although the guidance was modified in this case to because insufficient data were available

Sediment

Not establishing sediment concentration goals would be consistent with the Clean Water Act and the Central Valley Water Board would continue interpreting the existing narrative objectives to determine attainment. The proposed sediment toxicity numeric target would ensure pyrethroid sediment concentrations are consistent with attainment of narrative objectives.

The 304(a) guidance only applies to aqueous concentrations, so any numeric criteria for sediment concentrations would have to fall under the "other scientifically-defensible methods" category. Using an MATC for a sensitive species would be scientifically defensible as a no-effect level if the species was known to be the most sensitive resident species. *Hyalella azteca* is the most sensitive species in the sediment data sets for all six pyrethroids and is also the most sensitive known resident species in the watersheds. The ESG_{OC} alternatives based on the 1st, 2.5 and 5th percentile UC Davis chronic criteria would provide a similar level of protection in sediments as their analogous water quality criteria, thus would be consistent with the Clean Water Act.

5.6.7.2 Endangered Species Act and California Endangered Species Act

There are a number of aquatic species within the Sacramento River and San Joaquin River basins that are listed as threatened, endangered, or species of concern under the Endangered Species Act. These include the Delta smelt, Sacramento splittail, green sturgeon, steelhead trout, and multiple runs of Chinook salmon. To be consistent with the Endangered Species Act, the pyrethroid concentration goals must protect the aquatic life in the Sacramento River and San Joaquin River basins, particularly threatened and endangered species.

Aqueous Concentrations

Pyrethroid concentration goals based on water quality criteria derived using the UC Davis method (using the 1st, 2.5, or 5th percentile of the SSDs) would be protective of threatened and endangered species because available toxicity data for these species were assessed in the criteria derivation. All of the UC Davis criteria are well below available toxicity values for endangered fish. However, protection of species includes protection of the food web on which they depend. For the endangered fish, this includes protection of the resident invertebrates. Concentration goals being proposed are based on protection of *H. azteca*, which is the most sensitive of the resident species that have been tested. In addition, the concentration goals are proposed for use as prohibition triggers and TMDL allocations – both of which apply at the point of discharge. Additional

dilution will likely be available in many receiving waters – so resulting pyrethroid concentrations in receiving waters will likely be significantly less, providing a margin of safety for impacts to endangered species. When these concentration goals are achieved, pyrethroids will not significantly contribute to any cumulative impacts to threatened and endangered species.

Sediment

There are no aquatic arthropods listed as threatened or endangered, but benthic invertebrates are an important part of the aquatic food web and may affect endangered fish species. The no change alternative for sediment concentration goals would likely be protective of benthic organisms and consistent with the Endangered Species Act because evaluation guidelines used to interpret the narrative objectives are based on data for *Hyalella azteca*, which is known to be a sensitive species compared to other aquatic organisms. Sediment bioassays are also used to assess compliance with the narrative objectives for sediment and these tests also use *Hyalella azteca*. The no-effect level MATC alternative relies on toxicity data for *Hyalella azteca*, thus if these levels are protective of this sensitive species, they are also likely protective of endangered species, thus this alternative would be consistent with the Endangered Species Act. The ESG_{OC} alternatives based on the 1st, 2.5 and 5th percentile UC Davis chronic criteria would provide a similar level of protection in sediments as their analogous water quality criteria, thus would be consistent with the Endangered Species Act.

5.7 Pyrethroid Concentration Goal Staff Recommendation

5.7.1 **Aqueous Concentrations**

Based on the evaluation of section 13241 factors, consistency with State and Federal laws and policies, and consistency with the overall project goal and project objectives, the recommended pyrethroid concentration goals are the 2015 UC Davis method criteria based on the 5th percentile of the species sensitivity distributions. While the 2.5 percentile 2015 UC Davis criteria were also identified as meeting the overall project goals, the 5th percentile criteria are recommended based on additional review of achievability, as well as economic and policy considerations. The proposed concentration goals also include accounting for additivity of the six pyrethroids, as well as bioavailability. In combination with a phased implementation program to allow development of new information, concentration goals based on the 5th percentile:

- Are consistent with the level of protection recommended in USEPA's methodology for the derivation of aquatic life criteria (USEPA 1985);
- Are consistent with independent scientific peer review recommendations for development of criteria to protect aquatic life;
- Are reasonably protective of aquatic life beneficial uses;
    - Based on comparison of the recommended chronic criteria versus the LC_{50} for the most sensitive species, the 5th percentile values are lower than or, in one case at, the LC_{50}, indicating reasonable protection for even the most sensitive identified species;
- Have been derived considering full additivity of the six pyrethroids, which is known to be conservative in some cases due to known antagonism effects between the individual pyrethroids;
- Utilize best available science in consideration of bioavailability by utilizing freely dissolved concentrations, consistent with the UC Davis criteria recommendation;
- Are closer to the concentrations that may be reasonably measured using current laboratory technology;
    - Detection limits are currently close to allowing determination of attainment of the 5th percentile based criteria, but well above the lower criteria concentrations based on the 1st or 2.5th percentile values.

In addition, if combined with a phased implementation program that focuses on moving toward improved water quality while gathering additional information, the 5th percentile goals:

- Provide reasonable protection of aquatic ecosystems during the first phase of the program while management practices are initiated and additional information on achievability and cost are determined; and

- Will result in meaningful reductions during the first phase of this control program.

Significant reductions in pyrethroid concentrations will be realized by attaining the proposed concentration goals, as discussed in section 5.6.3. The significant reductions in pyrethroid concentration will likely require several years and significant investment by the regulated community. As discussed in sections 6 and 7, the concentration goals are proposed for use as prohibition triggers and TMDL allocations – both of which apply at the point of discharge. Additional dilution will likely be available in most receiving waters – so resulting pyrethroid concentrations in receiving waters will likely be significantly less, providing an additional margin of safety. Commercial analytical methods that can reliably detect pyrethroids at the proposed pyrethroid concentration goals are not currently available. However, analytical methods for pyrethroids are continuing to be developed and improved. Detection limits are currently close to allowing determination of attainment of the 5th percentile based criteria, but well above the lower criteria concentrations. The proposed concentration goals are well below current concentrations in pyrethroid-impaired water bodies in urban and agricultural areas, so attaining these goals in these water bodies and throughout the Sacramento and San Joaquin River basins will be a significant water quality improvement. Due to a lack of monitoring data and limitations in analytical detection limits, there is considerable uncertainty as to what reductions will be needed to attain the proposed concentration goals in most discharges in order to meet the TMDL allocations and prohibition triggers.

Potential impacts from alternative pesticides and the need to have a balanced approach to regulation of all pesticide discharges is also a key consideration. The lower the concentration goals, the more likely members of the regulated community who have control over pesticide applications seek alternative pesticides with less water quality regulatory controls than pyrethroids. While the proposed regulatory approach was designed to avoid unintended regulatory consequences, potential for regulatory consequences due to non-attainment of the goals would be greater with the lower concentration goals based on the 2.5th percentile.

The proposed Basin Plan amendment would be reviewed within 15 years after adoption and the concentration goals will be reviewed at that time. If it does not appear that the pyrethroid concentration goals are adequately protective, the Central Valley Water Board can choose lower concentration goals at that time.

The criteria derived using the USEPA method are not recommended for numeric targets because acute and chronic criteria are not available for all six pyrethroids. While the criteria derived with the USEPA method could be used in combination with criteria from

the UC Davis method, using criteria from a single method provides consistency. The 2015 water quality criteria derived using the UC Davis method based on the 1st percentile are not recommended because they are more likely to be overprotective of beneficial uses than the 2.5 or 5th percentile criteria. The scientific basis of the proposed Basin Plan amendment was peer reviewed in accordance with Health and Safety Code Section 57004, and two of the three reviewers concluded that the 1st percentile criteria may be overprotective of aquatic life beneficial uses. The 2.5 percentile criteria may be overly conservative during the first phase of the program while information on effectiveness and cost is being developed. If post-adoption review of the proposed Basin Plan amendment indicates that the pyrethroid concentration goals are not reasonably protective of aquatic ecosystems, then more protective concentration goals should be considered for adoption for use in Equation 7 and Equation 8.

The staff recommendation is to use an additive concentration approach with the concentrations expressed as freely dissolved concentrations to account for bioavailability. The recommended acute pyrethroid trigger is given in Equation 7 and is for a 1-hour averaging period. The recommended chronic pyrethroid trigger is given in Equation 8 and is for a 4-day averaging period.

Equation 7

$$CGU_{acute} = \frac{C_{bif}}{ACG_{bif}} + \frac{C_{cyf}}{ACG_{cyf}} + \frac{C_{cyp}}{ACG_{cyp}} + \frac{C_{esf}}{ACG_{esf}} + \frac{C_{lcy}}{ACG_{lcy}} + \frac{C_{per}}{ACG_{per}}$$

Where:
C_{bif} = Average concentration of bifenthrin from a 1-hour averaging period (ng/L),
C_{cyf} = Average concentration of cyfluthrin from a 1-hour averaging period (ng/L),
C_{cyp} = Average concentration of cypermethrin from a 1-hour averaging period (ng/L),
C_{esf} = Average concentration of esfenvalerate from a 1-hour averaging period (ng/L),
C_{lcy} = Average concentration of lambda-cyhalothrin from a 1-hour averaging period (ng/L),
C_{per} = Average concentration of permethrin from a 1-hour averaging period (ng/L),
ACG_{bif} = Bifenthrin acute concentration goal (ng/L),
ACG_{cyf} = Cyfluthrin acute concentration goal (ng/L),
ACG_{cyp} = Cypermethrin acute concentration goal of (ng/L),
ACG_{esf} = Esfenvalerate acute concentration goal of (ng/L),
ACG_{lcy} = Lambda-cyhalothrin acute concentration goal of (ng/L),
ACG_{per} = Permethrin acute concentration goal (ng/L),
CGU_{acute} = Acute concentration goal units, which is the sum of acute pyrethroid concentration-to-goal ratios. If CGU_{acute} exceeds one (1) that indicates an exceedance of the acute additive pyrethroid trigger.

Equation 8

$$CGU_{chronic} = \frac{C_{bif}}{CCG_{bif}} + \frac{C_{cyf}}{CCG_{cyf}} + \frac{C_{cyp}}{CCG_{cyp}} + \frac{C_{esf}}{CCG_{esf}} + \frac{C_{lcy}}{CCG_{lcy}} + \frac{C_{per}}{CCG_{per}}$$

Where:
C_{bif} = Average concentration of bifenthrin from a 4-day averaging period (ng/L),
C_{cyf} = Average concentration of cyfluthrin from a 4-day averaging period (ng/L),
C_{cyp} = Average concentration of cypermethrin from a 4-day averaging period (ng/L),
C_{esf} = Average concentration of esfenvalerate from a 4-day averaging period (ng/L),
C_{lcy} = Average concentration of lambda-cyhalothrin from a 4-day averaging period (ng/L),
C_{per} = Average concentration of permethrin from a 4-day averaging period (ng/L),
CCG_{bif} = Bifenthrin chronic concentration goal (ng/L),
CCG_{cyf} = Cyfluthrin chronic concentration goal of (ng/L),
CCG_{cyp} = Cypermethrin chronic concentration goal of (ng/L),
CCG_{esf} = Esfenvalerate chronic concentration goal (ng/L),
CCG_{lcy} = Lambda-cyhalothrin chronic concentration goal (ng/L),
CCG_{per} = Permethrin chronic concentration goal (ng/L),
$CGU_{chronic}$ = Chronic concentration goal units, which is the sum of pyrethroid concentration-to-goal ratios. If $CGU_{chronic}$ exceeds one (1) that indicates an exceedance of the chronic additive pyrethroid trigger.

This additivity formula establishes a level of protection for the toxic potential of mixtures of pyrethroids equivalent to the level of protection established in their individual concentration goals. An analogous additivity formula has been established in previous Basin Plan amendments for mixtures of chlorpyrifos and diazinon. According to the Basin Plan, additivity must be considered when multiple pesticides are detected. Including the additivity formula in the pyrethroid triggers will provide clarity and establish the same level of protection for all Sacramento River and San Joaquin River basin water bodies, regardless of whether or not they have TMDLs established.

As discussed in section 5.2.2, use of freely dissolved pyrethroid concentrations are recommended for determining achievement of the pyrethroid triggers. Methods for measuring or estimating freely dissolved concentrations are described in sections 5.2.2.1 and 5.2.2.2.

5.7.2 Sediment Concentrations

The recommendation for sediment-associated pyrethroids is no establishment of concentration goals, which means that the narrative objectives would continue to be interpreted. Based on the current science, no-effect levels in the form of MATCs for

single species or numeric sediment criteria may be scientifically defensible, but are not well established for use as water quality objectives or to interpret water quality objectives. The state of science for sediment criteria is not as well established as it is for water quality criteria, and by continuing to interpret the narrative objectives, the Central Valley Water Board will have flexibility in changing the numeric evaluation guidelines if and when values with higher certainty are available.

5.8 Evaluation of Ambient Water Quality Information

Environmental water quality samples were collected in the Sacramento-San Joaquin Delta from receiving waters (creeks and rivers), storm drains, agricultural drains, and wastewater treatment plant effluents (Weston and Lydy 2010). The summarized results were published and the detailed data for particulate organic carbon (POC), dissolved organic carbon (DOC), total pyrethroid concentration, and 96-hour *Hyalella azteca* toxicity results are provided in Appendix B. This data set for 109 samples was used to calculate the freely dissolved pyrethroid pesticide concentrations using Equation 3 and the partition coefficients presented in Table 5-3. The freely dissolved pyrethroid concentrations were calculated and then considered additively using the acute and chronic additivity formulas given in Equation 7 and Equation 8. The concentration goal units calculated with the additivity formulas and the estimated freely dissolved concentrations were then compared to the toxicity test results associated with the data.

The data presented is ambient and discharge toxicity data which demonstrates the natural variability in any environmental system. Since toxicity identification evaluations were not performed on the samples, other constituents besides pyrethroids that contributed or caused toxicity in the individual samples could not be identified (e.g., seven samples in the data set tested toxic to *H. azteca*, but contained no detectable pyrethroids).

While the comparisons to the environmental information cannot be use to select specific numeric goals due to the inherent variability in natural systems, the evaluations do show that increasing concentrations of pyrethroids appear to contribute to toxicity in environmental samples. This data set shows that the proposed acute and chronic 5th percentile concentration goals do capture samples in which pyrethroids are likely contributing to toxicity (Figure B-1 and Figure B-2), and only very few samples in which pyrethroids did not cause toxicity (Figure B-2).

Further discussion of the data is contained in Appendix B.

6 ADDRESSING IMPAIRED WATERS

There are 15 water body segments in the Sacramento River and San Joaquin River basins identified as impaired by pyrethroids on the 303(d) list (section 2.3). There are ten listings in urban watersheds where the only identified source of pyrethroid discharges is urban runoff. There are also six listings in agricultural watersheds where the only identified source of pyrethroid discharges is agricultural runoff, including one water body with two listings (both sediment toxicity and water column exceedance). Staff recommends two different approaches to address the impairments in urban and agricultural watersheds.

To address the pyrethroids impairments in urban watersheds, staff proposes total maximum daily loads. TMDLs or other pollution controls are required when water quality impairments are identified in order to bring the water body into attainment of water quality standards. The proposed TMDLs are described in section 6.1. To address the pyrethroids impairments in agricultural watersheds, staff proposes that they are addressed under Category 4b of the 303(d)/305(b) Integrated Report. U.S. EPA's regulations recognize that other pollution control requirements may obviate the need for a TMDL in impaired waters if those controls are stringent enough to implement applicable water quality standards within a reasonable period of time. (40 C.F.R. § 130.7(b)(1).) The pollution controls in agricultural watersheds fit these requirements, and this is called a Category 4b demonstration. The proposed Category 4b approach is described in section 6.2, and the demonstration to satisfy the U.S. EPA requirements are listed in Appendix C.

Different approaches are proposed to address impairments in urban and agricultural watersheds because while TMDLs are generally required to address impaired waters, the Board's existing regulatory programs for agricultural dischargers, and control measures implemented by agricultural discharges have proven effective at rectifying pesticide water quality impairments, especially in cases where the Board establishes compliance parameters in the Basin Plan. This effectiveness has been demonstrated for the pesticides chlorpyrifos and diazinon, and the Regional Water Board used the Category 4b approach for these pesticides in a Basin Plan amendment adopted in March 2014 (Resolution R5-2014-0041). The Board's urban storm water regulatory programs do not have as long of a history regulating pesticide discharges that result in attainment of water quality standards.

Agricultural dischargers have a high degree of source control over pesticides because the dischargers are also the pesticide users. If clear numeric goals for pyrethroids are adopted in the Basin Plan combined with oversight by the Regional Board's Irrigated Lands Regulatory Program, it is likely that control measure implemented by agricultural dischargers will result in attainment of water quality standards related to pyrethroids in the specified time period. The Category 4b approach is appropriate for agricultural dischargers because the existing regulatory program has proven capable of bringing water bodies into attainment with standards, and TMDLs would be duplicative of the requirements already in place.

Urban storm water management entities (e.g., MS4s) do not have direct control of the multiple sources of pesticides that may be utilized throughout their service areas and released into their discharges. There are control measures available to MS4s that are expected to reduce pesticide loads to the levels needed to attain water quality standards, but their effectiveness has not been demonstrated as they have been for agricultural dischargers. In addition, state law prohibits local public entities, such as MS4s, from regulating the sale or use of pesticide products, and thus they cannot directly limit the use of pyrethroids within their service area. MS4s may need a more flexible time schedule to attain water quality standards related to pyrethroids as they determine the most effective management practices to reduce pesticide concentrations. While flexible time schedules are available under a TMDL, they are not available under the Category 4b approach; therefore TMDLs are the recommended approach for addressing the impaired waters in urban watersheds.

6.1 Total Maximum Daily Loads for Urban Impaired Waters

Section 303(d)(1)(C) of the Clean Water Act requires the establishment of Total Maximum Daily Loads for waters identified on the 303(d) list, if the USEPA 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."

A TMDL is the loading capacity, or maximum amount of a contaminant that a water body can receive without exceeding water quality standards. The TMDL is the sum of the individual wasteload allocations (WLAs), load allocations (LAs), and a margin of safety. WLAs are the portion of the receiving water's loading

capacity allocated to existing or future point sources (e.g., wastewater and storm water) 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. Although the term "load" often refers to "mass", the federal regulations do not restrict the expression of TMDLs to units of mass. TMDLs can be expressed in terms of "… mass per time, toxicity, or other appropriate measure[s]." Numeric targets are quantitative values used to measure whether or not the applicable water quality standards are attained. In this case the applicable objectives are the narrative toxicity and pesticide objectives. This section provides a summary of the alternatives considered and a description of the recommended alternative for defining the loading capacity, the WLAs, and the LAs for pyrethroids in the water bodies in the Sacramento River and San Joaquin River Basins that are 303(d)-listed for pyrethroids due to urban runoff. Numeric targets are described that will provide the quantitative means to evaluate attainment of applicable water quality standards.

6.1.1 Numeric Targets

There are two proposed numeric targets for pyrethroid pesticides, one covering additive water column concentrations, and the other covering sediment toxicity. The Pyrethroid Pesticides Water Column Additivity Numeric Target would ensure that the water body attains water quality objectives for pyrethroids in the water column. The Sediment Toxicity Numeric Target would ensure that benthic organisms are protected and ensure that the water body attains water quality objectives for pyrethroids in bed sediments.

6.1.1.1 Pyrethroid Pesticides Water Column Additivity Numeric Target

The proposed water column additivity numeric targets would be equivalent to the proposed additive numeric triggers (section 5.7.1). This target would be consistent with the level of protection in current narrative toxicity water quality objectives, since the most sensitive tested organisms would be reasonably protected, as discussed in section 5.7. In order to measure this numeric target, each pyrethroid would need to be measured in a water sample to calculate the sum for the acute and chronic averaging periods defined in Equation 7 and Equation 8. As stated in the proposed numeric triggers, the freely dissolved concentrations of pyrethroids may be used in Equation 7 and Equation 8 to account for bioavailability of these compounds.

6.1.1.2 Sediment Toxicity Numeric Target

The proposed sediment toxicity numeric target provides a quantitative means of measuring whether the narrative toxicity objective is attained. The 303(d) listings

for urban water bodies were all due to pyrethroid-caused toxicity in sediments. Therefore, to address pyrethroid impairments in these water bodies, the TMDL must address sediment toxicity through the establishment of a sediment toxicity numeric target. This numeric target would be measured based on the results of 10-day sediment toxicity tests with *Hyalella azteca* assessing survival as the biological endpoint. *Hyalella azteca* was chosen as the test organism because it is a standard test organism and it is known to be the most sensitive sediment test organism for pyrethroid pesticides, and thus will be a sensitive indicator of whether or not sediments are attaining the narrative toxicity standards with regard to pyrethroids. In the proposed monitoring and surveillance requirements, it is also specified that if a sediment sample is determined to be toxic then chemical analysis of that sample for pyrethroids should be conducted in order to verify whether the toxicity is due to pyrethroid pesticide residues.

6.1.2 Loading Capacity

The loading capacity is the amount of pyrethroids that can be assimilated by a water body without exceeding water quality standards and provides the basis for defining allocations to the pyrethroid sources. Since multiple pyrethroids can be present at levels of concern, additive toxicity is accounted for in the numeric targets, and should also be considered in determining the loading capacity in order to be consistent with the Basin Plan (Water Quality Objectives section, Pesticides heading, III-6.00). Loading capacity can be expressed as a concentration or as mass-per-time. Determination of a mass-based loading capacity for a river or stream requires pesticide monitoring data and an estimate of the volume of water or the amount of flow available to assimilate the pollutant load. A concentration-based loading capacity is preferable because it is an immediate measurement of whether the numeric target is attained, it minimizes the sampling needed to assess compliance (i.e., no flow data is necessary), and is consistent with other pesticide control programs in the Central Valley. For these reasons, the recommended loading capacity is a concentration-based loading capacity, equal to the proposed acute and chronic additive pyrethroid pesticides numeric triggers. Under this scenario, pyrethroid concentrations would be measured and used in Equation 7 and Equation 8 to calculate the concentration goal units for the proposed acute and chronic numeric triggers.

The recommended loading capacity is consistent with the recommended concentration goals for the water column (section 5.7.1), as well as the narrative toxicity water quality objective and the narrative pesticide objective. Under this alternative, the loading capacity is a maximum allowable concentration that is not dependent on the flow regime and does not require additional data collection

beyond concentration of the six pyrethroids and bioavailability parameters (total organic carbon and dissolved organic carbon). Defining and assessing compliance are straightforward with a concentration-based loading capacity in that monitoring data are sufficient information and no additional calculations are required. There is minimal uncertainty associated with the recommended method of defining the loading capacity because it would not be altered by changes in flows, withdrawals, or flow routing, there is no error involved in applying this method, there are no data gaps that need to be filled in order to use it, and seasonal variations and critical conditions are taken into account because the loading capacity is not dependent on flow or other environmental conditions. The recommended numeric triggers (based on criteria derived by the UC-Davis method) are designed to be protective of sensitive species and threatened and endangered species at all life-stages, thus when the loading capacity is not exceeded, conditions should be protective of sensitive or critical life-stages of aquatic life.

Attainment of the loading capacity is also likely to result in attainment of the sediment toxicity numeric targets, as similar levels of reduction would be needed to attain either target (as shown in Table 5-13). The proposed loading capacity is defined based on the water column targets, since these can be used more directly in defining TMDL allocations and water column concentrations respond more quickly to reductions in inputs than sediment concentrations. It may take longer to attain the sediment targets because sediment concentrations do not decrease as rapidly as water concentrations in response to reduced loading.

Because the WLAs and LAs are defined based on the loading capacity, the explanation of support for the loading capacity also applies to the WLAs and LAs. The loading capacity must be allocated to point and nonpoint sources as WLAs and LAs, respectively, which are described in the following sections.

6.1.2.1 Wasteload Allocations

Wasteload allocations would be assigned to all municipal separate storm sewer system (MS4) National Pollution Discharge Elimination System (NPDES) permittees that discharge to a water body on the 303(d) list for pyrethroids due to urban runoff. All of the water bodies on the 303(d) list for pyrethroids in urban areas have an urban runoff source. These nine urban water bodies on the 303(d) list for pyrethroids are in the urban areas of Sacramento and Roseville. In order to address these impairments, pyrethroid pesticides WLAs are proposed for the Sacramento and Roseville municipal separate storm sewer systems. The proposed WLAs for pyrethroid pesticides are equivalent to the concentration-

based loading capacity. The water bodies that are subject to the TMDL and the dischargers to which WLAs are assigned are listed in Table 6-1. NPDES-permitted dischargers within the TMDL watersheds that are not assigned wasteload allocations and explanations as to why they need not be addressed by wasteload allocations are given in Appendix D. Because urban runoff from MS4s is the only source of pyrethroids to the TMDL water bodies and because of the diffuse nature of the sources of pyrethroids in urban runoff, compliance with wasteload allocations will be determined using appropriate representative receiving water monitoring rather than directly monitoring outfalls.

Although MS4s have limited regulatory tools in terms of directly controlling pesticide use, it is expected that through the iterative implementation actions identified in the proposed amendment over the compliance time frame the WLAs will be attained in urban storm water. The proposed Basin Plan amendment authorizes MS4 permits to implement applicable WLAs associated with pyrethroid TMDLs through the use of best management practices. Under the proposed amendment, the MS4s would be responsible for implementing best management practices to control pyrethroid pesticides in their discharges to the maximum extent practicable, meeting applicable WLAs by the final compliance deadline for the TMDL (20 years from the effective date of this Basin Plan amendment). Specific BMPs that are effective in controlling pesticides in urban storm water are identified in section 7.1. The implementation actions identified in the proposed amendment also include actions that the Board will take to ensure pyrethroid water quality issues are adequately addressed by the agencies responsible for regulating pyrethroid use and recommended actions for DPR and USEPA. A combination of iterative storm water BMP implementation and implementation of the authorities responsible for regulating pesticide use is expected to result in the attainment of the wasteload allocations for storm water discharges. Attaining the numeric targets and allocations is expected to take several years. Due to uncertainty in effectiveness of the BMPs in urban areas, a phased, iterative approach is required to assess progress and adjust management practices and/or the TMDL as appropriate.

Table 6-1 Wasteload allocation assignments and applicable TMDL water body segments

Point Source Discharger	NPDES permit #	TMDL water body segments	Water Body ID
City and County of Sacramento Storm Water Discharges from Municipal Separate Storm Sewer Systems	CAS085324	Arcade Creek	CAR5192100019980813113546
		Chicken Ranch Slough	CAR5192100019980817094238
		Strong Ranch Slough	CAR5192100019980817095051
		Morrison Creek	CAR5191100019980817123042
		Elder Creek	CAR5191100019980817124745
City of Roseville Storm Water Discharges from Municipal Separate Storm Sewer Systems	CAS000004	Curry Creek (Placer and Sutter Counties)	CAR5192200020070510155010
		Kaseberg Creek (tributary to Pleasant Grove Creek, Placer County)	CAR5192200020070510154406
		Pleasant Grove Creek (upstream of Fiddyment Rd)	CAR5192200020070510150258
		Pleasant Grove Creek, South Branch	CAR5192200020070510153551

6.1.2.2 Load Allocations

Load allocations for pyrethroid pesticides are not needed or proposed for any nonpoint source dischargers within the watershed. Within the TMDL watersheds (Table 6-1), urban runoff discharged from municipal separate storm water systems is identified as the only source of pyrethroids loading, thus there are no nonpoint sources to which LAs could be assigned in these water bodies.

6.1.2.3 Margin of Safety and Seasonal Variations

The recommended WLAs have an implicit margin of safety and therefore an additional explicit margin of safety is not required. The WLAs are equal to the concentration-based loading capacity, which is equivalent to the proposed numeric triggers. The proposed TMDL has an implicit margin of safety in that allocations are assigned equal to the loading capacity concentrations, and does not account for dilution in the TMDL water bodies receiving storm water discharges. There will likely be dilution available in the TMDL water bodies because it is unlikely that all of its tributaries are discharging at concentrations approaching the proposed concentration goals. Thus, the available dilution provides a margin of safety for the TMDL water bodies.

The recommended methodology for allocating the loading capacity also assumes no significant reductions in pyrethroid loading due to removal from the water column or sediments by degradation. Degradation processes are likely to take place, so this assumption further contributes to the implicit margin of safety. Because the WLAs and loading capacity are all defined on a concentration-basis, all seasonal variations and critical conditions are explicitly considered in the recommended method for defining the numeric triggers, loading capacity and allocations.

6.2 Category 4b for Agricultural Waters

U.S. EPA regulations recognize that alternative pollution control requirements may obviate the need for a TMDL. Specifically, segments are not required to be included on the section 303(d) list if "[o]ther pollution control requirements (e.g., best management practices) required by local, State, or Federal authority" are stringent enough to implement applicable water quality standards (WQS) (see 40 CFR 130.7(b)(1)) within a reasonable period of time. These alternatives to TMDLs are commonly referred to as "Category" 4b determinations in reference to one of the classifications used in 303(d)/305(b) Integrated Reports.

Agricultural dischargers are regulated under the Irrigated Lands Regulatory Program, which has waste discharge requirements in place that require implementation measures when a water quality objective or water quality trigger limit is exceeded and irrigated lands discharges are causing or contributing to the exceedance. The acute and chronic pyrethroid triggers in the proposed amendment would be used as trigger limits in the Irrigated Lands Regulatory Program. In addition, specific pollution controls are included in the proposed amendment to ensure that the applicable water quality objectives would be attained in a reasonable time period. Because agricultural dischargers have a high degree of control over pyrethroid use in the impaired watersheds, if the proposed requirements to attain applicable water quality objectives for pyrethroids are adopted, then water quality standards can be attained in the impaired agricultural water bodies in a specified time period. In addition, agricultural dischargers have completed several management plans for pyrethroids (see Appendix E). There are five examples in which pyrethroids were identified as a cause of an exceedance, which required dischargers to implement management plans for pyrethroids. Completion of a management plan indicates that improved management practices implemented by agricultural dischargers have resolved the water quality problem. Because it can be demonstrated that water quality standards will be attained in a specified time period, impairments in

agricultural watersheds can be addressed under Category 4b of the 303(d)/305(b) Integrated Report.

7 IMPLEMENTATION PROGRAM

The Porter-Cologne Water Quality Control Act 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." (Wat. Code, § 13242).

This section evaluates options for how the Regional Water Board can ensure the pyrethroid discharges are controlled, consistent with the overall regulatory approach discussed in section 3. Options for ensuring compliance with the TMDL allocations and ensuring reasonable protection of beneficial uses are evaluated for the sources of these pesticides.

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

1. Not allowing discharge of waste in certain areas or under certain conditions (Wat. Code, § 13243.);
2. Issuing waste discharge requirements (WDRs) (Wat. Code, § 13263.), which are sometimes issued as combined WDRs and NPDES permits (when NPDES permits are required under the federal Clean Water Act);
3. Conditionally waiving WDRs (Wat. Code, § 13269.); and
4. Issuing cleanup, abatement orders, and other enforcement options (Wat. Code, § 13304.).

As discussed above, for urban water bodies with identified pyrethroid impairments, TMDLs are the recommended tool to regulate discharges to attain water quality objectives in these water bodies. Under the proposed amendment, NPDES MS4 permits regulating discharges to water bodies with pyrethroid TMDLs would need to contain requirements to achieve compliance with the proposed TMDL allocations. As discussed above, for agricultural water bodies with identified pyrethroid impairments, the establishment of the requirements in the proposed amendment and the irrigated lands regulatory program's waste discharge requirements, would support a demonstration that these water bodies are being addressed by regulatory requirements other than a TMDL (category 4b demonstration).

In addition to addressing existing impairments, part of the goal of this project is to put controls in place that would address pyrethroid discharges throughout the Sacramento and San Joaquin River Basins to help prevent future impairments. As discussed in section 3, a conditional prohibition is proposed that would prohibit pyrethroid discharges above concentration goals unless the discharger implements management practices to reduce pyrethroid discharges.

In addition to the actions that will be required of dischargers, the proposed amendment contains commitments that the Central Valley Water Board will take actions to support proactive pesticide use regulation through involvement in pesticide regulation efforts. Recommended actions for the California Department of Pesticide Regulation and U.S. EPA Office of Pesticide Programs are also included in the proposed amendment to ensure that their regulation of pesticide use is protective of water quality.

7.1 Municipal Storm Water Discharges

National Pollution Discharge Elimination System permits are issued to point sources including municipal storm water dischargers. Municipal storm water is regulated through the issuance of municipal separate storm water system (MS4) permits. There are two types of MS4 permits: Phase I and Phase II. Phase I permits are issued as individual permits to medium (serving between 100,000 and 250,000 people) and large (serving >250,000 people) municipalities. Phase II permits are issued as a general permit to small (serving <100,000 people) municipalities. Phase I and Phase II MS4 permits require dischargers to develop and implement a Storm Water Management Plan (SWMP) to reduce pollutants to the maximum extent practicable (MEP). SWMPs are developed by the permittee and specify the BMPs that will be used to address potential contaminant sources, including pesticides. MEP is the performance standard specified in Section 402(p) of the Clean Water Act and is a standard by which compliance with the storm water requirements can be evaluated. In addition to the SWMP, all Phase I permittees in the Project Area have a Pesticide Plan. Pesticide Plans identify pesticide control strategies and meet the requirements for a Management Plan as described in the Basin Plan. For the purpose of this amendment, the term “Management Plan” refers to a SWMP and/or Pesticides Plan (where applicable) for MS4s.

There are no known physical treatments for storm water systems that can achieve the proposed numeric triggers for pyrethroids. State law does not allow local authorities to ban or limit pesticide sales and use. Therefore holding storm water dischargers to the standard of attaining numeric effluent limitations or receiving water limits could lead to widespread compliance issues. Attainment of the proposed pyrethroid triggers in storm water will likely require continued support through actions of the municipal dischargers

working together with the Central Valley Water Board, and state, federal and local agencies responsible for registering pesticides and regulating pesticide use as part of an overall pesticide pollution prevention strategy. This strategy requires significant involvement of the MS4s to ensure success. Therefore a BMP-based approach, built on the MEP standard, and emphasizing pollution protection activities, is proposed for MS4 dischargers to be included as part of the TMDL and conditional prohibition.

Implementation of BMPs will serve to reduce pyrethroids in urban water bodies and prevent future impairments. Surveillance and monitoring associated with these implementation measures are also proposed to assess progress in achieving the pyrethroid triggers (section 8.1).

The TMDLs in the proposed amendment would assign WLAs to MS4s that directly discharge into a 303(d)-listed water body (section 6.1.2.1). Where WLAs are established, compliance with the proposed WLAs can be attained by implementing BMPs to reduce pyrethroid pesticides in urban runoff.

Specific BMPs are listed in the Proposed Basin Plan Amendment for Pyrethroid Pesticides. The specific BMPs include education and outreach activities and pollution prevention activities. Education and outreach activities include targeted outreach programs to encourage reduced reliance on pesticides that threaten water quality, providing point-of-purchase materials to pesticide retailers that provide information on proper use and disposal of pesticides as well as potential water quality impacts and less toxic pest control methods, conducting outreach to provide information about integrated pest management , and encouraging management practices that minimize pesticide runoff, such as irrigation management and landscape design. Pollution prevention activities include reducing reliance on pyrethroids and other pesticides that threaten water quality in the discharger’s own operations and property, and developing and implementing an integrated pest management policy that applies to the discharger’s staff and contractors. The management plans must identify a set of management practices that taken as a whole, are reasonably expected to effectively reduce pyrethroid levels in their discharges, and to mitigate the potential for replacement insecticide products to cause additional water quality impairments. The proposed amendment would require that dischargers consider all of the listed measures before choosing specific measures to implement under the SWMP, whether or not the discharger is subject to the TMDL. Under the proposed amendment, dischargers may also identify other control measures that are not included in the Basin Plan amendment. Because many of these BMPs may be more efficiently implemented when entities collaborate and cooperate, the proposed amendment specifies that BMPs may be implemented by individual urban runoff management entities, jointly by two or more

entities acting in concert, or cooperatively through a regional or statewide approach, as appropriate.

The challenges for urban dischargers of pesticides have been recognized by the State Water Resources Control Board, which as part of the Strategy to Optimize Resource Management of Storm Water (STORMS) is developing a Statewide Framework for Urban Pesticide Reduction that is scheduled for State Water Board consideration in 2018. Central Valley Water Board staff is part of the team participating in the development of that framework. The draft proposed amendment has been crafted so that it would be compatible with and supportive of the potential statewide framework.

7.2 Agricultural Dischargers

Consistent with the State Water Board's *Policy for Implementation and Enforcement of the Nonpoint Source Pollution Control Program*, irrigated lands dischargers in the Project Area are regulated with WDRs or conditional waivers. For irrigated agricultural dischargers regulated through the Irrigated Lands Regulatory Program (ILRP), Regional Water Board requirements are implemented through WDRs for individual growers and growers who are part of a third party group (Order R5-2012-0116-R2, R5-2013-0100, R5-2014-0032, R5-2014-0030, R5-2014-0029, R5-2013-0120, R5-2014-0002, R5-2014-0001). For irrigated lands grown in association with dairies, Basin Plan requirements are implemented under the Dairy Program WDRs (Order R5-2013-0122). The proposed implementation provisions are the same for both irrigated agricultural dischargers regulated under ILRP WDRs and irrigated agricultural dischargers regulated under the Dairy Order and are described below.

7.2.1 **Irrigated Lands Regulatory Program**

The ILRP WDRs require the submittal of a Surface Water Quality Management Plan (SQMP) or an update to the Comprehensive Surface Water Quality Management Plan (CSWQMP) when an applicable water quality objective or water quality trigger limit is exceeded. The Orders require that a SQMP is developed within 60 days of an exceedance. If a CSWQMP is being used instead of individual SQMPs, an update is required annually. All ILRP WDRs contain a time schedule for compliance with surface water limitations that requires attainment of water quality objectives within 10 years of the adoption of a SQMP.

Under the proposed amendment, future exceedances would result in the need for the development of a new or revised SQMP or CSWQMP. Under the proposed amendment, any previously-established timelines in existing SQMPs or CSWQMP would still apply.

The existing WDRs already require a program of implementation and surveillance and monitoring when a water quality objective or water quality trigger limit is exceeded. A TMDL is not necessary for the five water bodies in agricultural areas because there are already pollution controls in place that would lead to attainment of applicable water quality objectives within a reasonable period of time if the proposed implementation plan is adopted. (40 CFR 130.7(b)(1)). This approach is commonly called a Category 4b determination, in reference to one of the classifications used in the 303(d)/305(b) Integrated Reports. Further discussion and the rationale for the Category 4b demonstration is provided in Appendix C. The Category 4b determinations would apply to the following water bodies: Del Puerto Creek, Hospital Creek, Ingram Creek, and Mustang Creek.

7.2.2 Irrigated Lands Associated with Dairies

Dairies that grow crops (e.g., alfalfa) in association with their operation are potential sources of pyrethroid pesticides to surface waters. Dairies, and associated croplands, are currently permitted under a WDRs General Order (Order R5-2013-0122). The Order prohibits discharges from milk cow dairies that cause or contribute to an exceedance of any applicable State or federal water quality criteria, or a violation of any applicable State or federal policies or regulations. Monitoring and reporting requirements are specified in an associated MRP. The MRP requires monitoring of storm water runoff from land application areas; however, in the current Order there are no requirements to monitor pesticides.

The options for the croplands regulated under the dairy program with the potential to discharge pyrethroids to surface water would be to 1) develop their own management plans and monitoring programs or 2) participate in the management plans, and monitoring programs already established by the coalition groups regulated under the ILRP WDRs.

7.2.3 Available Practices

There are many agricultural management practices effective in reducing off-site movement of pyrethroid pesticides into surface water. Information on trends in pyrethroid pesticide use is described in section 2.2.1, but detailed information on the extent of implementation of runoff mitigation practices is not currently available (ICF International 2010, 2011). Available information indicates that many of these practices are already used by a significant portion of the growers in the Central Valley (ICF International 2010, 2011). The major types of management practices available for reducing pyrethroid pesticides agricultural discharges are:

Pest management practices
Pesticide application practices

Vegetation management practices
Water management practices
Sediment and erosion control

A broad range of practices for controlling runoff are available to growers when they use pesticides that pose significant risks to water quality, such as pyrethroids (Zhang et al. 2010). These practices include changes in application practices and adoption of vegetation management and water management practices that prevent or reduce runoff.

Pest management practices include removal of pest habitat, such as orchard sanitation (removal of mummy shells), biological controls to reduce pest pressure, and pesticide choice (use of alternative pesticides).

Changes in pesticide application practices could include turning off outward facing airblast sprayer nozzles at the end of rows and on outside rows, 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 (e.g., orchard floors during the dormant season), constructed wetlands, and vegetated drainage ditches. In addition to reducing runoff, vegetative cover would also reduce runoff of sediment and excess nutrients.

Water management practices have a goal of reducing off-site movement of irrigation water and sediment that contains pyrethroids. These practices include improvements in water infiltration and runoff control such as increased irrigation efficiency and distribution uniformity, optimized irrigation scheduling, reduced water applications (e.g., use of sprinklers, microsprinklers, buried or surface drip irrigation), increased use of soil moisture monitoring tools, use of sediment detention basins, increased use of tailwater return systems, use of polyacrylamide (PAM) to reduce sediment loads in return water, and vegetated drainage ditches.

The appropriate actions for individual growers will vary depending on the crops grown, field conditions, and pest pressures. The Board will not require implementation of specific practices or technologies at this time, but may review proposed actions in management plans based upon the likelihood that the growers' collective or individual actions will be protective of water quality in the Sacramento River and San Joaquin River basins water bodies.

Examples of five successfully completed management plans for pyrethroids and the management practices implemented in these watersheds are described in Appendix E.

7.3 Municipal and Domestic Wastewater Discharges

Municipal and domestic wastewater dischargers in the Project Area are not subject to the proposed TMDLs because there are currently no publicly-owned treatment works (POTWs) that discharge to water body segments that are 303(d)-listed for pyrethroids. However, POTWs would be subject to the conditional prohibition of pyrethroid discharges in exceedance of the proposed numeric triggers.

As with many other pollutants, POTWs have little control over pyrethroid levels in their influent; such pesticides are present in drainage and sewage that POTWs receive for treatment. However, pyrethroid loads pose a unique problem for POTWs for several reasons. The first significant problem is that state law prohibits local authorities, such as cities, from regulating pesticide use by ordinance, limiting their authority to impose mandatory source control. In conjunction with this problem, staff is unaware of any practical technology for removing pyrethroids from effluent down to the low concentrations (part per trillion levels) of the proposed chronic numeric trigger.

State law does not allow local authorities to ban or limit pesticide sales and use. Therefore holding wastewater dischargers to the standard of attaining numeric effluent limitations or receiving water limits could lead to widespread compliance issues. Therefore a BMP-based approach, including pollution protection activities, is proposed for wastewater dischargers to be included as part of the conditional prohibition.

Implementation of BMPs will serve to reduce pyrethroids and prevent future impairments. Surveillance and monitoring associated with these implementation measures are also proposed to assess progress in achieving the pyrethroid triggers (section 8.1).

Specific BMPs are listed in the Proposed Basin Plan Amendment for Pyrethroid Pesticides. The specific BMPs include education and outreach activities and pollution prevention activities. Education and outreach activities include targeted outreach programs to encourage reduced reliance on pesticides that threaten water quality, providing point-of-purchase materials to pesticide retailers that provide information on proper use and disposal of pesticides as well as potential water quality impacts and less toxic pest control methods, conducting outreach to provide information about integrated pest management , and encouraging management practices that minimize pesticide runoff, such as irrigation management and landscape design. Pollution prevention activities include reducing reliance on pyrethroids and other pesticides that threaten

water quality in the discharger's own operations and property, and developing and implementing an integrated pest management policy that applies to the discharger's staff and contractors. The management plans must identify a set of management practices that taken as a whole, are reasonably expected to effectively reduce pyrethroid levels in their discharges, and to mitigate the potential for replacement insecticide products to cause additional water quality impairments. The proposed amendment would require that dischargers consider all of the listed measures before choosing specific measures to implement in developing pesticide management plans. Under the proposed amendment, dischargers may also identify other control measures that are not included in the Basin Plan amendment. Because many of these BMPs may be more efficiently implemented when entities collaborate and cooperate, the proposed amendment specifies that BMPs may be implemented by individual urban runoff management entities, jointly by two or more entities acting in concert, or cooperatively through a regional or statewide approach, as appropriate.

7.4 Vector Control

In the general NPDES permit for pesticide discharges from vector control applications (Order 2012-0003-DWQ), it is stated that permittees may not discharge residual pyrethroids to water bodies on the 303(d) list for pyrethroids. Several pyrethroids are approved for the vector control use, including permethrin, resmethrin, sumithrin, prallethrin, and etofenprox, and all have receiving water monitoring triggers. Of these, only permethrin is being addressed by the proposed amendment. Vector control applications account for only 3% of all pyrethroid use in the Project Area (based on annual average from 2007-2011, CDPR 2013). In addition, a recent statewide study showed no residual toxicity in areas where permethrin was applied for vector control (Phillips et al. 2014b).

The NPDES permit specifies that discharges of pesticides from vector control applications shall not cause or contribute to an in-stream excursion above a water quality objective adopted by the State or Regional Water Boards. According to the permit, dischargers must develop a pesticides application plan and implement BMPs when applying pesticides. If monitoring data for residual pesticides show exceedance of the monitoring triggers or an adopted water quality objective, the discharger must, at a minimum, evaluate its application methods, BMPs, and the appropriateness of using alternative products. As a result of the evaluation, the General Permit may be re-opened to add numeric Receiving Water Limitations for the residual pesticides exceeding the triggers.

Because the State Water Boards permitting for vector control sprays requires that vector control operations will not cause or contribute to water quality objective exceedances and these applications represent an insignificant source of pyrethroids to impaired waters in the Project Area, no specific provisions for vector control sprays are included in the proposed amendment.

7.5 Implementation Actions for the Central Valley Water Board

The Basin Plan amendment proposes that the Central Valley Water Board encourage, monitor, and enforce implementation actions by dischargers. Additionally, continued engagement by the Board in USEPA and DPR regulation of pesticide use is a key element in the proposed implementation program. Therefore, the proposed amendment would also express commitment by the Central Valley Water Board to continue proactive involvement in the regulation of pesticide usage through participation in DPR and USEPA Office of Pesticide Programs pesticide registration and regulation of pesticide use. The goal of this action is to work with these agencies to improve risk assessments, registrations, and other use regulations in order to prevent water quality issues from registered pesticide uses. The six actions that the Regional Board would commit to upon adoption of the proposed Basin Plan amendment are as follows:

1) Track U.S. EPA and DPR pesticide evaluation and registration activities as they relate to surface water quality and share monitoring and research data with U.S. EPA and DPR;

Both the USEPA OPP and DPR have several registration and evaluation actions they take to review pesticide usage and impacts to human health and water quality. The Central Valley Water Board needs to actively follow these actions so as to provide input during appropriate times, such as the USEPA OPP Pesticide Registration Review or DPR's Annual Registration Renewal. By tracking these actions as they are occurring and providing input including monitoring and research data as to the adverse effects of pesticides, the Central Valley Water Board can offer solutions to reduce and prevent problems associated with pesticide use.

2) When necessary, request that U.S. EPA coordinate implementation of the Federal Insecticide, Fungicide, and Rodenticide Act and the Clean Water Act;

When there is the potential for water quality impairment or when water quality impairment has occurred, the Central Valley Water Board will request that the USEPA implement FIFRA and CWA regulations. This will be facilitated by the Central Valley Water Board by encouraging regulatory action to address the highest priority pesticides

causing impairments during their registration process and by sending the updated 303(d) listings, fact sheets and supporting data to the USEPA OPP. For pyrethroids the Central Valley Water Board has encouraged further regulation under FIFRA resulting in USEPA's label changes to protect water quality and accelerating timing for registration review of all pyrethroids.

3) Encourage U.S. EPA and DPR to fully address water quality concerns within their pesticide registration and use regulation processes, including urban runoff and wastewater discharges as well as agricultural runoff. This shall include providing comments on USEPA registration reviews for pesticides of concern;

In this action, the Central Valley Water Board will follow up the first action to track USEPA and DPR pesticide evaluation and registration activities by encouraging the USEPA and DPR to address water quality concerns. This will be done by analyzing pesticide regulatory documents to identify water quality protection gaps, reviewing scientific studies to assemble information needed to fill the identified gaps and communicating this information to USEPA and DPR through letters, meetings, informal communications, and presentations. Historically, USEPA and DPR both focused their modeling and monitoring on agricultural use of pesticides, but some progress has already been made as both USEPA and DPR have expanded their review processes for all pesticides to better address both urban runoff and wastewater discharges. Both agencies are responding to water quality problems from pyrethroid insecticides (DPR's pyrethroid reevaluation and Surface Water Protection regulations, and USEPA's label changes to protect water quality and accelerating timing for registration review of all pyrethroids).

4) Work with DPR, County Agricultural Commissioners, and the Structural Pest Control Board to promote pesticide application practices that result in discharges that comply with water quality regulations by participating in and providing support for regulatory and educational activities that promote these practices;

The Central Valley Water Board will work with the above listed authorities to ensure compliance of water quality standards. Outreach and education of best management practices to reduce pesticide discharges are relayed through these authorities. The Central Valley Water Board will assist with providing these best management practices and will support and publically recognize the development and implementation of pesticide labels, regulations, and best management practices by DPR, County Agricultural Commissioners, and the Structural Pest Control Board that result in improvements in water quality protection.

5) Assemble available information (such as monitoring data) to assist USEPA and DPR in taking actions necessary to protect water quality;

The Central Valley Water Board establishes water quality standards through the Basin Planning process. Water quality standards consist of the designated beneficial uses and water quality objectives of the Basin Plans. The Central Valley Water Board under Section 303 of the CWA interprets water quality standards for various pollutants and contaminants, including pesticides, and using available data creates a list of impaired water bodies. This list, known as the 303(d) List, as well as other available monitoring data and technical comments can then be sent to and utilized by DPR to take necessary regulatory action to protect water quality.

6) Use authorities (e.g., through permits or waste discharge requirements) to require implementation of best management practices and control measures to minimize pesticide discharges to surface waters;

In cases where water quality standards are not being met, the Central Valley Water Board has several authorities to require compliance. The authorities by which the Central Valley Water Board can require implementation of best management practices and control measures to minimize pesticide discharges to surface waters are individual or general WDRs, conditional waivers of WDRs, NPDES permits, and a conditional prohibition. Implementation of these authorities as they pertain to pyrethroids is discussed in the preceding sections.

7) Staff will provide periodic updates to the Board on overall progress at addressing pesticide related water quality concerns. These updates may include implementation control programs for specific pesticides, and coordination with U.S. EPA and DPR.

These actions will support and reinforce measures that dischargers may be required to implement in order to attain water quality objectives with respect to pyrethroid pesticides. The Central Valley Water Board recognizes that pesticide registration cannot be controlled by dischargers or the Regional Board, but that the Board may influence the registration process by sharing information regarding water quality impairments caused by pyrethroids and other pesticides. Central Valley Water Board staff has been regularly providing comments to USEPA and DPR to help ensure that water quality concerns are addressed in their pesticide regulation activities. The proposed amendment would express the Board’s commitment to continue that engagement as part of the program of implementation.

The proposed amendment also states that the Board intends to review the pyrethroid pesticides prohibition, the pyrethroid pesticides total maximum daily load allocations, the numeric pyrethroid triggers, and the implementation provisions no later than 15 years from the effective date of the amendment. This will allow the Board to re-asses the program after it has been implemented for a significant time, but before the compliance date of 20 years from the effective date of the amendment.

7.6 Recommended Implementation Actions for Other Agencies

The Central Valley Water Board recommends implementation actions in the Basin Plan amendment for two other agencies involved in registration of pesticide products, the California Department of Pesticide Regulation and the U.S. Environmental Protection Agency. These two agencies control pesticide registration and regulation, and therefore are the only agencies that have the authority to approve, modify or cancel product labels and registrations. Coordination with these two agencies is very important for making changes to current pesticide products and labels that are identified as causing water quality impairments and preventing future pesticide products from causing impairments.

Consistent with its authorities, for DPR, there are seven recommended actions aimed at reducing exceedances of water quality standards by registered pesticides:

1) Conduct statewide urban and agricultural monitoring program to identify pesticides applied in such a manner that runoff does or could cause or contribute to water quality concerns;
2) Deny registration to pesticide products during registration evaluation process that present an unacceptable risk to surface water;
3) Require registrants to provide information necessary to assess potential water quality impacts as a condition of registration, including, when necessary, development of analytical methods with adequately low limits of quantification in appropriate matrices;
4) Continue and enhance efforts to evaluate the potential for registered pesticide products to cause or contribute to water quality concerns, including consideration of fate and transport of pesticide discharges from wastewater treatment plants, urban runoff, and agricultural sources. Continuous evaluation efforts include monitoring, assessment, and special studies to address identified data gaps;
5) Notify USEPA of potential deficiencies in product labels for products that threaten water quality;
6) Work directly with registrants to address product uses specific to California environmental concerns;

7) Where necessary, develop and modify pesticide use regulations to address pesticide uses that are causing unacceptable water quality impacts;
8) Continue and enhance education and outreach programs to encourage integrated pest management and less toxic pest control (work with County Agricultural Commissioners, urban runoff management agencies, and the University of California Statewide Integrated Pest Management Program to coordinate activities);
9) Continue and enhance, in coordination with county agricultural commissioners, implementation and enforcement of water quality protection regulations and label requirements, including urban surface water protection regulations;
10) Continue and enhance reporting on progress and challenges in implementing water quality protection-related efforts for pesticides with concentrations of concern.

For U.S. EPA, there are three recommended actions:

1) Continue to improve the pesticide registration and registration review processes to ensure that pesticide applications and resulting discharges are protective of water quality and do not cause water quality impairments (i.e., restrict uses or application practices to manage risks). This should include consideration of fate and transport of pesticide discharges from wastewater treatment plants, urban runoff, and agricultural runoff;
2) Continue and enhance education and outreach programs to encourage integrated pest management and less toxic pest control;
3) Require registrants to provide information necessary to assess potential water quality impacts as a condition of registration, including, when necessary, adequate ecotoxicity data to develop water and sediment quality criteria for pesticides of concern and development of analytical methods with adequately low limits of quantification in appropriate matrices;
4) Complete studies to address critical data needs;
5) Respond in a timely manner to identified deficiencies in product labels for products that threaten water quality;
6) Continue and enhance internal coordination efforts between the Office of Pesticide Programs and the Office of Water to implement the above-stated actions to ensure pesticide registration decisions protect water quality.

8 SURVEILLANCE AND MONITORING

Surveillance and monitoring requirements are necessary to evaluate trends in pyrethroid discharges based on implementation of management practices. Under the proposed amendment, specific monitoring and reporting requirements will be established in the monitoring and reporting programs associated with NPDES permits, WDRs, and conditional waivers of WDRs. This section describes general surveillance and monitoring requirements for three types of dischargers proposed for inclusion in the Basin Plan. If monitoring such as that being done to meet existing program requirements meets or exceeds the proposed requirements, additional surveillance and monitoring may not be required.

Specific requirements for information to be collected can be required through monitoring and reporting programs established through WDRs or waivers of WDRs to ensure that the necessary information is collected and submitted to the Central Valley Water Board to determine progress in implementing the Basin Plan requirements and attaining water quality standards.

Three main alternatives for surveillance and monitoring were considered:

1. No change in existing surveillance and monitoring requirements. Do not include a general or specific monitoring and surveillance program in the Basin Plan;
2. Provide only general requirements on the monitoring and surveillance; and
3. Identify specific monitoring requirements, including methods, sites, and constituents.

Under alternative 1 (no-change to existing requirements), no additional information would be provided in the monitoring and surveillance chapter for the new water bodies. The existing general information on monitoring and surveillance in the Basin Plan would apply. Much of the required monitoring is already being conducted by Irrigated Lands Regulatory Program coalition groups and NPDES permittees. Under Alternative 1 it may be unclear as to what information should be collected to ensure that the Regional Water Board can determine progress in reducing pyrethroid discharges and there would be less information available about potential impacts of alternative pesticides.

Under alternative 2, the Basin Plan amendment would provide general requirements for the monitoring and surveillance to be conducted, but would allow flexibility in terms of the specific monitoring requirements. The general requirements would be structured to provide enough data to allow accurate and meaningful evaluation of compliance with the Basin Plan amendment. These requirements would also ensure that all programs are utilizing adequate monitoring methods.

Under alternative 3, the Basin Plan amendment would explicitly 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 for dischargers.

Alternative 2 is recommended because it will provide consistent requirements for the water bodies where the proposed numeric triggers would apply. Specific expectations for the information to be collected can be required through monitoring and reporting programs established through WDRs or waivers of WDRs to ensure that the necessary information is collected and submitted to the Central Valley Water Board to determine progress in implementing the Basin Plan requirements and attaining water quality standards. In addition, this alternative would allow dischargers to more readily rely on monitoring conducted by state or federal agencies, collaborative watershed efforts, or special studies if the data meet the requirements established in their permit or WDR and to allow dischargers to do representative monitoring, using a single monitoring site to represent multiple sites within a watershed or service area if they have similar characteristics and source loading. If the specific methods and number of monitoring sites required to meet those expectations remains flexible, it allow dischargers to take advantage of the efforts of different groups and agencies conducting monitoring and evaluating management practices, and to allow resources to be adjusted relative to the magnitude of the water quality threat without requiring an amendment to the Basin Plan. The recommended general monitoring and surveillance for the three discharger types are described below in sections 8.1, 8.2, and 8.3.

The types of data that will be required in order to provide information to meet the proposed monitoring goals include chemical analysis of water samples (receiving waters or effluents), receiving water toxicity testing, sediment toxicity testing, and possibly chemical analysis of sediments to determine whether pyrethroids are identified as causing or contributing to the toxicity. Chemical analysis of water samples would need to include total pyrethroid concentrations as well as dissolved and particulate organic carbon concentrations in order to estimate the freely dissolved pyrethroid concentration for comparison to the pyrethroid concentration goals.

Some amount of both receiving water toxicity data and sediment toxicity data are proposed for municipal storm water and agricultural dischargers because these sources tend to have higher particle loads, indicating they may affect aquatic organisms in the water column as well as benthic organisms once the particles settle. For municipal and domestic wastewater dischargers, only receiving water toxicity testing is proposed because these sources tend to have lower levels of particles that may settle out, meaning there is less potential for toxic effects in bed sediments.

While there has been pyrethroid monitoring done in the past, very little of it has collected the parameters needed to estimate the freely dissolved pyrethroid concentrations that are proposed to account for bioavailability. In order to determine what levels of pyrethroids are currently being discharged and are found in ambient waters, there are monitoring goals to determine the baseline conditions. Following the prohibition going into effect, trend monitoring would be required to track progress and determine effectiveness of the management practices being implemented, and additional goals are given for trend monitoring.

The monitoring goals for impaired waters are not separated into baseline and trend monitoring, because impairments have already been identified in these water bodies, and implementation actions are required to begin immediately.

Generally, monitoring data would be compared to the acute or chronic concentration goal based on the event in which a sample is collected. There are a number of factors that must be considered in this type of analysis (sample collection parameters, weather conditions, stream flow, etc.). Flexibility to consider such factors must be allowed to ensure selection of the most appropriate comparison for compliance consideration. Samples representing long-term average conditions are typically compared to the chronic concentration goal and samples representing transient, or short-term, conditions may be compared to the acute concentration goal.

8.1 Municipal Storm Water

Urban runoff from municipal storm water has been identified as the source of pyrethroids impairments in urban water bodies. For TMDL water bodies, there are five monitoring goals, designed to collect information regarding the attainment of the TMDL numeric targets and wasteload allocations:

1) Determine whether receiving waters are attaining the Pyrethroid Pesticides Water Column Additivity Numeric Targets and whether the wasteload allocations are being attained in discharges as measured at representative receiving water locations by providing pyrethroid and dissolved and particulate organic carbon concentration data;

2) Determine whether bed sediments are attaining the Sediment Toxicity Numeric Targets. In order to link sediment toxicity to pyrethroid pesticides, chemical analysis of the sediment for pyrethroid pesticides shall be performed if the sediment is toxic;

3) Provide *Hyalella azteca* toxicity test data to determine whether pyrethroid pesticides are causing or contributing to exceedances of the narrative water quality objective for toxicity in surface waters;

4) Determine whether the implementation of management practices is sufficient to attain the TMDL Allocations and Numeric Targets.

5) In cooperation with the Regional Water Board, USEPA and DPR, determine if monitoring and reporting programs for alternatives to pyrethroid pesticides are necessary and identify alternative insecticides for which monitoring might be appropriate with consideration of the commercial availability of acceptable analytical methods. If an alternative insecticide is identified as appropriate for monitoring, monitoring shall be performed by the discharger to determine whether alternatives to pyrethroid pesticides are being discharged at concentrations with the potential to cause or contribute to exceedances of applicable water quality objectives.

For municipal storm water dischargers that are not subject to the TMDL, the proposed implementation program consists of implementation of best management practices to the maximum extent practicable, and there are separate monitoring goals for baseline and trend monitoring.

The baseline pyrethroids monitoring and reporting program for municipal storm water discharges shall be designed to collect information necessary to:

1) Determine through representative receiving water monitoring whether discharges from municipal separate storm sewer systems are exceeding the Acute and Chronic Pyrethroid Triggers;

2) Provide pyrethroid and dissolved and particulate organic carbon concentration data and *Hyalella azteca* toxicity test data to determine whether pyrethroid pesticides are causing or contributing to exceedances of the narrative water quality objective for toxicity in surface waters or bed sediments. With Executive Officer approval, the baseline monitoring requirements may be met by submittal of a report, including a compilation and interpretation of representative monitoring data, demonstrating that the required information has been collected and is sufficient to make the required determinations.

The pyrethroids trend monitoring and reporting program for municipal storm water discharges shall be designed to collect information necessary to meet the above goals for the baseline monitoring, as well as:

3) Determine the effectiveness of management practices that are implemented to reduce pyrethroid levels in discharges;

4) In cooperation with the Regional Water Board, USEPA and DPR, determine if monitoring and reporting programs for alternatives to pyrethroid pesticides are necessary and identify alternatives for which monitoring might be appropriate with consideration of the commercial availability of acceptable analytical methods. If an alternative insecticide is identified as appropriate for monitoring, monitoring shall be performed by the discharger to determine whether alternatives to pyrethroid pesticides are being discharged at concentrations with the potential to cause or contribute to exceedances of applicable water quality objectives.

As part of the recommended alternative for general monitoring and surveillance requirements discussed above, municipal storm water dischargers would be allowed to use representative monitoring programs, including coordinated regional monitoring programs to meet their monitoring requirements. Specific monitoring requirements for dischargers would be determined either in the Monitoring and Reporting Programs of their respective NPDES MS4 permits or in a Regional Water Board-approved Storm Water Management Plan.

The proposed amendment also allows for the possibility that a discharger may discontinue routine monitoring of pyrethroid pesticides or alternatives if a discharger can demonstrate that pyrethroid pesticides are not found, or are not reasonably expected to be found, in receiving waters at concentrations with the potential to exceed the pyrethroid wasteload allocations or Acute and Chronic Pyrethroid Triggers. It is proposed that an assessment of pyrethroid pesticide monitoring data from all reliable sources would need to be conducted during permit renewal to determine whether pyrethroid pesticide monitoring would be required. However, if pyrethroid pesticides no longer have registered outdoor uses in the source area, then this assessment would not be required to be conducted and monitoring for pyrethroids would no longer be required.

Replacement of urban use of pyrethroids with other insecticides may result in water column or sediment toxicity. To determine whether dischargers should be required to monitor for alternative insecticides, the Central Valley Water Board would consult with DPR and the discharger and evaluate pesticide use patterns to determine whether any alternative pesticides could pose a threat to water quality. In this evaluation, the Regional Board would also determine whether analytical methods are available for alternative insecticides. The monitoring locations for replacement products would generally be the same as those used to monitor pyrethroid levels in the service area and the monitoring could be done concurrently. Sediment monitoring would 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.

8.2 Discharges from Agricultural Operations

Agricultural coalitions and individuals would be required to implement monitoring plans that are consistent with the following recommendations, though modifications may be required.

Pyrethroid pesticides monitoring is required for the agricultural water bodies with 303(d) impairments: Del Puerto Creek, Hospital Creek (San Joaquin and Stanislaus Counties), Ingram Creek (from confluence with Hospital Creek to Hwy 33), Ingram Creek (from confluence with San Joaquin River to confluence with Hospital Creek), and Mustang Creek (Merced County). As part of the recommended alternative for general monitoring and surveillance requirements discussed above, sampling would need to be representative of these water bodies either directly or through a representative monitoring program.

Monitoring for pyrethroid pesticides in water bodies other than those specifically named above that receive agricultural discharges will be determined through the Irrigated Lands Regulatory Program. If representative monitoring is conducted, any resulting monitoring plan or response action should be implemented in all water bodies represented by the site. The timing of monitoring should be based on the primary processes leading to surface water contamination, such as storm water runoff or irrigation return dischargers.

The third party coalitions that represent growers in the Irrigated Lands Regulatory Program have developed quality assurance project plans that likely cover some of the monitoring components that would be required by the proposed amendment. However, some monitoring components, such as water column analysis of pyrethroids, have not be analyzed in the past and the quality assurance project plans would need to be updated to include quality assurance for all monitoring components.

Changes in monitoring frequency may result if information such as pesticide use data, pesticide registration status, management practices, runoff potential, or other monitoring studies indicates additional or less monitoring is needed to meet the monitoring requirements. Evaluation of these types of information may also lead to discontinuation of pyrethroid pesticides monitoring in a given watershed if it can be demonstrated that exceedances of the proposed numeric triggers are unlikely, e.g., if pyrethroid use has stopped or significantly decreased or application practices or management practices make exceedances unlikely.

There are three monitoring goals for monitoring that addresses agricultural discharges to agricultural water bodies with 303(d) impairments:

1) Determine whether receiving waters are attaining the Acute and Chronic Pyrethroid Triggers by providing pyrethroid and dissolved and particulate organic carbon concentration data;

2) Determine whether receiving waters and bed sediments are attaining the narrative water quality objective for toxicity by providing *Hyalella azteca* toxicity test data;

3) Determine whether the implementation of management practices is sufficient to attain the Acute and Chronic Pyrethroid Triggers in receiving waters.

4) Determine whether alternatives to pyrethroid pesticides are being discharged at concentrations that have the potential to cause or contribute to exceedances of applicable water quality objectives.

For agricultural dischargers that are not discharging to water bodies with pyrethroids 303(d) impairments, there are separate monitoring goals for baseline and trend monitoring.

The baseline pyrethroids monitoring and reporting program for agricultural discharges shall be designed to collect information necessary to:

1) Determine through representative receiving water monitoring whether discharges from agricultural operations are exceeding the Acute and Chronic Pyrethroid Triggers (Table IV-Z) by providing pyrethroid and dissolved and particulate organic carbon concentration data;

2) Determine whether pyrethroid pesticides are causing or contributing to exceedances of the narrative water quality objective for toxicity in surface waters or bed sediments by providing *Hyalella azteca* toxicity test data;

The pyrethroids trend monitoring and reporting program for agricultural discharges shall be designed to collect information necessary to meet the above goals for the baseline monitoring, as well as:

3) Determine the extent of implementation of management practices to reduce off-site movement of pyrethroid pesticides and whether these practices are sufficient to attain the Acute and Chronic Pyrethroid Triggers;

4) Determine whether alternatives to pyrethroid pesticides are being discharged at concentrations that have the potential to cause or contribute to exceedances of applicable water quality objectives.

To assess the extent of implementation of management practices, information would need to be collected from growers on the types of practices they are implementing 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

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 pyrethroids runoff mitigation approaches to changes in pyrethroids loading.

Replacement of pyrethroids with other insecticides 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 could pose a threat to water quality. This type of evaluation has been conducted by agricultural coalitions in the past, and it is expected that these evaluations would be sufficient to achieve this monitoring goal. In addition, the Irrigated Lands Regulatory Program has developed a pesticide use evaluation process that all agricultural coalitions are required to follow in order to determine which pesticides to monitor in their watersheds. This evaluation process is expected to be used to determine the monitoring priorities for all coalitions beginning with the 2015-2016 monitoring year (CVRWQCB-CVR 2015) and is expected to result in monitoring that meets the monitoring goal for alternative insecticides.

8.3 Municipal and Domestic Wastewater

If the proposed pyrethroids numeric triggers are adopted, municipal and domestic wastewater dischargers would be required to submit baseline and trend monitoring data for pyrethroids in order to determine baseline levels of pyrethroids (including accounting for bioavailability) and track trends in discharges over time. Baseline monitoring for wastewater dischargers would be conducted concurrently with effluent characterization monitoring, which is required in NPDES permits, and would occur as permits are renewed. If required, trend monitoring would begin after the baseline monitoring is completed, or as directed by the Executive Officer.

As part of the recommended alternative for general monitoring and surveillance requirements discussed above, municipal and domestic wastewater dischargers would be allowed to use representative monitoring programs, including coordinated regional monitoring programs to meet their monitoring requirements. Specific monitoring requirements for dischargers would be determined in the Monitoring and Reporting Programs of their respective NPDES permits. Unless required by the Executive Officer, minor municipal and domestic wastewater dischargers, defined as discharging less than one million gallons per day, would be exempt from the proposed monitoring requirements because of their limited potential to affect surface waters and limited resources.

For municipal and domestic wastewater dischargers, the proposed implementation program consists of implementation of best management practices, and there are separate monitoring goals for baseline and trend monitoring.

The baseline pyrethroids monitoring and reporting program for municipal or domestic wastewater discharges shall be designed to collect information necessary to:

1) Determine whether pyrethroid concentrations in municipal or domestic wastewater discharges are exceeding Acute and Chronic Pyrethroid Triggers by providing pyrethroid and dissolved and particulate organic carbon concentration data;

2) Provide pyrethroid and dissolved and particulate organic carbon concentration data and *Hyalella azteca* toxicity test data to determine whether municipal or domestic wastewater discharges of pyrethroids are causing or contributing to exceedances of the narrative water quality objective for toxicity in receiving waters;

The pyrethroids trend monitoring and reporting program for municipal or domestic wastewater discharges shall be designed to collect information necessary to meet the above goals for the baseline monitoring, as well as:

3) Determine the effectiveness of management practices that are implemented to reduce pyrethroid levels in discharges;

4) In cooperation with the Regional Water Board, USEPA and DPR, determine if monitoring and reporting for alternatives to pyrethroid pesticides is necessary and identify alternatives for which monitoring might be appropriate with consideration of the commercial availability of acceptable analytical methods. If an alternative insecticide is identified as appropriate for monitoring, monitoring shall be performed by the discharger to determine whether alternatives to pyrethroid pesticides are being discharged at concentrations with the potential to cause or contribute to exceedances of applicable water quality objective.

Replacement of urban use of pyrethroids with other insecticides may result in water column or sediment toxicity. To determine whether dischargers should be required to monitor for alternative insecticides, the Central Valley Water Board will consult with DPR and dischargers and evaluate pesticide use patterns to determine whether any alternative pesticides could pose a threat to water quality. In this evaluation, the Regional Board would also determine whether analytical methods are available for alternative insecticides.

Under the proposed amendment, it is possible that a discharger may discontinue routine monitoring of pyrethroid pesticides or alternatives if a discharger can demonstrate that pyrethroid pesticides are not found in receiving water at concentrations with the potential to cause or contribute to exceedances of the numeric triggers. While routine monitoring may be discontinued based on this demonstration, pyrethroid pesticides would continue to be monitored once per permit cycle at least as long as pyrethroid pesticides are registered for use in the collection service area. This once per permit cycle monitoring requirement would remain because pyrethroid pesticide use may increase or decrease over time as different products are registered and trends in homeowner use, which may greatly affect pyrethroid levels in wastewater discharges, are difficult to track or predict.

8.4 Sample Collection

Recommended methods for sample collection and handling were developed by U.S. Geological Survey in cooperation with U.S. EPA to provide a standard operating procedure for collecting pyrethroid samples (Hladik et al. 2009). This sample collection standard operating procedure or similar consistent procedures are recommended for all samples collected for either pyrethroids chemical analysis or toxicity testing with *Hyalella azteca* in both water and sediment matrices. Pyrethroids have a tendency to bind to surfaces of sample collection containers or materials and following this standard operating procedure minimizes those losses and will result in accurate analyses that are not confounded by varying sample collection procedures.

8.5 Chemical Analysis and Reporting Limits

Laboratory methods are not proposed in this amendment as they frequently change and are typically specified by regulatory programs in monitoring and reporting requirements that are part of specific Regional Water Board orders. Commercial analytical methods that can reliably achieve adequate reporting limits based on the proposed pyrethroids numeric triggers are not currently available. In addition, U.S. EPA analytical methods that include pyrethroids do not have adequate reporting limits based on the proposed pyrethroids numeric triggers. Because chemical analysis methods with more sensitive reporting limits are desired for pyrethroids, staff is committed to coordinating with staff

from the Surface Water Ambient Monitoring Program (SWAMP) and the Environmental Laboratory Accreditation Program (ELAP) to ensure reliable and sensitive methods are available. The use of ELAP-accredited methods is generally expected for pyrethroids monitoring. It is also generally expected that pyrethroids analysis would be included in quality assurance project plans (QAPP) for regulatory programs that require a QAPP. Currently available analytical methods and reporting limits are summarized below.

The pyrethroid permethrin is included in the U.S. EPA method 608.2, which is an approved method under 40 CFR 136, meaning it is appropriate for uses regulated under the Clean Water Act, such as NPDES permits. However, the method detection limit for permethrin given in this method is 200 ng/L, which is more than two orders of magnitude above the proposed chronic concentration goal for permethrin of 1 ng/L. Using this method, a detection of permethrin would indicate that the numeric triggers were being greatly exceeded, and a non-detect result would not provide confidence that the concentration goal was not exceeded. Several other methods that are approved for analysis and sampling under the Clean Water Act include permethrin and one method includes permethrin, cyfluthrin and esfenvalerate (97 Fed. Reg. 29758). The U.S. EPA method 1699 includes two pyrethroid analytes, permethrin and cypermethrin (USEPA 2007). This method is not promulgated under 40 CFR 136, but is for general use and was issued by the U.S. EPA Office of Water and Office of Science and Technology. The detection limits for permethrin and cypermethrin in interference-free water are 0.059 ng/L and 0.066 ng/L, respectively, for U.S. EPA method 1699. This permethrin detection limit is below the proposed chronic concentration goal but the cypermethrin detection limit is slightly above the proposed acute concentration goal. It should be noted that detection limits for ambient samples and wastewater effluents would likely be higher because those types of samples have more complex matrices.

Several commercial laboratories perform pyrethroids analyses with reporting limits ranging from 0.5-10 ng/L for the six priority pyrethroids. Alternate analytical methods can be used in NPDES permitted monitoring and surveillance with approval of the Executive Officer if appropriate explanation is given, such as the alternate method has lower detection limits compared to approved 40 CFR 136 methods, and has comparable quality assurance and quality control parameters. Dischargers that are not regulated under NPDES permits do not have as many restrictions on analytical methods that they may use. Guidance on choosing appropriate and reliable chemical analysis methods for pyrethroids for ambient sampling and wastewater effluents will be provided to dischargers during permit renewals or modifications of monitoring and reporting plans.

Analytical methods for pyrethroids are continuing to be developed and improved. Many methods have relied on gas chromatography (GC) with electron capture detectors (ECD); however, GC-ECD methods are not highly selective, which is important in complex environmental matrices, and do not provide definitive confirmation of identified

compounds. Newer analytical methods use GC with triple quadrupole mass spectrometry with negative chemical ionization (GC-MS/MS-NCI). This instrumentation is very selective because it monitors not only the selected ions, but also the transitions, providing a high degree of certainty of the compound identity, even in complex matrices. The triple quadrupole setup also provides a cleaner signal by reducing the amount of background constituents that make it to the detector, which has been demonstrated to achieve lower detection limits compared to other instrumentation setups. In California, the California Department of Fish and Wildlife Water Pollution Control Laboratory and California Department of Food and Agriculture Center for Analytical Chemistry laboratory both have GC-MS/MS-NCI methods for pyrethroids analysis. Other local laboratories may be switching their pyrethroids analysis to this instrumentation setup in the near future. As analytical methods continue to be developed and improved, reporting limits for pyrethroids will more closely approach the proposed numeric triggers.

The staff recommendation regarding analytical methods and reporting limits for pyrethroids is that as laboratory methods evolve, dischargers should consider using methods that may be available with both method detection limits and reporting limits below the proposed pyrethroid numeric triggers. Staff recommends that dischargers shall consider the use of these methods, if available, and supply documentation of their consideration to the Regional Water Board staff, but may choose to use other methods if they have a valid reason (e.g., relative expense). Staff also recommends that laboratory methods for chemical analysis of pyrethroid pesticides shall be approved by the Executive Officer before they are used to meet the proposed monitoring requirements to ensure that adequate methods are being used. The proposed amendment specifies that when evaluating the chemical analysis method, the Executive Officer may consider Environmental Laboratory Accreditation Program (ELAP) accreditation, associated quality assurance and quality control provisions, scientifically peer reviewed methods, results of interlaboratory comparison studies, and/or other factors.

8.6 Toxicity Testing

Toxicity testing will be required to ensure that aquatic life beneficial uses are protected in surface waters as the result of potential cumulative and synergistic effects. To determine whether pyrethroids are causing or contributing to toxicity, either pyrethroid concentration data or toxicity identification evaluation information would be needed. The required test organism is the amphipod *Hyalella azteca*, because it is a standard test organism that has been demonstrated to be sensitive to pyrethroids. For sediment testing, EPA method EPA-600-R-00-064 is recommended (USEPA 2000). For water column testing EPA method EPA-821-R-02-012 is recommended (USEPA 2002), and following the measurement quality objectives provided in the SWAMP quality assurance

program plan (SWAMP 2008). If the EPA methods or SWAMP quality assurance program plan are updated in the future, the updated versions should be followed for all toxicity testing. There is also additional guidance on test organism age and size for *Hyalella azteca* that was recently recommended based on a laboratory intercalibration study coordinated by the Southern California Coastal Water Research Project (SCCWRP). When feasible, it is recommended that the SCCWRP guidance on test organism age and size is followed because it was demonstrated to improve comparability of toxicity results across labs (Schiff & Greenstein 2016). The use of ELAP-accredited methods is the expectation for toxicity testing and for regulatory programs that require quality assurance project plans, *Hyalella azteca* toxicity testing would need to be included in these plans.

9 ESTIMATED COSTS AND POTENTIAL SOURCES OF FUNDING

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 cost estimates of the proposed amendment to the affected dischargers.

It should be noted that without the proposed Basin Plan amendment, the discharges of pyrethroids would still need to be addressed under existing laws and regulations. These laws and regulations include the State's Nonpoint Source Policy and the existing Basin Plan water quality objectives for toxicity and pesticides discussed in the water concentration goals section of this report. The Basin Plan currently includes general implementation provisions for control of pesticide discharges.

Without the proposed Basin Plan amendment, implementation of many of the practices that control pyrethroids runoff would be required under pesticide use requirements and conditions. These pesticide use requirements and conditions include existing and pending regulations (section 2.4), including:

- DPR Reevaluation of Pyrethroids
- California Surface Water Protection Regulations for Pyrethroids (Title 3, California Code of Regulations, Sections 6970 and 6972)
- Bifenthrin Label Changes (MOA 2011)
- DPR Dormant Season Insecticide Spray Regulations (2007)
- USEPA Reevaluation of Pyrethrins, Pyrethroids and Synergists
- USEPA Environmental hazard and general labeling for pyrethroid non-agricultural outdoor products
- USEPA Pyrethroids Spray Drift Initiative
- Lawsuits Against USEPA Regarding Pesticides and Endangered Species

Due to uncertainty about pending and recently adopted requirements and their costs and effectiveness, their costs could not be explicitly considered in the cost calculations provided in this report. Therefore, the costs for pyrethroid monitoring and implementing management practices as part of the pyrethroids TMDLs, requirements for agricultural dischargers, or the pyrethroids control program under the conditional prohibition should be considered high-end cost estimates, since implementation of practices that reduce pyrethroid discharges to the Sacramento and San Joaquin River Basin water bodies, and monitoring and reporting related to pyrethroids are, to some degree, required by current laws and regulations, and additional requirements are likely to be in place in the near future.

There are two potential options for the pyrethroid concentration goals. The costs for baseline monitoring would not differ whether the pyrethroid concentration goals are the 2.5 or 5th percentile UC Davis values. Trend monitoring and management plan implementation costs would only differ between the two concentration goal alternatives in that fewer dischargers may be required to do trend monitoring and implement management plans if the higher concentration goals are adopted because it is possible that some are discharging pyrethroids at levels above the 2.5 percentile concentration goals, but about the 5th percentile concentration goals. However, the costs per discharger for trend monitoring and implementation of management plans are not expected to differ between the two concentration goal alternatives. Under either alternative, large reductions are likely needed, so the extent of implementation will be similar between the two alternatives.

The cost estimates provided in this section are not intended to represent a maximum or minimum level because the monitoring plans and implementation needed may differ for each discharger dependent on the characteristics of their discharge and receiving waters.

9.1 Estimated Costs to Municipal Storm Water Dischargers

Under the proposed amendment, municipal storm water permittees would need to implement management practices as described in section 7 and monitoring as described in section 8 and report on progress to the Board.

Monitoring of municipal storm water will be necessary to evaluate attainment of the wasteload allocations and progress in reducing pyrethroid discharges. This cost estimate assumes that water samples are collected four times per year at one representative site to characterize pyrethroid concentrations in an MS4's storm water.

For Phase I MS4s that are already required to conduct monitoring, additional pyrethroids monitoring could be conducted concurrently with current monitoring activities, resulting in some cost savings for personnel time, travel and equipment, and planning, monitoring, and coordination. For Phase II MS4s, most monitoring activities are relatively new requirements; therefore they will not likely have opportunities for cost savings by consolidating planning and coordination activities that are already occurring. The cost estimates for MS4s includes chemical analysis and toxicity testing costs, as well as personnel time, travel, equipment, planning, monitoring, and coordination costs (Table 9-1). Total costs for a 5-year permit cycle are estimated to be $43,414 per MS4, which would be an annual estimated cost of $8,682.80.

Both Phase I and Phase II MS4s will be required to implement pollution prevention measures and conduct outreach and education under the proposed Basin Plan amendment. The costs for implementing these measures are estimated, but may vary

significantly based on the population covered by the MS4. Some MS4s may already participate in these activities or similar activities, so there may be opportunities for cost savings by modifying some of these activities to ensure they include pyrethroid pesticides.

As an example of potential costs for a Phase I MS4 in the Project Area, costs were requested from the Sacramento Stormwater Quality Partnership for implementing program elements to address pesticides. The program elements included: Monitoring Program/Special Studies/TMDL, Target Pollutant Reduction Program, Public Outreach, and Miscellaneous Elements and Activities. In fiscal year 2013/2014, each of these program elements had an annual budget ranging from $21,000 to over $680,000 (Table 9-2, Sacramento Stormwater Quality Partnership). Many of the specific activities implemented under each of the program elements would meet the requirements of the proposed amendment. For example, this particular MS4 invests in commenting on pesticide regulatory activities; this activity would fulfill the proposed amendment requirement to “track U.S. EPA and DPR pesticide evaluation and registration activities as they relate to surface water quality and encourage these agencies to accommodate urban water quality concerns within their pesticide registration processes.” Other activities such as investing in IPM consultants and supplies would also be considered a means of performance-based compliance with the proposed amendment’s requirement to “train the discharger’s employees to use integrated pest management techniques and require that they adhere to integrated pest management practices to the maximum extent practicable.” Phase I MS4s already implement many of the activities that would be required by the proposed amendment, meaning that there would be no additional costs incurred. For elements or activities not already implemented, it may be possible that current activities could be re-focused and/or available funds could be re-allocated to meet the requirements of the proposed amendment. For these reasons, it is likely that little or no additional costs would be incurred by Phase I MS4s for education and outreach and pollution prevention measures. The primary additional costs expected are those associated with monitoring and reporting (Table 9-1).

As an example of cost estimates for one larger Phase II MS4 with identified pyrethroids impairments (Roseville, CA) for education, outreach, and pollution prevention measures were estimated to range from $15,000 to $30,000 annually (Delyn Ellison-Lloyd, City of Roseville, personal communication, March 2015). Education and outreach activities included participating in the program called “Our Water, Our World” that provides educational fact sheets for less toxic pest control that are placed in hardware stores that sell pesticides, and employment of an integrated pest management (IPM) advocate that trains hardware store employees in IPM practices covering both pesticides and fertilizers and also provides education at public outreach events. Pollution prevention activities include training municipal operations staff in IPM practices. The activities described above were estimated to cost $15,000 annually.

Table 9-1 Estimated monitoring and reporting costs for MS4 dischargers
All cost estimates are in 2015 dollars.

Water Chemistry	
Number of pyrethroids water samples	*4*
QA/QC samples (20% of samples collected)	*1*
Total # samples	*5*
Analytical cost per sample	*$973.50*
Total organic carbon (TOC)	*$73*
Dissolved organic carbon (DOC)	*$98*
Permit Cycle Water Chemistry Costs	**$5,722.50**
Receiving Water Toxicity Testing	
Number of toxicity samples	*4*
*Toxicity testing cost per sample (*96-hour *Hyalella azteca)*	*$1,000*
Data entry charge	*$42*
Permit Cycle Receiving Water Toxicity Testing Costs	**$4,168**
Sediment Toxicity	
Number of toxicity samples	*5*
Toxicity testing cost per sample (10-day Hyalella azteca)	*$1,630*
Sediment grain size	*$131.25*
Sediment Total Organic Carbon (TOC)	*$131.25*
Permit Cycle Toxicity Testing Costs	**$9,462.50**
Sediment Chemistry	
Number of pyrethroids sediment samples	*5 (max)*
QA/QC samples (20% of samples collected)	*1*
Total # samples	*6*
Analytical cost per sample	*$973.50*
Permit Cycle Sediment Chemistry Costs	**$5,841**
Personnel & Planning Costs	
Number of person-days for sample collection (2 person crew covering 6 sites)	*8*
Sample collection & preparation as a percent of person-days for sampling	*25%*
Total person-days for sample collection & preparation	*10*
Cost per person-day (8 hours @ $70 per hour)	*$560*
Sampling personnel cost	$5,600
Travel costs (assumes 300 miles of driving at $0.55 per mile for each person-day)	$1,320
Equipment/Supplies	$550
Monitoring Plan & Quality Assurance Plan (Assumes 0.5 person month @ $10,750 per person month)	*$5,375*
Monitoring Reports (Assumes 0.5 person month @ 10,750 per person month)	*$5,375*
Monitoring Planning, Coordination and Reporting Cost Per MS4	$10,750
Permit Cycle Personnel & Planning Costs	**$18,220**
Total Monitoring Cost per 5-year permit cycle	**$43,414**
Total Annual Monitoring and Reporting Cost for MS4	**$8,682.80**

Table 9-2 Cost estimates for implementing program elements that address pesticides (Sacramento Stormwater Quality Partnership).

Program Element/Activity	Budget
Monitoring Program/Special Studies/TMDL	$682,000
Target Pollutant Reduction Pesticides Plan Pesticide Regulatory Activities	$21,000
Public Outreach Surveys Marketing Website Partnerships	$37,000
Integrated Pest Management	$50,000
School Education	$176,000
Miscellaneous	$220,000
Total	$1.1 million

Planned pollution prevention activities to be implemented in the future are intensive education and outreach on reducing pesticide discharges in a neighborhood identified as the primary source for a pyrethroids 303(d) listing, as well as conducting a survey on pest control practices in this neighborhood that will be shared with the DPR as part of a collaborative effort. DPR will be conducting pyrethroids surface water monitoring in this neighborhood, and they will be able to analyze the data for trends before and after outreach is conducted in the neighborhood. The Water Board's Stream Pollution Trends (SPoT) program will also be conducting sediment toxicity testing and pyrethroids analysis in this watershed. This intensive neighborhood effort is estimated to cost an additional $15,000; combined with the continued efforts described above, the total costs for this MS4 will be approximately $30,000 a year.

9.2 Estimated Costs for Agricultural Dischargers

The costs associated with the implementation of the Long-Term Irrigated Lands Regulatory Program to agricultural dischargers were estimated as a part of the *Draft Technical Memorandum Concerning the Economic Analysis of the Irrigated Lands Regulatory Program* (*Draft Technical Memorandum*, ICF International 2010). Those costs estimates were revised in 2011 (CRWQCB-CVR, Resolution No. R5-2011-0075), and are included in the Basin Plan under *Estimated Costs of Agricultural Water Quality Control Programs and Potential Sources of Financing*. The total annual cost of the Long-term Irrigated Lands Regulatory Program given in the Basin Plan is estimated to range from $216 million to $1,321 million (2007 dollars).

Data from the *Draft Technical Memorandum* (ICF International 2010) were used to estimate costs for monitoring and reporting (Table 9-3) and costs of implementing management practices on a per-acre basis (Table 9-4). The estimated cost to implement agricultural monitoring and surveillance based on the per acre monitoring costs from ICF International (2010), and the number of acres treated with pyrethroids is $1,397,569 (Table 9-3). The per-acre cost estimates of management practices which are reasonably foreseeable as methods of compliance are broken out in Table 9-4. These costs to implement practices to meet the existing water quality standards (the narrative toxicity and pesticides water quality objectives) would not be in addition to the costs associated with the Long-term Irrigated Lands Regulatory Program, but are a portion of those costs.

Costs are also estimated for the specific monitoring requirements outlined in the proposed amendment (Table 9-5). These cost estimates are based on water column sampling in the same number of the monitoring sites as currently proposed for monitoring for pesticides by the six coalitions in the 2017-18 water year. It was assumed that this number of sites would be tested five times a year for water column chemistry and toxicity, and twice per year for sediment chemistry and toxicity. Sediment toxicity testing and follow up sediment chemistry already occurs under the Irrigated Lands Monitoring program, so the costs of sediment toxicity testing and half of the sediment chemistry costs were not included in the total cost estimated in Table 9-5. These cost estimates assume the costs for the overall monitoring program, including equipment, sample collection, etc., are pre-existing costs under the ILRP. Incremental costs of updating monitoring plans and additional reporting for pyrethroids are included in the cost estimate.

The annual costs estimated in Table 9-5 ($1,386,748) are essentially equal to overall monitoring and surveillance costs shown in Table 9-3 (1,397,569), indicating that the costs of the agricultural monitoring requirements in the proposed amendment are mostly within the pre-existing costs of the Long-Term Irrigated Lands Regulatory Program.

The monitoring and reporting cost estimate of 1.4 million per year based on the calculation shown in Table 9-5 is utilized in the proposed amendment language since it was based on specific monitoring that would likely be needed to meet the monitoring goals. However, as is stated in the proposed amendment, the monitoring cost estimate for the pyrethroid pesticides control program is likely a high-end estimate, as similar monitoring and reporting costs would likely be incurred due to other Central Valley Water Board requirements to meet pre-existing Basin Plan requirements under the Long-Term Irrigated Lands Regulatory Program. Potential sources of financing for agriculture are identified in the revised Technical Memorandum (CRWQCB-CVR 2011).

Table 9-3 Monitoring and reporting costs for agricultural dischargers

	Regional Surface Water Monitoring ($)[1]	Total Acreage[a]	Regional Surface Water Monitoring $/acre	Average Pyrethroid-Treated Acreage (2007-2011)[b]	Regional Surface Water Monitoring Cost for Pyrethroid-Treated Acreage
Sacramento River	$1,529,794	2,286,395	$0.67	519,542	$348,093
San Joaquin River	$2,498,733	2,126,028	$1.18	889,387	$1,049,476
Sacramento River and San Joaquin River Basins	–	–	–	–	$1,397,569

[a] Data from Table 2-19 and Table 3-3 *Draft Technical Memorandum* (ICF International 2010)
[b] Data from the DPR's Pesticide Use Reporting Database (CDPR 2013)

Table 9-4 Management practice cost per acre
Table adapted from Table 2-9 *Draft Technical Memorandum* (ICF International 2010)

Management Practice	**Cost per acre**
Irrigation water management	$69
Tailwater recovery system	$89
Pressurized irrigation system	$160
Cover crop	$48
Vegetated buffer	$1

Table 9-5 Estimated monitoring and reporting costs for agricultural dischargers

Number of monitoring sites	
Sacramento Valley Coalition	*20*
Rice Coalition	*7*
San Joaquin County and Delta Coalition	*15*
East San Joaquin Valley Coalition	*19*
Westside San Joaquin Valley Coalition	*21*
Grasslands Bypass Coalition	*8*
Total number of monitoring sites	90
Receiving Water Chemistry Testing	
Number of pyrethroids water samples (5 per site per year)	*450*
QA/QC samples (20% of samples collected)	*90*
Total # samples	*540*
Analytical cost per sample	*$973.50*
Total organic carbon (TOC)	*$73*
Dissolved organic carbon (DOC)	*$98*
Data entry charge	*$35*
Annual Water Chemistry Costs	**$636,930**
Receiving Water Toxicity Testing	
Number of toxicity samples (5 per site per year sampled)	*450*
Toxicity testing cost per sample (96-hour Hyalella azteca)	*$1,000*
Data entry charge	*$42*
Annual Receiving Water Toxicity Testing Costs	**$468,900**
Sediment Toxicity	
Number of sediment toxicity samples (2 per site per year)	*180*
Toxicity testing cost per sample (10-day Hyalella azteca)	*$1,630*
Sediment grain size	*$131.25*
Sediment Total Organic Carbon (TOC)	*$131.25*
Data entry charge	*$42*
Annual Sediment Toxicity Testing Costs	**$348,210**
Sediment Chemistry	
Number of pyrethroids sediment samples (2 per site per year)	*180*
QA/QC samples (20% of samples collected)	*36*
Total # samples	*216*
Analytical cost per sample	*$973.50*
Data entry charge	*$35*
Annual Sediment Chemistry Costs	**$217,836**
Total Annual Analysis Cost for Ag Dischargers	**$1,671,876**

Total Additional Analysis Cost for Ag Dischargers (excludes pre-existing costs for sediment toxicity testing costs and half of the sediment chemistry costs)	***$1,214,748***
Additional monitoring plan and quality assurance plan development costs (assumes 1 person month at $10,750 per person month)	*$10,750*
Additional annual monitoring report preparation cost (assumes 1 person month at $10,750 per person month)	*$10,750*
Total monitoring planning and reporting costs per coalition	**$21,500**
Basin-Wide Monitoring Plan Development and Reporting Costs for Six Coalitions	**$129,000**
Total Annual Monitoring and Reporting Cost for Ag Dischargers	**$1,386,748**

9.3 Estimated Costs to Municipal and Domestic Wastewater Dischargers

Municipal and domestic wastewater permittees will need to monitor for pyrethroids for baseline monitoring. In the wastewater cost estimate, it was assumed that four effluent samples, four receiving water samples, and two QA/QC samples would be collected to assess whether the numeric triggers are exceeded every five years. The estimated annual monitoring and reporting costs for wastewater permittees is estimated to be $5,728.60 ($28,643 per 5-year permit term) (Table 9-6).

Education and outreach and pollution prevention efforts should encourage and facilitate proper use of pyrethroid pesticides, encourage the use of integrated pest management, and discourage the use of pesticides that pose significant risks to water quality. Costs associated with implementing management practices, education and outreach were estimated to be equal to those for municipal storm water dischargers because there was significant overlap in the recommended practices. Costs for large or small wastewater permittees for implementing pollution prevention and education and outreach activities are expected to fall in the range described for Phase I and Phase II MS4s in section 9.1.

Table 9-6 Estimated monitoring and reporting costs for municipal and domestic wastewater dischargers

Water Chemistry	
Number of effluent samples	*4*
Number of receiving water samples	*4*
Number of pyrethroids water samples	*8*
QA/QC samples (20% of samples collected)	*2*
Total # samples	*10*
Analytical cost per sample	$973.50
Total organic carbon (TOC)	*$73*
Dissolved organic carbon (DOC)	*$98*
5-year Permit Term Water Chemistry Costs	**$11,445**
Receiving Water Toxicity Testing	
Number of toxicity samples	*4*
*Toxicity testing cost per sample (*96-hour *Hyalella azteca)*	*$1,000*
Data entry charge	*$42*
5-year Permit Term Toxicity Testing Costs	**$4,168**
Personnel & Planning	
Number of person-days for sample collection (2 person crew collects samples in 2 hours, 4 times permit cycle)	*2*
Sample collection preparation as a percent of person-days for sampling	*25%*
Total person-days for sample collection & preparation	*2.5*
Cost per Person-day (8 hours at $70 per hour)	*$560*
Sampling personnel cost	$1,400
Travel costs (assumes 300 miles of driving at $0.55 per mile for each person-day)	$330
Equipment/Supplies	$550
Monitoring Plan & Quality Assurance Plan (Assumes 0.5 person month @ $10,750 per person month)	*$5,375*
Monitoring Reports (Assumes 0.5 person month @ 10,750 per person month)	*$5,375*
Monitoring Planning, Coordination and Reporting Cost Per MS4	$10,750
Permit Cycle Personnel & Planning Costs	**$13,030**
Total Monitoring Cost per 5-year permit cycle	**$28,643**
Total Annual Monitoring and Reporting Cost for POTW	**$5,728.60**

10 POLICIES

The State Water Board and the Central Valley Water Board have a number of existing policies and Management Agency Agreements (MAAs) that are applicable to the proposed amendment. Any proposed changes to the Basin Plan must be consistent with existing state laws, regulations, and Water Boards policies. All state agencies, departments, boards, and offices are required to comply with state policies for water quality control when carrying out activities that affect water quality, unless they are otherwise directed or authorized by statue, in which case they shall indicate to the State Water Board in writing their authority for not complying with such policy (Wat. Code, §13146). This section evaluates the consistency between the proposed amendment and existing applicable state and regional laws and policies.

10.1 Antidegradation Analysis

USEPA (40 CFR §131.12) and the State of California (State Water Board Resolution 68-16) have adopted antidegradation policies as part of their approach to regulating water quality. The Central Valley Water Board must ensure that its actions do not violate the federal or State Antidegradation policies.

10.1.1 **Federal Antidegradation Policy**

The Federal Antidegradation Policy (40 CFR §131.12) states:

> "(a) The State shall develop and adopt a statewide antidegradation policy and identify the methods for implementing such policy pursuant to this subpart. The antidegradation policy and implementation methods shall, at a minimum, be consistent with the following:
>
> (1) Existing instream water uses and the level of water quality necessary to protect the existing uses shall be maintained and protected.
>
> (2) Where the quality of the waters exceeds levels necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water, that quality shall be maintained and protected unless the State finds, after full satisfaction of the intergovernmental coordination and public participation provisions of the State's continuing planning process, that allowing lower water quality is necessary to accommodate important economic or social development in the area in which the waters are located. In allowing such degradation or lower water quality, the State shall assure water quality adequate to protect existing uses fully. Further, the State shall assure that there shall be achieved the highest statutory and regulatory requirements for all new and existing point sources and

all cost-effective and reasonable best management practices for nonpoint source control.

(3) Where high quality waters constitute an Outstanding National Resource Waters, such as waters with exceptional ecological, recreational or quality shall be maintained and protected.

(4) In those cases where potential water quality impairment associated with a thermal discharge is involved, the antidegradation policy and implementing method shall be consistent with section 316 of the Act."

10.1.2 **State Antidegradation Policy**

Antidegradation provisions of State Water Board Resolution No. 68-16 ("Statement of Policy with Respect to Maintaining High Quality Waters in California") state, in part:

"(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 increased 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."

10.1.3 **Antidegradation Analysis of the Proposed Amendments**

The proposed Basin Plan amendment complies with both the federal and state antidegradation policies. The proposed amendment will ensure the protection of existing uses because it covers all water bodies in the basin with designated or existing aquatic life beneficial uses (WARM/COLD) and the numeric triggers are designed to provide protection to those uses, which were identified as the most sensitive. To the extent that permitted activities designed to ensure compliance with the proposed amendment will cause degradation of water quality, that activity's detrimental impact on water quality, if any, will be measured against the interest in allowing limited discharges of these pesticides. Overall, the proposed amendment is expected to result in an improvement in water quality in the Sacramento River and San Joaquin River basins.

None of the water bodies to which the pyrethroids control program would apply under the proposed amendment are part of an Outstanding National Resource Waters area. This project does not relate to impairments due to thermal discharges.

The majority of pyrethroid discharges are regulated under Regional Board orders. Relevant Regional Board orders include those issued pursuant to the National Pollutant Discharge Elimination System (NPDES) for municipal storm water, municipal or domestic wastewater, and vector control applications and waste discharge requirements that regulate discharges from irrigated agriculture. All of the relevant Regional Board orders must ensure that the regulated discharges do not result in impairments of applicable water quality standards. Any substantial change in discharge quantity or quality under either the NPDES dischargers or agricultural dischargers would trigger further environmental evaluation.

Point source discharges will continue to be regulated under NPDES permits. Discharges of pyrethroids or alternative pesticides from point sources are not expected to increase as a result of the proposed amendment because best management practices to reduce discharges of pyrethroids would be required for municipal storm water and municipal or domestic wastewater dischargers. These practices are expected to lead to reductions in pyrethroid discharges, as well as reductions in other constituents. The proposed monitoring requirements for municipal storm water and municipal or domestic wastewater dischargers include monitoring to assess potential impacts of alternatives to pyrethroids. If these alternative pesticides are found to have potential to affect water quality, the Regional Water Board will be aware of their potential through the required monitoring and assessments and will require dischargers to address them to ensure compliance with the federal antidegradation policy, the State Antidegradation Policy, and the Central Valley Water Board's Antidegradation Implementation Policy.

Agricultural discharges will continue to be regulated under Waste Discharge Requirements (WDRs) through the Irrigated Lands Regulatory Program (ILRP) where Best Practical Treatment Controls are implemented as needed to control degradation of water quality in both surface and ground waters. The WDRs require growers to conduct evaluations of their management practices to ensure they are protecting groundwater and surface water. Regional water quality management plans are required for areas where irrigated agriculture may be contributing to water quality problems based on exceedances of water quality triggers. All growers will be required to conduct a farm evaluation to determine what farm practices are currently being implemented and to determine whether any improvements can be made to protect water quality. Coalitions must prepare Water Quality Management Plans anytime water quality triggers have been exceeded more than once in three years. Water quality triggers are based on the water quality objectives applicable to surface water and groundwater within the Order's

watershed area. Growers need to implement practices consistent with specified management plans to address the identified problems. If implemented practices aren't protective, growers will need to implement improved practices that will achieve water quality goals.

Some practices available to agricultural dischargers that could lead to further reduction of pyrethroid levels in surface water could result in increased infiltration of water, changes in timing of application of pyrethroids, or increased use of other pesticides that have the potential to degrade ground or surface water. Discharges of these other pesticides would still be regulated by the Central Valley Water Board under the Irrigated Lands Regulatory Program. The proposed monitoring requirements for agricultural dischargers include monitoring to assess potential impacts of alternatives to pyrethroids. If these alternative pesticides are found to have potential to affect water quality, the Regional Water Board will be aware of their potential through the required monitoring and assessments and will require dischargers to address them to ensure compliance with the federal antidegradation policy, the State Antidegradation Policy, and the Central Valley Water Board's Antidegradation Implementation Policy.

10.2 State Water Board Policies

The State Water Board is authorized to adopt state policy for water quality control (Wat. Code, §13140). State Water Board water quality control plans supersede any regional water quality control plans for the same waters to the extent of any conflict (Wat. Code, §13170). The following State Water Board policies are applicable to the proposed amendment:

- Water Quality Control Policy for the Enclosed Bays and Estuaries of California (Resolution 74-43)
- Policy for Implementation and Enforcement of the Nonpoint Source Pollution Control Program (Resolution 2004-0030)
- Water Quality Control Policy for Developing the Clean Water Act Section 303(d) List (2004-0063, 2015-0005)
- Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California (Resolution 2005-0019)
- Water Quality Control Policy for Addressing Impaired Waters: Regulatory Structure and Options (Resolution 2005-0050)
- Policy for Compliance Schedules in National Pollutant Discharge Elimination System Permits (Resolution 2008-0025)
- Water Quality Enforcement Policy (Resolution 2009-0083)
- Recycled Water Policy (Resolution 2013-0003)

These policies and their relevance to the proposed control program for pyrethroids are described in the following sections.

10.2.1 Water Quality Control Policy for the Enclosed Bays and Estuaries of California

This policy was adopted by the State Water Board in 1974 and provides water quality principles and guidelines for the prevention of water quality degradation in enclosed bays and estuaries, including the Sacramento-San Joaquin Delta, to protect the beneficial uses of such waters. The Central Valley Water Board must enforce the policy and take actions consistent with its provisions. Sections of the policy relevant to this Basin Plan amendment are discussed below.

> This policy does not apply to wastes from vessels or land runoff except as specifically indicated for siltation (Chapter III 4.) and combined sewer flows (Chapter III 7).

The agricultural runoff sources of pyrethroids to the Sacramento River and San Joaquin River basin water bodies are from direct land runoff, and this policy is not relevant to those sources that discharge via land runoff. This policy does apply to combined sewer flows and the proposed amendment addresses discharges of pyrethroids from municipal storm water and from municipal and domestic wastewater dischargers.

> There is a considerable body of scientific evidence and opinion which suggests the existence of biological degradation due to long-term exposure to toxicants which have been discharged to the San Francisco Bay-Delta system. Therefore, implementation of a program which controls toxic effects through a combination of source control for toxic materials, upgraded wastewater treatment, and improved dilution of wastewaters, shall proceed as rapidly as is practicable with the objective of providing full protection to the biota and the beneficial uses of Bay-Delta waters in a cost-effective manner.
>
> Persistent or cumulative toxic substances shall be removed from waste to the maximum extent practicable through source control or adequate treatment prior to discharge.
>
> Nonpoint sources of pollution shall be controlled to the maximum practicable extent.

The proposed Basin Plan amendment would require source controls for toxic materials (pyrethroid pesticides) that currently discharge to the Sacramento-San Joaquin Delta and its tributaries in the Sacramento River and San Joaquin River basins with the objective of providing full protection to the biota and beneficial uses of the Bay-Delta. The proposed amendment would also provide implementation requirements for controlling both point and nonpoint source pollution to the maximum extent practicable. Thus, the proposed Basin Plan amendment would be consistent with implementing this policy.

10.2.2 Water Quality Control Policy for Developing the Clean Water Act Section 303(d) List (Listing Policy)

The Listing Policy was adopted in 2004 and updated in 2015. Pursuant to the Water Code section 13191.3(a), this state policy for water quality control describes the process by which the State Water Board and the Regional Water Boards will comply with the listing requirements of Clean Water Act section 303(d) (SWRCB 2004). The Listing Policy establishes a standardized approach for developing California's section 303(d) list to achieve water quality standards and maintain beneficial uses in all of California's surface waters. The Listing Policy applies only to the listing process methodology used to comply with Clean Water Act section 303(d).

Clean Water Act section 303(d) requires states to identify waters that do not meet, or are not expected to meet by the next listing cycle, applicable water quality standards after the application of certain technology-based controls and schedule such waters for development of Total Maximum Daily Loads or other pollution controls. (40 CFR §130.7(c) and (d).)

The fifteen pollutant-water body 303(d) impairments for pyrethroids will all be addressed as a result of the proposed amendment, either through adoption of TMDLs or implementation of other pollution controls that obviate the need for TMDLs. The numeric triggers for pyrethroids in the proposed amendment may be used in future 303(d) List development because they are intended to provide a level of protection consistent with the narrative water quality objectives for toxicity.

10.2.3 Policy for Implementation and Enforcement of the Nonpoint Source Pollution Program (Nonpoint Source Policy)

The Nonpoint Source Policy, adopted in May 2004, clarifies the applicability of the Porter-Cologne Water Quality Control Act to nonpoint sources. The Nonpoint Source Policy describes five key elements that must be included in a nonpoint source implementation program. This policy makes it clear that all nonpoint source discharges must be regulated under waste discharge requirements, waivers of waste discharge requirements, a Basin Plan prohibition, or some combination of these administrative tools.

The proposed Basin Plan amendment is consistent with the Nonpoint Source Policy because it provides a framework for the Board's use of WDRs, waivers of WDRs, and/or a Basin Plan prohibition to regulate nonpoint source discharges of pyrethroids.

10.2.4 Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California (State Implementation Plan)

The State Implementation Plan applies to discharges of priority pollutants into the inland surface waters, enclosed bays, and estuaries of California subject to regulation under the Porter-Cologne Water Quality Control Act and the federal Clean Water Act. Regulation of priority toxic pollutants may occur through the issuance of NPDES permits or other regulatory approaches. The goal of the State Implementation Plan is to establish a statewide, standardized approach for permitting discharges of toxic pollutants to non-ocean waters.

Priority pollutants that are subject to the State Implementation Plan are defined in the National Toxics Rule and California Toxics Rule. Pyrethroids are not defined as priority pollutants according to either rule. Although there is not a requirement to use the State Implementation Plan for controlling pyrethroids, the State Water Board has held that the Central Valley Water Board may use the this plan as guidance for water quality-based controls for other pollutants (State Water Board Water Quality Orders 2002-0016 and 2004-0013). However, because best management practices are proposed for cases when a municipal or domestic wastewater discharger has the reasonable potential to cause or contribute to an exceedance of the proposed pyrethroid triggers, the State Implementation Plan would not be needed or apply to these cases.

10.2.5 Water Quality Control Policy for Addressing Impaired Waters (Impaired Waters Policy)

The Impaired Waters Policy describes the requirements that must be used by the State and Regional Water Boards to correct impairments to the waters of the state. There are several sections of this policy that are applicable to this proposed amendment.

Correcting the pyrethroids impairments in the Sacramento and San Joaquin River basins will likely require multiple actions of the Central Valley Water Board to achieve compliance from all dischargers in the basins; therefore a Basin Plan amendment or other regulation is necessary. (State Water Board Resolution 2005-0050, p. 5). The California Department of Pesticide Regulation and the U.S. EPA have both recently taken actions that will affect the non-agricultural use of pyrethroids. These actions are expected to reduce pyrethroids in urban surface waters, but these actions may not bring impaired water bodies into compliance with water quality standards. Furthermore, these actions do not address agricultural sources of pyrethroids, which account for six of the fifteen 303(d) listings in the Project Area.

The proposed amendment includes provisions to address all water bodies in the Sacramento and San Joaquin River basins that are 303(d)-listed for pyrethroids. Pyrethroids TMDLs are included for the 303(d)-listed water bodies in urban watersheds,

and the Proposed Basin Plan Amendment for Pyrethroid Pesticides contains all of the necessary elements of a TMDL, which are the loading capacity, allocations, consideration of seasonal variations, and a margin of safety. (State Water Board Resolution 2005-0050, p.4). For the 303(d)-listed water bodies in agricultural watersheds, specific pollution controls that meet the requirements for a Category 4b demonstration are included. The proposed amendment will be implemented by the use of existing regulatory tools, including prohibitions of discharge, NPDES permits, WDRs, and waivers of WDRs. (State Water Board Resolution 2005-0050, p. 5). A Basin Plan amendment is the appropriate means for the adoption of a TMDL and specific pollution controls for pyrethroids in Sacramento River and San Joaquin River basins that are impaired for pyrethroids. Therefore this Basin Plan amendment has been prepared in a manner consistent with this provision of the Impaired Waters Policy.

10.2.6 **Policy for Compliance Schedules in National Pollutant Discharge Elimination System Permits**

The State Water Resources Control Board's *Policy for Compliance Schedules in National Pollutant Discharge Elimination System Permits*, Resolution No. 2008-0025 (Compliance Schedule Policy), authorizes the Central Valley Water Board to include a compliance schedule in a permit for an existing discharger to implement a new, revised, or newly interpreted water quality objective or criterion in a water quality standard that results in a permit limitation more stringent than the limitation previously imposed. The proposed Basin Plan amendment will establish a new interpretation of the narrative toxicity water quality objective with the TMDL numeric targets in water bodies where TMDLs are being established. Therefore, in accordance with the Compliance Schedule Policy and existing authority in the Basin Plan, MS4 permittees that are subject to a pyrethroid TMDL proposed in this Basin Plan amendment would be authorized to apply for and receive a compliance schedule in their MS4 permit for achieving attainment of the WLA associated with the TMDL. In no instance will a compliance schedule allow for a final date of WLA attainment that is beyond the final compliance deadline for the applicable TMDL.

10.2.7 **Water Quality Enforcement Policy**

The State Water Board adopted this policy to ensure enforcement actions are consistent, predictable, and fair. The policy describes tools that the State and Regional Water Boards may use to determine the following: type of enforcement order applicable, compliance with enforcement orders by applying methods consistently, and type of enforcement actions appropriate for each type of violation. The State and Regional Water Boards have authority to take a variety of enforcement actions under the Porter-Cologne Water Quality Control Act. These include administrative permitting authority such waste discharge requirements (WDRs), waivers of WDRs, and Basin Plan prohibitions. The proposed Basin Plan amendment does not implicate the Water Quality

Enforcement Policy but any enforcement of the proposed Basin Plan amendment would occur in accordance with that policy.

10.2.8 **Recycled Water Policy**

The goals of the Recycled Water Policy are to increase the use of recycled water and storm water and increase water conservation. The proposed amendment is consistent with these goals because it is expected to lead to improved water quality, particularly for storm water. Higher quality water improves the viability of water recycling. In addition, the proposed amendment may be an additional factor that causes a discharger to decide to recycle water rather than continuing to discharge to surface water, which may have increased costs for monitoring and BMP implementation.

10.3 Consistency with Central Valley Water Board Policies

There are several Central Valley Water Board policies that are relevant to the proposed amendment. These policies are contained in the Water Quality Control Plan for the Sacramento River Basin and the San Joaquin River Basin; they are:

- Urban Runoff Policy
- Controllable Factors Policy
- Water Quality Limited Segment Policy
- Application of Water Quality Objectives Policy
- Watershed Policy

These policies and their relevance to the proposed control program for pyrethroids are described in the following sections.

10.3.1 **Urban Runoff Policy**

The Urban Runoff Policy states that municipal and industrial plants must assess the impact of urban runoff on receiving water quality and consider abatement measures if a problem exists. Additionally, effluent limitations for storm water runoff must be included in NPDES permits where water quality problems exist.

This policy is applicable to the proposed Basin Plan amendment because it addresses constituents found in municipal wastewaters and urban runoff. The proposed amendment includes requirements for monitoring pyrethroids, numeric triggers, and a program of implementation including wasteload allocations applicable to NPDES dischargers.

10.3.2 **Controllable Factors Policy**

The Controllable Factors Policy states that controllable factors, including actions, conditions, or circumstances resulting from human activities, are not allowed to cause further degradation of water quality in instances where other factors have already resulted in water quality objectives being exceeded (Basin Plan, p. IV-15.00). This policy applies to the proposed amendment because the amendment addresses water

quality impairments caused by synthetic pyrethroid pesticides, which are not naturally occurring constituents, from agricultural, wastewater and urban sources. A variety of methods are available to control pyrethroid discharges. The Basin Plan amendment requires implementation of these control measures that are expected to result in attainment of applicable water quality objectives within a reasonable period of time.

10.3.3 Water Bodies with Special Water Quality Problems

Water Quality Limited Segments (WQLSs) are those sections of water bodies that do not meet quality standards even after point source effluents are controlled. The Basin Plan allows additional treatment beyond minimum federal requirements to be imposed on dischargers to WQLSs and requires that dischargers are assigned a maximum allowable load of pollutant so that water quality objectives can be met (Basin Plan, pp. IV-7.00). The proposed Basin Plan amendment is consistent with this policy because it establishes TMDLs for several water bodies within the Project Area that are included in the Clean Water Act section 303(d) list of Water Quality Limited Segments, and it allocates the allowable loads to nonpoint source and NPDES dischargers.

10.3.4 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. This policy states that pesticide discharges to surface waters from nonpoint sources will primarily be achieved by implementation of management practices that minimize or eliminate pesticide discharges and the effectiveness of these practices will be evaluated by using chemical analysis and toxicity monitoring data. This policy allows for flexibility in the management practices used and states that practices should be reviewed to ensure they are achieving reductions in pesticide discharges and will eventually result in attainment of water quality standards. This policy also recognizes that for the best results, the Regional Board must coordinate its efforts with other agencies, such as DPR.

The proposed Basin Plan amendment addresses both nonpoint and point sources of pyrethroids. The proposed amendment requires agricultural dischargers to impaired waters to submit a management plan to describe the actions they will take to meet the applicable water quality objectives. The management plans for agricultural dischargers will be administered through the Long-Term Irrigated Lands Regulatory Program of the Central Valley Water Board when possible. The proposed Basin Plan amendment includes monitoring and surveillance provisions that require both chemical analysis and toxicity testing to ensure progress toward attaining applicable water quality objectives. These provisions also require dischargers to evaluate the effectiveness of management practices; this evaluation would also be reviewed by the Regional Board.

The Central Valley Water Board has been working with DPR to identify possible ways the agencies can coordinate to reduce pesticide discharges that lead to water quality impairments. In addition, the proposed amendment includes specific actions that the Regional Board will implement to continue and improve coordination with both DPR and U.S. EPA.

10.3.5 **Application of Water Quality Objectives Policy**

This Basin Plan amendment proposes the establishment of acute and chronic TMDL numeric targets for six pyrethroids to interpret the narrative water quality objective for toxicity. The numeric targets account for additive toxicity of pyrethroids because these pesticides all have a similar toxicological mode of action. The proposed amendment requires compliance based upon the additive toxicity of these pesticides when present together in accordance with the Water Quality Objectives policy (Basin Plan, pp. IV-16.00-18.00).

10.3.6 **Watershed Policy**

The Central Valley Water Board conducted outreach to the stakeholders in the area covered by this Basin Plan amendment, as discussed in section 11.8. These outreach activities were conducted to gain participation of stakeholders as part of implementation of the Watershed Policy (Basin Plan, p. IV-21.00). This report focuses on identifying and addressing the uses of pyrethroids that are likely contributing most significantly to their presence in Central Valley surface waters, which is also consistent with the Watershed Policy.

10.4 Management Agency Agreement with the California Department of Pesticide Regulation

The State Water Board and the California Department of Pesticide Regulation have a Management Agency Agreement (MAA) 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 (SWRCB and CDPR 1997). The State Water Board and Central Valley Water Board 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 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 County Agricultural Commissioners. Stage four is a regulatory approach based on Central Valley Water Board authorities.

DPR began the stage three process in August 2006 (CDPR 2006) by placing many products containing pyrethroids into the reevaluation process. As a continuation of stage three, DPR promulgated surface water protection regulations for urban uses of pyrethroid products that went into effect in July 2012. Registrants voluntarily submitted label changes restricting non-agricultural outdoor uses of bifenthrin, which were accepted in 2011 by the USEPA in coordination with DPR.

Stage four is 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 in order to meet statutory obligations. Because pyrethroids concentrations in the Sacramento River and San Joaquin River basin water bodies have been found to exceed narrative 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 pyrethroids, 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 pyrethroid discharges.

10.5 Human Right to Water

In 2012, California passed what is referred to as the Human Right to Water law (AB 685), which calls on state agencies to consider the human right to water "when revising, adopting, or establishing policies, regulations, and grant criteria." (Wat. Code § 106.3). This consideration must include the safety, affordability, and accessibility of water for human consumption, cooking, and sanitary purposes.

The proposed pyrethroids control program focuses on protection of aquatic life (WARM/COLD) beneficial uses because they are more sensitive to pyrethroids than the municipal and domestic supply (MUN) beneficial use. Thus, protection of aquatic life beneficial uses for pyrethroids should also provide protection of the municipal and domestic supply beneficial use for pyrethroids. In the development of the proposed amendment, several alternatives were considered and one of the evaluation criteria was protection of aquatic life beneficial uses. All of the alternatives that were determined to be protective of aquatic life beneficial uses should also advance the human right to water because they are designed to improve water quality. The proposed amendment is not contrary to the goal of securing universal access to safe drinking water in terms of the safety, affordability, and accessibility of water because it is expected to result in improved surface water quality and is not expected to result in additional costs to water purveyors or to reduce water supply.

10.6 Climate Change

Climate change is a priority for the Central Valley Water Board and the State Water Board. This section discusses the possible effects of climate change and drought conditions on the achievability of the proposed amendment, and whether the regulations in the proposed amendment would encourage or require any activities that may result in negative effects in drought conditions or in an altered climate.

Future climate conditions cannot be predicted with full accuracy, but there are several likely scenarios for changes in precipitation in the Project Area. Climate change may lead to more of the precipitation to fall as rain rather than snow in the Project Area. This scenario may lead to more runoff events and/or more runoff overall. An increase in runoff totals or in runoff events may lead to more pyrethroids being washed into creeks and streams. This scenario may particularly affect urban watersheds because it has been demonstrated that the majority of pyrethroids loading in urban streams occurs due to storm water runoff and if there is more runoff then more pyrethroids may be mobilized. In this scenario, municipal storm water dischargers may need to focus their implementation of BMPs on those practices that reduce pyrethroids in storm water runoff in order to comply with the proposed amendment.

Another possible scenario that may occur due to climate change is that there may be fewer precipitation events per year, and therefore less runoff in the Project Area overall. Under this scenario, it would like be less difficult for municipal storm water dischargers to comply with the requirements in the proposed amendment because it would reduce loading of pyrethroids in urban streams. Pyrethroid loading in agricultural watersheds is more likely to occur in the dry season because that is when the majority of agricultural pyrethroids are applied, so changes in precipitation during the winter are not expected to impact pyrethroid loading in agricultural watersheds. Because it is likely that the majority of pyrethroid loading in wastewater influents is from indoor uses, changes in runoff are unlikely to impact the ability for wastewater dischargers to comply with the requirements of the proposed amendment.

The effects of drought conditions on complying with the regulations in the proposed amendment may be mixed. Under drought conditions there would be less precipitation, and therefore less runoff, which reduces loading of pyrethroids to surface waters. However, there would also be less dilution in streams in drought conditions, which would lead to higher concentrations of pyrethroids. The actions that dischargers are expected to take as a result of the proposed amendment are not expected to worsen or exacerbate drought conditions. In agricultural watersheds, irrigation management practices (e.g., using drip irrigation and tailwater recovery systems) are expected to reduce pyrethroid loading to surface waters, and would also be beneficial practices when water is scarce in drought conditions.

The actions that dischargers may take as a result of the proposed amendment are not expected to significantly affect carbon sequestration. Likely management practices for wastewater and municipal storm water dischargers do not involve changes to land use, but rather focus more on outreach, education and pollution prevention activities. For agricultural dischargers, it is possible that some management practices implemented as a result of the proposed amendment may slightly increase carbon sequestration (e.g., cover crops). None of the practices that are expected to be implemented as a result of the proposed amendment are likely to decrease carbon sequestration.

11 CALIFORNIA ENVIRONMENTAL QUALITY ACT (CEQA) REVIEW

This California Environmental Quality Act (CEQA) review is an analysis of the potential environmental impacts management practices and associated mitigation measures that could be implemented by dischargers to comply with the proposed Basin Plan amendment to control pyrethroids and potential replacement pesticides in Sacramento River and San Joaquin River basin water bodies. This analysis evaluates the potential environmental impacts and mitigation practices that could be implemented by agricultural users, wastewater treatment plants, and municipal storm water systems to comply with the proposed amendment. The adoption of a policy for water quality control is a regulatory program that has been certified by the State's Secretary for Resources as exempt from the requirement of the CEQA (Pub. Res. Code, § 21000 et seq.) to prepare an Environmental Impact Report (EIR) or Negative Declaration. (Cal. Code of Regs., tit. 14, § 15251, subd. (g); Cal. Code of Regs., tit. 23, § 3775.). Instead, this staff report and the environmental checklist provided herein satisfy the requirements of the State Water Board's Regulations for Implementation of CEQA, Exempt Regulatory Programs, which are found at California Code of Regulations, title 23, sections 3775 et seq.

The Central Valley Water Board's substantive obligations when adopting performance standards such as TMDLs are described in Public Resources Code section 21159. Section 21159 requires that an agency perform an environmental analysis at the time of the adoption of a rule or regulation requiring the installation of pollution control equipment or a performance standard or treatment requirement. Section 21159(a) requires that the environmental analysis, at a minimum, include all of the following:

(1) An analysis of the reasonably foreseeable environmental impacts of the methods of compliance.
(2) An analysis of reasonably foreseeable mitigation measures to lessen the adverse environmental impacts.
(3) An analysis of reasonably foreseeable alternative means of compliance with the rule or regulation that would have less significant adverse impacts (Pub. Res. Code, § 21159(a).)

Section 21159 requires that the environmental analysis "shall take into account a reasonable range of environmental, economic, and technical factors, population and geographic areas, and specific sites." A "reasonable range" does not require an

examination of every site, but a reasonably representative sample of them. The Central Valley Water Board is prohibited from specifying the manner of compliance with its orders; therefore, the actual environmental impacts will necessarily depend upon the compliance strategy selected by the dischargers.

This environmental analysis provides a program-level review of potential environmental impacts and possible measures to mitigate those impacts. The analysis is based on the reasonably foreseeable methods of compliance with the proposed amendment and it is also based on several assumptions:

1. The baseline for evaluating agricultural practices, including field-crop and orchard maintenance such as tilling, irrigation, pest pressure assessments and responses, and runoff control, assumes the use of standard motorized farming equipment (e.g., tractors and their appurtenances – tillers, spreaders, sprayers, etc.) and laborers to operate the equipment and perform other normal crop tending activities.
2. The baseline for evaluating urban practices, including monitoring and outreach, and the staff resources to implement such activities.
3. There are thresholds of significance for each Environmental Resource Category (see table below) to which potential impacts from implementing management practices can be compared.
4. Only those management practices (i.e., practices requiring materials or effort beyond that required for standard baseline agricultural activities) with the potential to significantly impact the environment are addressed in this report.
5. The potential for management practices to significantly impact the environment are considered individually and cumulatively.

An evaluation of the reasonably foreseeable significant environmental impacts to each of the eighteen environmental resource categories that could result from implementation of the management practices that are different from, or in addition to, standard practices is conducted in this CEQA analysis. Measures by which potentially significant levels of environmental impacts could be managed or mitigated to less than significant levels are also described.

11.1 Project Description

Project title

Amendment to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Pyrethroid Pesticides Runoff to the Sacramento and San Joaquin Rivers

Project sponsor's name and address

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

Contact person and phone number

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Project location

The Project Area includes all water bodies in the Sacramento River and San Joaquin River basins with a designated or existing WARM and/or COLD beneficial use. Some of these water bodies are listed in the Basin Plan; however, many of the affected water bodies have a WARM/COLD beneficial use designation based on the tributary rule. The land use in the Project Area, described further in section 2.1 of this staff report, is predominantly agricultural, but includes urban, open space/rangeland, public lands, and wildlife habitat.

General plan designation

Not applicable

Zoning

Not applicable

Description of project

The project is a proposed amendment to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins. The proposed amendment will establish a control program for pyrethroid pesticides to protect water bodies in the Sacramento River and San Joaquin River basins from impairment due to discharges of pyrethroid pesticides.

The goal of the proposed amendment is to reduce pyrethroid concentrations in Sacramento River and San Joaquin River basin water bodies to concentrations that are protective of aquatic life (WARM and/or COLD) beneficial uses. The proposed amendment includes:

- A conditional prohibition of discharges of pyrethroid pesticides above acute and chronic numeric concentration triggers for six pyrethroids (bifenthrin, cyfluthrin, cypermethrin, esfenvalerate, lambda-cyhalothrin, and permethrin) that applies to discharges to Sacramento and San Joaquin River Basin water bodies that have a designated or existing WARM and/or COLD aquatic life beneficial use.
- Total maximum daily loads - including wasteload allocations for point sources - for nine water bodies that are on the federal Clean Water Act section 303(d) List of Impaired Water Bodies due to elevated concentrations of pyrethroids;
- Implementation requirements to ensure attainment of the TMDL allocations;
- Implementation requirements under the conditional prohibition that will ensure pyrethroid discharges are reduced;
- Monitoring and surveillance requirements to evaluate attainment of the TMDL allocations and trends in pyrethroid concentrations and effectiveness of management practices to reduce pyrethroid discharges; and
- Provisions to address potential impacts from replacement pesticides.

This evaluation covers two potential options for the pyrethroid concentration goals that would serve as the prohibition triggers and TMDL targets: concentration goals based on the 5th percentile UC Davis criteria and concentration goals based on the 2.5 percentile UC Davis criteria. While concentration goals based on the 5th percentile UC Davis criteria are proposed, this analysis is also applicable to concentration goals based on the 2.5 percentile UC Davis criteria. These two options are not evaluated separately because the implementation of management practices is not expected to differ significantly depending on which trigger values are adopted. If the higher trigger values are adopted, fewer dischargers may be required to implement management practices to reduce discharges of pyrethroids because it is possible that some are discharging pyrethroids at levels above the lower potential trigger values (2.5 percentile UC Davis values), but above the higher potential trigger values (5th percentile UC Davis values). Under either alternative, large reductions are likely needed by many dischargers and it is difficult to estimate the number of dischargers who would be required to implement management practices until the initial baseline monitoring is completed. The extent of implementation of management practices is not expected to differ significantly under the two alternatives for numeric triggers, thus the two alternatives fall under the same CEQA analysis.

11.2 Mitigation Measures

The Central Valley Water Board is required to identify and analyze potentially significant environmental effects that may occur as a result of the adoption of new standards, along with reasonably foreseeable mitigation measures that could reduce the

significance of these potential effects. Mitigation is defined in the California Code of Regulations, title 14, section 15370, as:

(a) Avoiding the impact completely by not taking a certain action or parts of an action;

(b) Minimizing impacts by limiting the degree or magnitude of the action and its implementation;

(c) Rectifying the impact by repairing, rehabilitating, or restoring the impacted environment;

(d) Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and

(e) Compensating for the impact by replacing or providing substitute resources or environments (Cal. Code of Regs., tit. 14, § 15370).

Analyzing potential environmental impacts resulting from the adoption of an environmental policy or regulation (such as the proposed amendment) is considerably different from analyzing the types of impacts described in environmental impact reports for “typical” development projects (such as the building of limited amounts of residential housing or the construction of minor infrastructure projects). The environmental effects of a policy or regulation occur as a consequence of the implementation of management practices utilized by regulated entities to comply with the policy or regulation, whereas the impacts analyzed in a “typical” environmental impact report occur as a result of the construction and operation of the project itself. Therefore, for the purposes of this environmental analysis, mitigation measures are considered those measures that could be implemented by regulated entities to ensure that the actions that they take to comply with the proposed amendment result in minimal environmental impacts. Though the mitigation measures themselves might lead to further environmental impacts, any analysis of those attenuated impacts would be unduly speculative.

Because this review focuses on a program-level analysis of potential environmental impacts, it defers project-level environmental analyses to the time and place when the site-specific projects are approved. For example, a discharger or group of dischargers seeking waste discharge requirements from the Board must ensure that their discharges are in compliance with the Basin Plan, as amended, and may select among the methods of compliance identified in this evaluation, or may propose an innovative method of complying with the pyrethroid provisions in the Basin Plan. Before the discharger’s proposal is approved and the requirements are adopted, the Board will ensure that all elements of the discharger’s proposal have undergone environmental analysis, and that the site-specific environmental effects that could occur as a result of the discharger’s proposal are mitigated to the greatest extent feasible.

Mitigation measures will be incorporated into the design and construction of site-specific projects. Implementation of the mitigation measures described below in each Environmental Checklist Category may be required through the Board's adoption of waste discharge requirements or waivers of waste discharge requirements, or may be imposed by other regulatory agencies as specified in the discussion.

11.3 Environmental Checklist

Impacts due to implementation of new agricultural management practices: Following the adoption of the proposed amendment, regulated agricultural entities may need to implement additional management practices to ensure that their discharges will be in compliance with the provisions of the proposed amendment. A range of these foreseeable management practices are described in section 7.2.3. The Board used current agricultural practices, the Long-Term Irrigated Lands Regulatory Program (ILRP) as implemented under Waste Discharge Requirements (WDRs), and the analysis completed in the Environmental Impact Report for the ILRP (ICF International 2010, 2011) as a baseline for determining the significance of the impacts that could be caused by the implementation of new agricultural management practices. For the most part, these new management practices consist primarily of minor modifications to currently-utilized standard agricultural practices.

Impacts due to implementation of new management practices by NPDES permittees: Wastewater and storm water dischargers may be required to implement additional strategies or practices to reduce discharges of pyrethroids. These practices include education, outreach and pollution prevention measures described in the Proposed Basin Plan Amendment for Pyrethroid Pesticides.

The environmental checklist consists of a category-by-category analysis of potential impacts in eighteen environmental resource categories. For each subcategory, the Board has evaluated the level of significance of the impacts that could occur due to the implementation of the proposed amendment. The four levels of potential environmental impact are described below.

> **"No Impact":** Most of the management practices are based on generally accepted, standard agricultural practices. Where new management practices do not differ significantly from currently-implemented management practices, the new practices will not create negative impacts to environmental resources. Most of the practices that are expected to be implemented in nonagricultural areas to fulfill the requirements of the proposed amendment are already imposed by other regulatory programs. A "No Impact" box is checked in the Environmental

Checklist if there are no potential significant environmental impacts associated with any of new management practices.

"Less than Significant Impact": A "Less than Significant Impact" box is checked if one or more new management practices could have an impact on the associated environmental resource category and this impact is considered to be less than significant.

"Less Than Significant Impact with Mitigation Incorporated": A "Less than Significant Impact with Mitigation Incorporated" box is checked if one or more new management practices could have a significant impact on the associated environmental resource category, but incorporated mitigation measures can reduce the potential significance of these impacts to less than significant levels.

"Potentially Significant Impact": A "Potentially Significant Impact" box is checked if one or more new management practices could have a significant impact on the associated environmental resource category, and the incorporation of mitigation measures would not reduce these potential impacts to less than significant levels.

Following the checklists for each Resource Category are discussions explaining the Board's rationale for how the checklists were completed. Where mitigation measures must be incorporated to reduce the potential significance of the environmental impacts, or where the impacts remain potentially significant even after mitigation, the Board has included tables to explain the reasonably foreseeable methods of compliance, the reasonably foreseeable environmental impacts associated with the methods of compliance, and alternative methods of compliance or mitigation measures that could reduce the significance of environmental impacts.

Environmental Checklist

Environmental resource Category	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	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 that would adversely affect day or nighttime views in the area?	☐	☐	☒	☐

I) Implementation of management practices (e.g., water management, construction and operation activities, use of alternative pesticides, pollution prevention measures) to comply with the proposed amendment is unlikely to interfere with, degrade, or damage scenic resources because they are expected to occur within presently-active agricultural acreage, municipal sites (e.g., storm water conveyances) or in urban settings. Likewise, implementation of additional strategies or practices at WWTPs is unlikely to cause impacts to aesthetics because such activities would most likely take place at the plant, out of public view. Implementation of practices in municipal separate storm sewer system (MS4) areas has potential to affect the aesthetics in urban areas for short periods of time (e.g. during construction activities); as such, the effects of this project on aesthetics are expected to be less than significant.

I.a) It is possible that as a result of the proposed project, an adverse effect could be made on a scenic vista, for example, during construction; however, such an effect is not expected to be substantial because areas that will likely require additional management practices and/or mitigation measures are unlikely to significantly affect the view of scenic vistas. Therefore, the impacts of the proposed project are expected to have a less than significant impact on Aesthetic Impact I.a.

I.b) It is possible that as a result of the proposed project, an adverse effect could be made on scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway; however, the effects are not expected to be substantial because areas that will likely require additional management practice and/or mitigation measures are unlikely to be in areas that would necessitate damage to such resources (e.g., practices and measures would likely occur on existing agricultural land, at wastewater treatment plants, or on small urban sites). The impacts of the proposed project, therefore, are expected to have a less than significant impact on Aesthetics Impact I.b.

I.c) It is possible that as a result of the proposed project, degradation of the existing

visual character or quality of a site or its surroundings may potentially occur; however, these effects are not expected to be substantial as they will likely occur on agricultural, urban, or private areas that are out of view or are not of very high visual character or quality. Therefore, the effects of the proposed project are expected to be less than significant on Aesthetics Impact I.c.

I.d) It is possible that as a result of the proposed project, a new source of light or glare that would adversely affect day or nighttime views could be created; however, it is highly unlikely and is not expected to be substantial. The expected management practices and mitigation measures have potential to result in light or glare while certain practices are implemented (e.g., during construction), however light or glare is not expected to be substantial or long-term. Therefore, the effects of the proposed project are expected to be less than significant on Aesthetics Impact I.d.

Environmental resource Category	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
II. AGRICULTURAL AND FORESTRY RESOURCES. 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) Conflict with existing zoning for, or cause rezoning of, forest land (as defined in Public Resources Code section 12220(g)) or timberland (as defined by Public Resources Code section 4526)?	☐	☐	☒	☐
d) Result in the loss of forest land or conversion of forest land to non-forest use?	☐	☐	☒	☐
e) Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland, to non-agricultural use or conversion of forest land to non-forest use?	☐	☐	☒	☐

II) Management practices have already been developed and are already commonly used to manage pollutants and to conserve water and the proposed amendment is not expected to cause drastic changes in the types of currently-employed management practices. Also, management practices will be largely implemented on existing agricultural lands, at wastewater treatment plants, or in small areas in urban settings.

II.a) It is likely that only relatively small portions of agricultural areas (e.g., field or orchard borders) will be removed from agricultural production to be dedicated to non-production implementation practices. Although growers might construct retention ponds to comply with the proposed amendment, these relatively small areas unassociated with direct crop production would provide significant environmental benefits and would likely not result in significant loss of productive farmland and associated incremental income. Additionally, agricultural areas converted to re-use, store, or treat recycled drainage water are considered supplemental to standard, local, and project-level agricultural operations and, therefore, they remain agricultural uses. For these reasons, foreseeable practices implemented as a result of the proposed project are expected to be less than significant on Agricultural and Forestry Resources Impact II.a.

II.b) The proposed project is not expected to conflict with existing zoning for agricultural use or the Williamson Act contract, because foreseeable management practices are expected to be consistent with agricultural zoning requirements. No impact is expected for Agricultural and Forestry Resources Impact II.b.

II.c) Implementation of management practices to comply with the proposed project are unlikely to conflict with existing zoning, or cause rezoning of, forest land or timberland because practices are not likely to require zoning changes or dramatically change the

land's current use. Pyrethroids are not commonly used in these areas so it is unlikely that new management practices will need to be implemented on forest lands and no impact is expected for Agricultural and Forestry Resources Impact II.c.

II.d) Implementation of management practices to comply with the proposed project is unlikely to result in the loss of forest land or conversion of forest land to non-forest use because pyrethroids are not commonly used on forestry lands. Esfenvalerate and permethrin were the only pyrethroids applied to forest trees or lands in the Project Area from 2007-2011 and over this 5 year period, less than 50 pounds of these chemicals were applied to forest lands, which accounts for 0.01% of pyrethroid use (CDPR 2013). Therefore, impacts are expected to be less than significant on Agricultural and Forestry Resources Impact II.d.

II.e) Implementation of management practices to comply with the proposed project are unlikely to result in changes in the existing environment that could result in conversion of Farmland to non-agricultural use because foreseeable management practices would either not convert farmland to non-agricultural use or would only convert small fractions of Farmland to non-production areas (see Agricultural and Forestry Resources Impact II.a), and costs are expected to be within the range of costs considered by the Board in the establishment of the existing Long Term Irrigated Lands Regulatory Program. Similarly, the proposed project is not expected to result in the conversion of forest land to non-forest use (see Agricultural and Forestry Resources Impact II.d). As a result, the implementation of management practices to comply with the proposed amendment would have a less than significant impact on Agricultural and Forestry Resources Impact II.e.

Environmental Resource Category	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
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?	☐	☒	☐	☐
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 that exceed quantitative thresholds for ozone precursors)?	☐	☒	☐	☐
d) Expose sensitive receptors to substantial pollutant concentrations?	☐	☒	☐	☐
e) Create objectionable odors affecting a substantial number of people?	☐	☐	☒	☐

III) Seven of the state's 15 air basins are partially or completely within the Project Area; they are the Northeast Plateau, Sacramento Valley, Mountain Counties, Lake County, Great Basin, San Joaquin Valley, and San Francisco Bay air basins. State air quality standards exist for ten air pollutants: ozone, suspended particulate matter (PM10), fine particulate matter (PM2.5), carbon monoxide, nitrogen dioxide, sulfur dioxide, sulfates, lead, hydrogen sulfide, and visibility reducing particles. Ambient air quality measurements are compared to state standards annually.

Based on the 2013 amendments to the area designations for state air quality standards (CARB 2013; adopted 10 April 2014), there are one or more non-attainment areas (NAAs) within the Project Area for the state ozone, PM2.5, PM10, and hydrogen sulfide standards. Designated NAAs for the state ozone, carbon monoxide, nitrogen dioxide, and sulfur dioxide are required to develop a plan to attain standards.

The following constituents also have national ambient air quality standards: carbon monoxide, lead, PM2.5, PM10, nitrogen dioxide, ozone, and sulfur dioxide. Violations of national ambient air quality standards have resulted in NAAs for ozone and PM2.5 in the parts of the Project Area. Portions of the Mountain Counties and Sacramento Valley air basins and the entire San Joaquin Valley and San Francisco Bay Area air basins do not meet the federal ozone standard. Several counties within the Sacramento Valley Air Basin and the entire San Joaquin Valley and San Francisco Bay Area air basins do not meet the federal PM2.5 standard.

The federal Clean Air Act requires states to meet the national ambient air quality

standards and specify how they will meet those goals in a State Implementation Plan. The State Implementation Plan describes the measures that will be taken in order to comply with federal nitrogen oxides (NOx) and volatile organic compounds (VOCs) because they can form ozone. Because of this, the Board is sensitive to any potential incremental negative impacts that might occur as the result of new regulatory action and several mitigation measures are proposed to mitigate the project's potential impacts on air quality, which are described in Table 10-1.

The changes in management practices (e.g., water management, use of alternative pesticides, construction and operational activities, pollution prevention measures) that might be implemented to comply with the proposed project have potential to cause impacts to air quality. Changes in water management practices could result in impacts to air quality; potential impacts and mitigation measure are described in more detail below.

III.a) Pest management: Pesticides pose an air quality concern because they can contribute to VOCs, which are precursors to ozone. State and federal ozone standards are not attained in several areas within the Project Area. Air quality management plans are established to reach state and federal ozone standards in identified NAAs. Possible alternative pesticides that might be used if the proposed amendment is adopted that are known to contribute to VOC emissions are abamectin, chlorpyrifos, and fipronil (Neal et al. 2013). Mitigation measures are described in Table 10-1. Pest management practices (e.g., orchard sanitation), which might be implemented as a result of adoption of the proposed amendment, have potential to lead to an increase in PM2.5 and PM10 and equipment emissions. In addition, use of alternative pesticides for a given pest might conflict with or obstruct the implementation of applicable air quality plans. These impacts are expected to be less than significant with mitigation incorporated because only a subset of pyrethroid users will begin to use alternative products and not all alternatives will be more volatile than pyrethroids. In addition, DPR and the California Air Resources Board have programs and regulations in place that should reduce and/or mitigate for such impacts.

Water management: Changes in water management practices (e.g., irrigation water management, pressurized irrigation, tailwater recovery) have potential to result in conflicts with or obstruct implementation of applicable air quality plans. Drier croplands and landscaped areas might result in greater potential for airborne particulates (e.g., PM2.5 and PM10) and greater potential for volatilization (e.g., increase in ozone or ozone precursors); however, potential impacts due to drier croplands and landscaped areas are expected to be less than significant with mitigation incorporated. Mitigation measures are described in Table 10-1. In addition, mitigation measures for these potential impacts are required in the Long-Term Irrigated Lands Regulatory Program WDRs.

Construction and operational activities: Construction and operational activities could potentially result in conflicts with or obstruct implementation of applicable air quality management plans. The installation of management practices that require earth-moving activities, such as detention basins or tailwater recovery systems, could result in

localized fugitive dust (e.g., PM2.5 and PM10) and heavy equipment emissions, including criteria air pollutants such as ozone and ozone precursors such as VOCs, reactive organic gases (ROGs) and NOX, PM10, and PM2.5. There are several NAAs for the state PM2.5 and state and federal PM10 and ozone standards within the Project Area, with corresponding air quality management plans.

Due to the relatively small size, duration, and frequency of construction activities, substantial impacts on air quality plans are not likely. In addition, potential air quality impacts from operational emissions might include vehicle trips to conduct surface water quality monitoring and diesel-powered wells in tailwater recovery systems or in equipment changes or additions at WWTPs. As monitoring is already occurring, a substantial increase in associated vehicle trips is not expected and the installation of new treatment technologies is not likely to result due the proposed project. Although construction and operational activities have potential to impact applicable air quality management plans, impacts are expected to be less than significant with mitigation incorporated for Air Quality Impact III.a. Mitigation measures are described in Table 10-1. In addition, mitigation measures for these potential impacts are required in the Long-Term Irrigated Lands Regulatory Program WDRs.

Vegetation management: Vegetation management practices such as planting cover crops, installing buffer strips, and allowing native vegetation to grow in field edges and ditches are unlikely to conflict with or obstruct implementation of the applicable air quality plan because more vegetative cover should result in reduced potential for airborne particulates (e.g., PM2.5 and PM10) and volatilization (e.g., increase in ozone or ozone precursors).

Urban discharger management practices: The management practices recommended for urban dischargers, such as education and outreach and pollution prevention measures, are unlikely to conflict with or obstruct implementation of the applicable air quality plan because these practices are unlikely to require increased vehicle trips or other measures that would increase air quality pollutants.

III.b) Pest management practices: Cultural practices used instead of pyrethroid applications could potentially increase PM2.5 and PM10 due to soil disturbance. Other potential impacts include an increase in VOCs and NOx from the use of tractors and mowers. Some of these practices, such as orchard sanitation, have already been adopted on a wide scale and although increasing their implementation might cause potential impacts to air quality impact III.b., impacts are expected to be less than significant when mitigation measures are incorporated. Mitigation measures are described in Table 10-1.

The use of alternative pesticides could violate an air quality standard or contribute substantially to an existing or projected air quality violation; however, this impact is expected to be less than significant with mitigation incorporated because the DPR and the Air Resources Board have programs and regulations in place that should reduce and/or mitigate for such impacts. Mitigation measures are described in Table 10-1.

Water management: Changes in water management practices are unlikely to result in a violation of an air quality standard or contribute substantially to an existing or projected air quality violation because it is unlikely that water management practices will change significantly as a result of the proposed project. There is a potential for drier croplands and landscaped areas to result in greater potential for airborne particulates and VOCs, but potential impacts are expected to be less than significant with mitigation incorporated for Air Quality Impact III.b. Mitigation measures are described in Table 10-1. In addition, mitigation measures for these potential impacts are required in the Long-Term Irrigated Lands Regulatory Program WDRs.

Construction and operational activities: Construction and operational activities should not violate any air quality standards or contribute substantially to an existing or projected air quality violation because such activities are not expected to be needed on a large scale. Where activities are implemented, they are expected to be short-term and intermittent, with little likelihood of resulting in a violation of any air quality standard or contributing substantially to an existing or projected air quality violation. Potential impacts are expected to be less than significant with mitigation incorporated for Air Quality Impact III.b. Mitigation measures are described in Table 10-1. In addition, mitigation measures for these potential impacts are required in the Long-Term Irrigated Lands Regulatory Program WDRs.

Vegetation Management: Vegetation management practices such as planting cover crops, installing buffer strips, and allowing native vegetation to grow in field edges and ditches are unlikely to lead to a violation of any air quality standard or contribute substantially to an existing or projected air quality violation because more vegetative cover should result in reduced potential for airborne particulates (e.g., PM2.5 and PM10) and volatilization (e.g., increase in ozone or ozone precursors).

Urban discharger management practices: The management practices recommended for urban dischargers, such as education and outreach and pollution prevention measures, are unlikely to lead to a violation of any air quality standard or contribute substantially to an existing or projected air quality violation because these practices are unlikely to require increased vehicle trips or other measures that would increase air quality pollutants.

III.c) Pest Management Practices: Cultural practices could potentially increase PM2.5 and PM10 due to soil disturbance. Other potential impacts include an increase in VOCs and NOx from the use of tractors and mowers. Some of these practices, such as orchard sanitation, have already been adopted on a wide scale and although increasing their implementation might cause potential impacts to air quality impact III.c., impacts are expected to be less than significant when mitigation measures are incorporated. Mitigation measures are described in Table 10-1. In addition, mitigation measures for these potential impacts are required in the Long-Term Irrigated Lands Regulatory Program WDRs.

Pesticides pose an air quality concern because they can contribute to VOCs, which are precursors to ozone. The California Department of Pesticide Regulation is responsible for maintaining an emission inventory and reducing VOCs caused by pesticides for five ozone NAAs (Cal. Code Regs., tit. 3, § 6452.4). Two ozone NAAs occur within the Project Area – the Sacramento Metro area and the San Joaquin Valley. The State Implementation Plan requires that VOC emissions are reduced by 12% in the San Joaquin Valley and 20% in the other four NAAs, compared to 1990 levels. The most recent emissions report evaluated VOC emissions from 1990 through 2011 (Neal et al. 2013). The report includes a list of the top ten pesticides contributing to VOCs for each of the five NAAs. For the Sacramento Metro area and San Joaquin Valley, non-fumigant insecticides on the list include: abamectin, bifenthrin and chlorpyrifos. Of these, abamectin is of concern because it is a potential replacement product for several crops that have high pyrethroid use, such as almonds and tomatoes, based on the analysis in the staff report for the proposed project. For most products, it is the formulation additives that most significantly contribute to VOC emissions, rather than the active ingredients. For some active ingredients, there are product formulations designated as high-VOC or low-VOC, including abamectin and chlorpyrifos (Neal et al. 2013). These designations allow pesticide applicators to be aware of the air quality impacts of the products they choose, and indicates that VOC regulations (3 CCR 6880) apply to these products. Low-VOC products might not be feasible for all uses, but are feasible for many. The pesticide VOC regulations include a VOC trigger that, if exceeded in the previous year based on DPR's annual emission inventory report, can result in the use of high-VOC products being prohibited the following two or more seasons. Low-VOC products are not prohibited in these instances and would remain available for growers. The pesticide VOC regulations enforced by DPR are likely to prevent exceedances of the VOC emission goals and therefore are expected to result in less than significant impacts to the criteria pollutant ozone in the San Joaquin Valley. In addition, carbaryl, which is a possible replacement product, is on DPR's 6860 Toxic Air Contaminants List.

The use of alternative pesticides – especially if the replacement products contain chlorpyrifos or abamectin – has potential to result in a net increase of criteria pollutants in non-attainment areas; therefore, mitigation measures are recommended. Although impacts have potential to occur as a result of alternative pesticide use, they are expected to be less than significant with mitigation incorporated for Air Quality Impacts III.c. Mitigation measures are described in Table 10-1. In addition, mitigation measures for these potential impacts are required in the Long-Term Irrigated Lands Regulatory Program WDRs.

Water management: Changes in water management practices could result in impacts to air quality standards. Drier croplands and landscaped areas might result in greater potential for airborne particulates (e.g., PM2.5 and PM10) and VOCs, which are precursors to ozone. These potential impacts are expected to be less than significant with mitigation incorporated for Air Quality Impact III.c. Mitigation measures are described in Table 10-1. In addition, mitigation measures for these potential impacts are required in the Long-Term Irrigated Lands Regulatory Program WDRs.

Construction and operational activities: Construction and operational activities could potentially impact air quality. Construction activities that require earth-moving (e.g., installation of vegetated buffers, pressurized irrigation) could result in localized fugitive dust and/or emissions of criteria air pollutants from the exhaust of heavy equipment. Motor emissions of concern include criteria air pollutants such as ozone and ozone precursors such as reactive organic gases (ROGs) and NOX, PM10, and PM2.5. These potential impacts are expected to be less than significant with mitigation incorporated for Air Quality Impact III.c. Mitigation measures are described in Table 10-1. In addition, mitigation measures for these potential impacts are required in the Long-Term Irrigated Lands Regulatory Program WDRs.

Vegetation Management: Vegetation management practices such as planting cover crops, installing buffer strips, and allowing native vegetation to grow in field edges and ditches are unlikely to 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 because more vegetation cover should result in reduced potential for airborne particulates (e.g., PM2.5 and PM10) and volatilization (e.g., increase in ozone or ozone precursors).

Urban discharger management practices: The management practices recommended for urban dischargers, such as education and outreach and pollution prevention measures, are unlikely to 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 because these practices are unlikely to require increased vehicle trips or other measures that would increase air quality pollutants.

III.d) Pest management practices: Cultural practices could potentially increase PM2.5 and PM10 due to soil disturbance. Other potential impacts include an increase in VOCs and NOx from the use of tractors and mowers. Changes in pest management practices have potential to result in exposure of sensitive receptors to substantial pollutant concentrations because these activities are typically short-term and intermittent. Although there is a potential for air quality impacts due to pest management practices, they are expected to be less than significant with mitigation incorporated. Mitigation measures are described in Table 10-1. In addition, mitigation measures for these potential impacts are required in the Long-Term Irrigated Lands Regulatory Program WDRs.

The use of alternative pesticides is not expected to substantially increase pollutant concentrations; therefore, sensitive receptors will not be exposed to substantial pollutant concentrations. Although some air pollution have potential to occur as a result of the use of alternative pesticides (e.g., increase in VOCs), it is expected to be less than significant with mitigation incorporated. Mitigation measures are recommended in Table 10-1.

Water management: Changes in water management practices might result in an increase in air pollutant concentrations. For example, drier fields might result in an increase in PM2.5 and PM10. Also, there is potential for drier, warmer fields to result in

an increase in VOCs from volatile pesticides or formulations. The potential increase in these air pollutants is not expected to expose sensitive receptors to substantial pollutant concentrations because water management practices are unlikely to change substantially as a result of the proposed project. Impacts due to changes in water management practices are expected to be less than significant with mitigation incorporated for Air Quality Impact III.d. Mitigation measures are described in Table 10-1. In addition, mitigation measures for these potential impacts are required in the Long-Term Irrigated Lands Regulatory Program WDRs.

Construction and operational activities: Construction and operational activities are not expected to expose sensitive receptors to substantial pollutant concentrations because these activities are expected to be short-term and intermittent. Also, it is unlikely that the construction and operational activities would significantly increase as a result of the proposed amendment. Although there is a potential for air quality impacts due to construction and operational activities, they are expected to be less than significant with mitigation incorporated. Mitigation measures are described in Table 10-1. In addition, mitigation measures for these potential impacts are required in the Long-Term Irrigated Lands Regulatory Program WDRs.

Vegetation management: Vegetation management practices such as planting cover crops, installing buffer strips, and allowing native vegetation to grow in field edges and ditches are unlikely to expose sensitive receptors to substantial pollutant concentrations because more vegetation cover should result in reduced potential for airborne particulates (e.g., PM2.5 and PM10) and volatilization (e.g., increase in ozone or ozone precursors).

Urban discharger management practices: The management practices recommended for urban dischargers, such as education and outreach and pollution prevention measures, are unlikely to expose sensitive receptors to substantial pollutant concentrations because these practices are unlikely to require increased vehicle trips or other measures that would increase air quality pollutants.

III.e) Pest management practices: Pest management practices are not expected to expose a substantial number of people to objectionable odors because such activities are likely to occur for short periods in areas with relatively small populations, and these activities, such as clearing mummy shells from orchard floors, are not known to create objectionable odors. Air Quality Impact III.e is expected to be less than significant.

The use of alternative pesticides is expected to result in impacts that are less than significant because large-scale pesticide use occurs in areas with relatively low populations, thus any potential objectionable odors of alternative pesticides are unlikely to affect a substantial number of people. Air Quality Impact III.e is expected to be less than significant.

Water management: Changes in water management could result in impacts to air quality. Drier croplands and landscaped areas might result in greater potential for airborne particulates (e.g., PM2.5 and PM10), but are not expected to create objectionable odors affecting a substantial number of people. Air Quality Impact III.e is expected to be less

than significant.

Construction and operational activities: Construction and operational activities are not expected to expose a substantial number of people to objectionable odors because such activities are likely to occur for short periods in areas with relatively small populations. Air Quality Impact III.e is expected to be less than significant.

Vegetation management: Vegetation management practices such as planting cover crops, installing buffer strips, and allowing native vegetation to grow in field edges and ditches are not known to create any objectionable odors. Air Quality Impact III.e is expected to be less than significant.

Urban discharger management practices: The management practices recommended for urban dischargers, such as education and outreach and pollution prevention measures, are unlikely to expose a substantial number of people to objectionable odors because these practices are unlikely to produce objectionable odors. Air Quality Impact III.e is expected to be less than significant.

Table 10-1 Potential Air Quality Impacts and Associated Mitigation Measures

Management Practices Implemented to Comply with Proposed BPA	Potentially Significant Impacts	Mitigation Measures and Alternatives
Dischargers might use alternative pesticides that impact air quality.	Changes in pesticide use could result in improved water quality, but could lead to impacts to air quality, including particulate matter such as ozone, ozone precursors, PM_{10} and $PM_{2.5}$, and volatile toxic substances. (Air Quality Impacts a, b, c, and d)	Mitigation Measure III.1: Avoid and mitigate for potential impacts to air quality caused by alternative pesticide use. ▪ DPR has several air programs that implement requirements to reduce air quality impacts. Programs include: • Toxic Air Contaminants • Volatile Organic Compounds Emissions • Fumigants ▪ In addition, in non-attainment areas, the Air Pollution Control Districts develop implementation plans to reduce air impacts and improve air quality.
Dischargers might change water management practices to reduce discharges.	Changes to agricultural water management practices should result in improved water conservation, but could lead to drier croplands and landscaped areas, hence, a greater potential for airborne particulates and increased volatilization of toxic substances. (Air Quality Impacts a, b, c, and d.)	Mitigation Measure III.2: Avoid and mitigate for potential impacts to air quality caused by water management practices. ▪ Careful application and timing of water or dust suppression chemicals, planting of cover crops, and conservation tillage. Water management practices must be done in compliance with applicable air quality plans.

Dischargers might construct or operate management features (e.g., construct tailwater recovery systems or install pressurized irrigation or operate diesel- power pumps).	▪ Earthmoving-based management practices could result in short-term, localized fugitive dust or emissions of criteria air pollutants from the exhaust of heavy equipment. (Air Quality Impacts a, b, c, and d.) ▪ Motor emissions from construction activities might include criteria air pollutants and ozone precursors of concern such as ROG and NO_X and particulate matter including PM_{10} and $PM_{2.5}$. (Air Quality Impacts a, b, c, and d) ▪ Diesel emissions or emissions from other engines might include criteria air pollutants and precursors of primary concern, including ozone precursors such as ROGs and NO_X, and particulate matter such as PM_{10}, and $PM_{2.5}$. (Air Quality Impacts a, b, c, and d)	Mitigation Measure III.3: Avoid and mitigate for potential air quality impacts caused by construction or operations of management features. ▪ Facilities are required to comply with the rules and regulations from the applicable AQMD or APCD, and all equipment should be maintained in proper working condition according to manufacturer's specifications. As required by the ILRP WDRs: ▪ Limit idling time for commercial vehicles, including delivery and construction vehicles. ▪ Use low- or zero-emission vehicles, including construction vehicles.
Dischargers might change pest management practices.	Some pest management practices (e.g., clearing or destroying mummy hulls in almond orchards) might result in emissions including criteria pollutants and precursors of primary concern, including ozone precursors such as ROGs and NO_x, particulate matters ($PM_{2.5}$ and PM_{10}). (Air Quality impacts a, b, c, and d).	Mitigation Measure III.4: Avoid and mitigate for potential air quality impacts caused by pest management practices. Pest management practices that include use of vehicles that release emissions should be implemented using the following BMPs, as applicable: ▪ Comply with the rules and regulations from the applicable Air Quality Management District (AQMD) or Air Pollution Control District (APCD). ▪ Minimize idling time either by shutting equipment off when not in use or reducing the time of idling. ▪ Maintain all equipment in proper working condition according to manufacturer's specifications. ▪ Use electric equipment when possible. ▪ Implement water management practices to reduce particulate matter and fugitive dust.
Dischargers might implement pesticide management practices.	Use of aerial drift retardants could affect air quality (e.g., VOCs, ROGs and NO_x)	Mitigation Measure III.5: Avoid and mitigate for potential impacts to air quality caused by pesticide management practices. ▪ Comply with label requirements. ▪ Consult DPR and State and local air districts regarding the use of aerial drift retardants.

Environmental resource Category	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
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 regulations, 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, or regulations or by the California Department of Fish and Game or U.S. 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?	☐	☒	☐	☐
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?	☐	☒	☐	☐

IV) The proposed amendment is designed to benefit biological resources by reducing pyrethroid pesticides in surface waters and sediments.

IV.a) The Sacramento and San Joaquin River Basins encompass thousands of acres of wetlands and marshes, and hundreds of species of birds and fish inhabit these watersheds. Seasonal wetlands and rice fields provide habitat for migratory birds of the Pacific Flyway, such as the state-listed Greater Sandhill Crane. In addition, several anadromous fish species such as American shad, salmon, steelhead trout, striped bass, and sturgeon reside in the low-elevation rivers and streams during at least part of their life cycle, or pass through these water bodies on their way upstream to spawn. Many of the species that reside in or migrate through the Delta's wetland and upland areas are federally- or state-listed as endangered, threatened, rare, or candidate species. It is not expected that practices implemented to comply with the proposed amendment will have

a substantial adverse effect on any species identified as a candidate, sensitive, or special-status species.

Pest management: Most pest management practices will be implemented on existing agricultural lands or within urbanized areas. While agricultural lands are unlikely to support native or special-status plants, they might provide habitat for special-status birds or other animals. Urbanized areas might support native vegetation or special-status plants and animals. Pest management practices, such as the use of alternative pesticides have potential to result in special status species being exposed to these pesticides; therefore, there is potential for alternative products to cause impacts on biological resources, including special-status fish, invertebrate species, and possibly fish, particularly if the alternative is more toxic to those species than pyrethroids or is bioaccumulative. Impacts to Biological Resources IV.a are potentially significant. Impacts are expected to be less than significant with mitigation incorporated. Mitigation measures are described in Table 10-2.

Pesticide application management: Changes to pesticide management practices are not expected to impact special-status species because these practices are designed to reduce impacts of pesticides on non-target areas. These practices might include increased frequency of calibration of sprayer nozzles, turning off airblast sprayers at row ends in orchards, and other practices designed to minimize drift and off-site movement of pesticides. Impacts to biological resources due to changes in pesticide management practices are expected to be less than significant.

Water management: It is possible that changes in water management practices could result in changes in the volume of water discharged to surface water. It is anticipated that the loss of sensitive communities or special-status species resulting from reduced runoff would be minimal because habitats only present during times of irrigation are unlikely to support sensitive communities or special-status species; however, there is insufficient information to fully assess what the impacts might be. Impacts on Biological Resources Impact IV.a may be potentially significant even with mitigation incorporated. Mitigation measures are described in Table 10-2.

Construction and operational activities: Construction activities have potential to impact special-status species by causing sediment discharges to surface water due to earth-moving activities and habitat destruction in the process of construction. It is also possible that the construction of buffers might occur on portions of agricultural fields that are not in production where habitat might exist. Although significant habitat destruction is unlikely, impacts from sediment discharges such as smothering fish eggs, is possible; therefore, mitigation measures that are expected to reduce potential impacts to less than significant are described in Table 10-2.

Urban discharger management practices: The management practices recommended for urban dischargers, such as education and outreach and pollution prevention measures, are unlikely to have a substantial adverse effect on any species identified as a

candidate, sensitive, or special-status species because these practices are unlikely to alter habitat for these species.

IV.b) Pest management: Changes in pest management practices might have an effect on riparian habitat or other sensitive natural communities, but impacts are likely to be less than significant because these practices would likely occur on existing agricultural land, landscaped areas, and at municipal sites, which are unlikely to be in previously undisturbed riparian habitat or sensitive natural communities. Although potential impacts cannot be quantified, they are expected to be less than significant with mitigation incorporated. Mitigation measures are described in Table 10-2.
The use of alternative pesticides could result in impacts on riparian habitat or other sensitive natural communities due to contaminated runoff or spray drift affecting these areas; however, impacts are not expected to be significant when mitigation is incorporated. The impact to Biological Resources Impact IV.b will be less than significant with mitigation incorporated. Mitigation measures are described in Table 10-2.

Pesticide application management: Changes in pesticide management practices are not expected to have an impact on riparian habitat or other sensitive natural communities as these practices are designed to reduce applications to and impacts on non-target areas. These practices might include increased frequency of calibration of sprayer nozzles, turning off airblast sprayers at row ends in orchards, and other practices designed to minimize drift and off-site movement of pesticides. Impacts to biological resources due to pesticide management are expected to be less than significant.

Water management: Changes in water management practices could affect riparian habitat or other sensitive natural communities and this impact may be potentially significant. Water management practices have potential to change significantly in some agricultural areas as a result of the proposed amendment, which could result in reduced runoff that has potential to reduce riparian habitat in areas that rely entirely or almost entirely on agricultural runoff. Impacts on Biological Resources Impact IV.b may be potentially significant even with mitigation incorporated. Mitigation measures are described in Table 10-2.

Construction and operational activities: Construction activities might have an impact on riparian habitat or other sensitive natural communities; however, potential impacts are not expected to be substantial because construction activities will be short-term and intermittent. Similarly, operational activities are unlikely to result in substantial adverse effects because these activities are likely to be implemented on existing agricultural land, landscaped areas, and municipal sites that are unlikely to be in riparian habitat or sensitive communities. Potential impacts are expected to be less than significant with mitigation incorporated. Mitigation measures are described in Table 10-2.

Urban discharger management practices: The management practices recommended for urban dischargers, such as education and outreach and pollution prevention measures,

are unlikely to have an effect on riparian habitat or other sensitive natural communities because these practices are unlikely to alter habitat or natural communities.

IV.c) Pest management: Changes to pest management practices are not likely to affect federally protected wetlands because these practices will be implemented on pre-existing agricultural land, landscaped areas, and municipal sites, not in federally protected wetlands. Although impacts are not expected, management practices are described in Table 10-2 that are expected to reduce impacts to the maximum extent possible. Potential impacts are expected to be less than significant with mitigation incorporated.

If alternative pesticides are discharged to federally protected wetlands, there is a potential for effects because pesticides can have adverse impacts on water quality. Potential impacts are expected to be less than significant with mitigation incorporated. Mitigation measures are described in Table 10-2.

Pesticide application management: Changes in pesticide management practices are not expected to have an impact on federally protected wetlands as these practices are designed to reduce applications to and impacts on non-target areas. These practices might include increased frequency of calibration of sprayer nozzles, turning off airblast sprayers at row ends in orchards, and other practices designed to minimize drift and off-site movement of pesticides. Impacts to biological resources due to pesticide management are expected to be less than significant.

Water management: Changes in water management practices could impact federally protected wetlands if there is a significant change in the volume of runoff. A reduction in the volume of water discharged could result in a reduction of the size of the wetland or cause the wetland to dry out. Water management practices have potential to change significantly in some agricultural areas as a result of the proposed amendment, which could result in reduced runoff that has potential to reduce wetland habitat in areas that rely entirely or almost entirely on agricultural runoff. Impacts on Biological Resources Impact IV.c may be potentially significant even with mitigation incorporated. Mitigation measures are described in Table 10-2.

Construction and operational activities: Construction activities have potential to affect federally protected wetlands because sediment can be discharged during construction activities and, although highly unlikely, construction could occur in protected areas. Construction and operational activities are expected to occur on existing agricultural land, landscaped areas, and at municipal sites and are unlikely to affect federally protected wetlands. Due to the potential for impacts, mitigation measures are described in Table 10-2. Potential impacts are expected to be less than significant with mitigation incorporated.

Urban discharger management practices: The management practices recommended for urban dischargers, such as education and outreach and pollution prevention measures,

are unlikely to affect federally protected wetlands because these practices are unlikely to result in alteration to wetlands.

IV.d) Pest management: Changes to pest management practices are unlikely to interfere with the movement of 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 because these practices will largely be implemented on existing agricultural lands, landscaped areas, and at municipal sites. Potential impacts are expected to be less than significant with mitigation incorporated. Mitigation measures are described in Table 10-2.

The use of alternative pesticides is unlikely to 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. If alternative pesticides enter such habitats, potential impacts like site avoidance or behavioral changes might occur, therefore mitigation measures are described in Table 10-2. Potential impacts are expected to be less than significant with mitigation incorporated.

Pesticide application management: Changes in pesticide management practices are not expected to interfere with the movement of 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 as these practices are designed to reduce applications to and impacts on non-target areas. These practices might include increased frequency of calibration of sprayer nozzles, turning off airblast sprayers at row ends in orchards, and other practices designed to minimize drift and off-site movement of pesticides. Impacts to biological resources due to pesticide management are expected to be less than significant.

Water management: Changes in water management practices have potential to impact the movement of 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. It is possible for water management practices to interfere with the movement of native resident or migratory fish if water releases are not adequate to provide suitable habitat for fish. Similarly, water management could interfere with the movement of native resident or migratory wildlife species, such as migratory birds, if previously-existing habitat, such as rivers, streams, ponds, and lakes, are impacted by water management practices. Water management practices have potential to change significantly in some agricultural areas as a result of the proposed amendment, which could result in reduced runoff that has potential to reduce suitable habitat in areas that rely entirely or almost entirely on agricultural runoff. Impacts on Biological Resources Impact IV.d may be potentially significant even with mitigation incorporated. Mitigation measures are described in Table 10-2.

Construction and operational activities: Construction and operational activities have potential to interfere with the movement of 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. Specifically, construction and operational activities could result in the discharge of sediment to surface water. This could impact aquatic organisms including native resident or migratory fish and could impede the use of native wildlife nursery sites. Additionally, the sound that is generated by construction and operational activities could affect the movement of native resident or migratory wildlife species, such as migratory birds. Potential impacts are expected to be less than significant with mitigation incorporated. Mitigation measures are described in Table 10-2.

Urban discharger management practices: The management practices recommended for urban dischargers, such as education and outreach and pollution prevention measures, are unlikely to interfere with the movement of 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 because these practices are unlikely to result in environmental modifications.

IV.e) Pest management practices, including alternative pesticides, pesticide application practices, water management, vegetation management, and associated construction and operational activities are unlikely to conflict with local policies or ordinances that protect biological resources because they are likely to be implemented in existing agricultural lands, landscaped areas, and at municipal sites with relatively few immediate biological resources to protect (e.g., trees). However, such policies and ordinances should be considered on a case-by-case basis so as to minimize impacts to the maximum extent possible. Potential impacts are expected to be less than significant with mitigation incorporated. Mitigation measures are described in Table 10-2.

IV.f) Pest management practices, including alternative pesticides, pesticide application practices, water management, vegetation management, and associated construction and operational activities are unlikely to conflict with provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan because they are likely to be implemented in existing agricultural lands, landscaped areas, and at municipal sites. However, such policies and ordinances should be considered on a case-by-case basis so as to minimize impacts to the maximum extent possible. Potential impacts are expected to be less than significant with mitigation incorporated. Mitigation measures are described in Table 10-2.

Table 10-2 Potential Biological Resource Impacts and Associated Mitigation Measures

Management Practices Implemented to Comply with Proposed BPA	Potentially Significant Impacts	Mitigation Measures and Alternatives
Dischargers might implement pest management practices, such as removal of pest habitat (e.g., orchard sanitation).	▪ This management practice could adversely affect riparian habitat and/or candidate, sensitive, or special-status species that depend on agricultural runoff (Possible Biological Resource Impact a, b).	Mitigation Measure: IV.1: Avoid and mitigate for potential impacts to biological resources caused by pest management practices. ▪ Avoid and minimize disturbance of riparian and other sensitive vegetation communities. ▪ Avoid and minimize disturbance to areas containing special-status plant or animal species. ▪ Where adverse effects on sensitive biological resources cannot be avoided, undertake additional CEQA review and develop a restoration or compensation plan to mitigate the loss of the resources ● Applicable policies, ordinances, and plans should be considered on a case-by-case basis so as to minimize impacts to the maximum extent possible.
Dischargers might use alternative pesticides that have potential to result in impacts to biological resources.	▪ Alternative pesticide use could adversely affect riparian habitat and/or candidate, sensitive, or special-status species that depend on agricultural runoff (Possible Biological Resources Impacts a, b). ▪ These management practices could have a substantial effect on federally protected wetlands as defined by section 404 of the Clean Water Act (Possible Biological Resources Impact c). ▪ These management practices could result in site avoidance, behavioral changes, or other impacts to fish and wildlife species (Possible Biological Resources Impact d). ▪ These management practices could potentially conflict with a local policy or ordinance that protects biological resources, an adopted Habitat conservation Plan, Natural	Mitigation Measure IV.2: The potential impacts of alternative pesticides on biological resources should be considered prior to the selection of an alternative pesticide. ▪ Seeking advice from a Certified Crop Advisor, Integrated Pest Management Specialist, or consultation with the Central Valley Water Board and/or DPR is recommended. ▪ When selecting an alternative pesticide, consider less toxic alternatives and evaluate 303(d) listings of impaired waters in the area where application will occur.

	Community Conservation Plan, or other approved local, regional, or state habitat conservation plan. (Possible Biological Resources Impact e and f).	
In order to prevent discharges of pyrethroid pesticides from entering surface waters, dischargers might implement water management practices that reduce agricultural runoff, such as recirculating water, or further limiting the application of irrigation water.	▪ These management practices could adversely affect riparian habitat and/or candidate, sensitive, or special-status species that depend on agricultural surface runoff (Biological Resources Impacts a, b). ▪ These management practices could have a substantial effect on federally protected wetlands as defined by section 404 of the Clean Water Act (Possible Biological Resources Impact c). ▪ These management practices have potential to substantially interfere with the movement of 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 if water releases are inadequate to provide suitable habitat for fish or wildlife (Possible Biological Resources Impact d). ▪ These management practices could potentially conflict with a local policy or ordinance that protects biological resources, an adopted Habitat conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan. (Possible Biological Resources Impact e and f).	<u>Mitigation Measure IV.3</u>: Avoid and mitigate for potential impacts to biological resources caused by water management practices. ▪ Where alternatives exist for preserving riparian habitat created by agricultural runoff, dischargers shall explore ways to preserve that habitat. Applicable policies, ordinances, and plans should be considered on a case-by-case basis so as to minimize impacts to the maximum extent possible. ▪ Regulated entities shall conduct a delineation of affected wetland areas to determine the acreage of loss in accordance with current United States Army Corps of Engineers (USACE) methods prior to implementing any management practice that will result in the permanent loss of wetlands. For compliance with the Clean Water Act section 404 permits and WDRs, compensation should be made for the permanent loss (fill) of wetlands to ensure no net loss of habitat functions and values for non-farming actives. Compensation ratios will be determined through coordination with the Central Valley Water Board and USACE as part of the permitting process. Compensation might be a combination of mitigation bank credits and restoration/creation of habitat, as described below: ▪ Purchase credits for the affected wetland type (e.g., perennial marsh, seasonal wetland) at a locally approved mitigation bank and provide written evidence to the resource agencies that compensation has been established through the purchase of mitigation credits. ▪ Develop and ensure implementation of a wetland restoration plan that involves creating or enhancing the affected wetland type. ▪ Avoid and minimize disturbance

		to areas containing special-status plant or animal species. ▪ Where adverse effects on sensitive biological resources cannot be avoided, undertake additional CEQA review and develop a restoration or compensation plan to mitigate the loss of the resources. ▪ Where construction in areas that might contain special-status fish species cannot be avoided through the use of alternative management practices, conduct an assessment of habitat conditions and the potential for presence of special-status fish species prior to construction; this might include the hiring of a qualified fisheries biologist to determine the presence of special-status fish species. ▪ Based on the species present in adjacent water bodies and the likely extent of construction work that might affect fish, limit construction to periods that avoid or minimize impacts to special-status fish species. ▪ Where construction periods cannot be altered to minimize or avoid effects on special status fish, the grower's coverage under this Order is not authorized. The grower must then apply for its own individual waste discharge requirements. Issuance of individual waste discharge requirements would constitute a future discretionary action by the board subject to additional CEQA review.
Dischargers might need to construct and operate features such as tailwater recovery systems, small-scale wetlands, or retention ponds (typically less than 5-acres) to prevent pyrethroid pesticides discharges from entering surface waters.	▪ Construction activities could adversely affect riparian habitat and/or candidate, sensitive, or special-status species that depend on agricultural surface runoff (Possible Biological Resources Impacts a, b). ▪ These management practices could have a substantial effect on federally protected wetlands as defined by section 404 of the Clean Water Act (Possible Biological Resources Impact c). ▪ These management practices could result in discharges of sediment that could cause impacts on aquatic	<u>Mitigation Measure IV.4:</u> Avoid and mitigate for potential impacts to biological resources caused by construction and/or operation of management features. As required by the ILRP WDRs: o Where detention basins are to be abandoned, retain the basin in its existing condition or ensure that sensitive biological resources are not present before modification. o Where construction in areas that might contain sensitive biological resources cannot be avoided through the use of alternative management practices, conduct an

		resources, including fish eggs (Possible Biological Resources Impact d). ▪ These management practices could potentially conflict with a local policy or ordinance that protects biological resources, an adopted Habitat conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan. (Possible Biological Resources Impact e and f).	assessment of habitat conditions and the potential for presence of sensitive vegetation communities or special-status plant and animal species prior to construction. this might include the hiring of a qualified biologist to identify riparian and other sensitive vegetation communities and/or habitat for special status plant and animal species; o Avoid and minimize disturbance of riparian and other sensitive vegetation communities. o Avoid and minimize disturbance to areas containing special-status plant or animal species. o Where adverse effects on sensitive biological resources cannot be avoided, undertake additional CEQA review and develop a restoration or compensation plan to mitigate the loss of the resources. o Purchase credits for the affected wetland type (e.g., perennial marsh, seasonal wetland) at a locally approved mitigation bank and provide written evidence to the resource agencies that compensation has been established through the purchase of mitigation credits. o Develop and ensure implementation of a wetland restoration plan that involves creating or enhancing the affected wetland type. ▪ Where construction in areas that might contain special-status fish species cannot be avoided through the use of alternative management practices, conduct an assessment of habitat conditions and the potential for presence of special-status fish species prior to construction; this might include the hiring of a qualified fisheries biologist to determine the presence of special-status fish species. ▪ Based on the species present in adjacent water bodies and the likely extent of construction work that might affect fish, limit

	construction to periods that avoid or minimize impacts to special-status fish species. ▪ Where construction periods cannot be altered to minimize or avoid effects on special status fish, the grower's coverage under this Order is not authorized. The grower must then apply for its own individual waste discharge requirements. Issuance of individual waste discharge requirements would constitute a future discretionary action by the board subject to additional CEQA review.

Environmental resource Category	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
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 or site or unique geological feature?	☐	☒	☐	☐
d) Disturb any human remains, including those interred outside of formal cemeteries?	☐	☒	☐	☐

V) Cultural resources include historical or archaeological resources, unique paleontological resources, geological features, or human remains (Pub. Res. Code, § 21159). Implementation of management practices to comply with the proposed amendment are unlikely to affect cultural resources, as most of the management practices will likely disturb only previously-developed agricultural and municipal areas and landscaped spaces. Additional areas are not expected to be disturbed. Because projects undertaken to comply with the requirements of the proposed amendment will not affect any known cultural resources, any potential impacts to cultural resources would occur as a result of construction occurring where previously-undiscovered cultural resources are located. The potential impacts of implementing management practices on cultural resources are expected to be less than significant with mitigation incorporated. Mitigation measures are described in Table 10-3.

V.a) Pest management practices, including the use of alternative pesticides, pesticide application practices, water management practices, vegetation management practices, associated construction and operational activities, and other practices implemented as a result of the proposed amendment are unlikely to cause a substantial adverse change in the significance of a historical resource as defined in §15064.5 because most activities will occur on agricultural lands, landscaped areas, and at municipal sites – all of which have typically undergone past disturbance and are unlikely to contain historical resources. Impacts might occur during construction if construction takes place on previously undisturbed sites; therefore, no impacts to historic resources and archaeological resources are expected.

V.b) Pest management practices, including the use of alternative pesticides, pesticide application practices, water management practices, vegetation management practices, associated construction and operational activities, and other practices implemented as a result of the proposed amendment are unlikely to cause a substantial adverse change in the significance of an archaeological resource pursuant to §15064.5 because most activities will occur on agricultural lands, landscaped areas, and at municipal sites – all of which have

typically undergone past disturbance and are unlikely to contain archaeological resources.; therefore, no impact is expected.

V.c) Pest management practices, including the use of alternative pesticides, pesticide application practices, water management practices, vegetation management practices, associated construction and operational activities, and other practices implemented as a result of the proposed amendment are unlikely to directly or indirectly destroy a unique paleontological resource or site or unique geological feature because most activities will occur on agricultural lands, landscaped areas, and at municipal sites – all of which have typically undergone past disturbance and are unlikely to contain archaeological resources. In the unlikely case that a direct or indirect destruction of a unique paleontological resource or site or unique geological feature occurs, mitigation measures are available to reduce impacts. Potential impacts are expected to be less than significant with mitigation incorporated. Mitigation measures are described in Table 10-3.

V.d) Pest management practices, including the use of alternative pesticides, pesticide application practices, water management practices, vegetation management practices, associated construction and operational activities, and other practices implemented as a result of the proposed amendment are unlikely to disturb any human remains, including those interred outside of formal cemeteries because most activities will occur on agricultural lands, landscaped areas, and at municipal sites – all of which have typically undergone past disturbance and are unlikely to contain such remains. In the unlikely case that human remains are disturbed, mitigation measures are recommended. Potential impacts are expected to be less than significant with mitigation incorporated. Mitigation measures are described in Table 10-3.

Table 10-3 Potential Cultural Resource Impacts and Associated Mitigation Measures

Management Practices Implemented to Comply with Proposed BPA	Potentially Significant Impacts	Mitigation Measures and Alternatives
Dischargers might need to construct features such as tailwater recovery systems, small-scale wetlands, or retention ponds (typically less than 5 acres) to prevent pyrethroid pesticides discharges to surface waters.	Construction activities could adversely affect previously undiscovered archaeological resources, unique paleontological resources, geological features, or human remains (Possible Cultural Resources Impacts a, b, c, and d)	▪ Mitigation Measure V.1: Avoid and mitigate for potential impacts to cultural resources caused by construction and/or operation of management features. These measures are required in ILRP WDRs and are also summarized in the Programmatic EIR (ICF International 2010, 2011). ▪ Where construction within areas that are likely to contain cultural resources cannot be avoided, conduct an assessment of the potential damage to cultural resources prior to construction; this might include hiring a qualified cultural resources specialist to identify evidence of cultural resources and to observe major excavation and earth-moving activities. ▪ Where assessment indicates that damage might occur, submit a non-confidential records search request to the appropriate California Historical Resources Information System information center and implement their recommendation. ▪ Where adverse effects to cultural resources cannot be avoided, develop site-specific mitigation measures to avoid or minimize the potential impacts. ▪ Additionally, pursuant to California Health and Safety Code and Public Resources Code: o If any archaeological, paleontological, or historical resources are discovered during construction activities, construction should stop within the vicinity of the find and a qualified cultural resources specialist should assess the significance of the resources. If necessary, the cultural resources specialist will develop appropriate treatment measures for the find. o If any human remains are discovered during construction activities, no further excavation or other site disturbance shall take place. The local coroner must make a determination as to whether the remains are of Native American origin, or whether an investigation into the cause of death is required. If Native American remains are identified and descendants are found, the descendants may inspect the site of the discovery of the remains. The descendants may recommend means for treating or disposing of the remains within 48 hours of inspecting them. If the landowner rejects the recommendation of the descendants, the descendants fail to make a recommendation, or no descendants are identified, then the landowner re-inters the remains and any items associated with the Native American burials on the property in a location not subject to future subsurface disturbance.

Environmental resource category	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
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?	☐	☐	☐	☒
e) Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater?	☐	☐	☐	☒

VI) Implementation of management practices to comply with the proposed amendment would result in a beneficial effect, if any, on geology and soils, although there could be some localized impacts on erosion during construction and maintenance activities. Management practices will likely reduce soil erosion and sediment discharges and should result in improved water conservation.

VI.a) Pest management practices, including the use of alternative pesticides, pesticide application practices, water management practices, vegetation management practices, and associated construction and operational activities, are standard practices that are not expected to expose people or structures to potential adverse effects such as rupture of a known earthquake fault, strong seismic ground shaking, seismic-related ground failure, or landslides because they cannot generate adequate energy to result in seismic impacts. No significant seismic impacts are expected.

VI.b) The use of alternative pesticides or pesticide application management practices are unlikely to result in substantial soil erosion or the loss of topsoil. Pest management

practices, water management practices, vegetation management practices, and associated construction and operational activities have potential to result in soil erosion or the loss of topsoil. Any activities undertaken to comply with the proposed amendment that might disturb soils or sediments must comply with existing Basin Plan narrative water quality objectives for sediment and turbidity. Potential impacts are expected to be less than significant with mitigation incorporated. Mitigation measures are described in Table 10-4.

VI.c) The foreseeable management practices including pest management, pesticide application management, water management, vegetation management, and associated construction and operational activities implemented as a result of the proposed amendment are unlikely to be located on a geologic unit or soil that is unstable. Furthermore, it is unlikely that the geologic unit or soil on which a management practice is implemented would become unstable because the intent of management practices would be to stabilize the soil to reduce sediment and storm water runoff. Therefore, practices should not result in on- or off-site landslides, lateral spreading, subsidence, liquefaction or collapse; no impact is expected.

VI.d) The implementation of management practices including pest management, pesticide application management, water management, vegetation management, and associated construction and operational activities, and other foreseeable control measures implemented as a result of the proposed amendment are unlikely to be located on expansive soil, creating substantial risks to life or property because practices will be largely implemented on existing agricultural lands, landscaped areas, and at municipal sites; no impact is expected.

VI.e) The foreseeable management practices implemented as a result of the proposed amendment would not cause soils to be incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater because it is unlikely that practices will be implemented in areas where this would be a concern and these practices and alternative pesticides would not significantly impact the soils' capability of supporting these systems. No impacts are expected for Geology and Soils Impact VI.e.

Table 10-4 Potential Geology and Soil Resource Impacts and Associated Mitigation Measures

Management Practices Implemented to Comply with Proposed BPA	Potentially Significant Impacts	Mitigation Measures and Alternatives
Water management and pest management practices, and associated construction and operational activities might result in soil erosion or the loss of topsoil.	▪ Soil erosion or the loss of topsoil. (Possible Geology and Soil Resources Impact b).	Mitigation Measure VI.1: Avoid and mitigate the potential impacts of water management practices, pest management practices, and associated construction and operational on soil erosion or the loss of topsoil. Construction activities will be regulated under either ILRP WDRS or storm water permits; these documents include provisions to prevent erosion.

Environmental resource Category	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
VII. GREENHOUSE GAS EMISSIONS. Would the Project:				
a) Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?	☐	☐	☒	☐
b) Conflict with any applicable plan, policy or regulation of an agency adopted for the purpose of reducing the emissions of greenhouse gases?	☐	☐	☒	☐

VII) Global climate change refers to observed changes in weather features that occur across the entire Earth, such as temperature, wind patterns, precipitation, and storms, over a long period. Global temperatures are regulated by naturally-occurring atmospheric gases, such as water vapor, carbon dioxide, methane, and nitrous oxide. These gases allow sunlight into the Earth's atmosphere, but prevent radiative heat from escaping into outer space, thus altering Earth's energy balance in a phenomenon called the "greenhouse effect." The term "natural greenhouse effect" refers to how greenhouse gases trap heat within the troposphere. The term "enhanced greenhouse effect" refers to an increased concentration of greenhouse gases (GHGs), which results in an increase in temperature of the surface-troposphere system.

VII.a) The three GHGs that could be generated during some agricultural practices are carbon dioxide, methane, and nitrous oxides. The primary source of GHG emissions related to management practices implemented to comply with the proposed amendment will be from construction and operational activities that require the use of fossil fuels. Expected construction activities include construction of retention ponds, which should only require short-term use of motorized equipment. Diesel-powered pumps for tailwater recovery systems might also generate a small volume of GHGs. These GHG emissions are expected to be transitory and in many cases short-term. A secondary source of GHG emissions is related to vehicle trips to conduct required monitoring. However, because thorough monitoring of surface water bodies and of agricultural management practices is already standard practice for most agricultural operations, additional vehicle miles would represent an insignificant contribution to GHG emissions. Surface water monitoring is also already required for NPDES dischargers, so additional vehicle miles would represent an insignificant contribution to GHG emissions for these dischargers as well. GHGs tend to accumulate in the atmosphere because of their relatively long lifespan. Consequently, their impact on the atmosphere is mostly independent of the point of emission. In other words, GHG emissions are more appropriately evaluated on a regional, state, or even national scale, rather than on a site-specific basis. No impacts are expected at the local level. Given the magnitude of state, federal, and national GHG emissions, it is unlikely that the relatively small volume of GHG emissions resulting from vehicle and equipment exhaust would result in a discernible effect on global climate change, consequently this impact is considered less than significant.

VII.b) Given the magnitude of state, federal, and national GHG emissions, it is unlikely that the relatively small volume of GHG emissions resulting from vehicle and equipment exhaust would

result in a discernible effect on global climate change or conflict with any applicable plan, policy, or regulation of an agency adopted for the purpose of reducing the emissions of greenhouse gases; consequently, this impact is considered less than significant on the global scale. Local impacts to air quality are expected to be less than significant.

Environmental Resource Category	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
VIII. HAZARDS AND HAZARDOUS MATERIALS. Would the Project:				
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 that is included on a list of hazardous materials sites compiled pursuant to Government Code §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.a) Implementation of management practices to comply with the proposed amendment is expected to reduce hazards to the public or the environment through the improper transport, release, use, disposal, or accidental dischargers of hazardous materials (e.g., pesticides). Management practices implemented to comply with the proposed amendment are expected to reduce pyrethroid pesticides discharges and to create fewer hazards to the public and the environment through the improper transport, release, use, or disposal of hazardous materials. Hazards could potentially result from the use of alternative pesticides; however, proper pesticide use and handling, including compliance with label requirements and regulations, should prevent impacts from hazards and hazardous materials. Likely pesticide alternatives to pyrethroids include abamectin, chlorpyrifos, chlorantraniliprole, diflubenzuron, dimethoate, fipronil, indoxacarb, malathion, methomyl, methoxyfenozide, pyriproxifen and spiromesifen,

depending on which pesticides are approved for particular crops or application sites. Chlorpyrifos has been proposed to be a restricted use pesticide because it has been identified as a surface water contaminant, as well as hazardous to human health (USEPA 2014). Chlorpyrifos has specific controls in the Basin Plan, therefore, widespread use of chlorpyrifos as an alternative to pyrethroids as a result of the proposed Basin Plan amendment is unlikely. The future use of each alternative pesticide is unknown; therefore, potential impacts could be significant. Impacts are expected to be less than significant with mitigation measures incorporated.

VIII.b) Water management and pest management practices are unlikely to create a significant hazard to the public or the environment by upset or accident conditions involving the release of hazardous materials into the environment. Construction and operational activities could result in impacts as well, but those impacts are also considered similar to baseline risks. The accidental release of alternative pesticides or an increase in use of aerial drift retardants could result in impacts; however those impacts are considered less than significant with mitigation incorporated.

VIII.c) The locations where emission or handling of hazardous or acutely hazardous materials, substances, or waste occurs are not expected to change as a result of this amendment, therefore, existing and/or proposed schools should not be affected. No impact is expected for Hazards and Hazardous Materials Impact VIII.c.

VIII.d) While management practices might be implemented on hazardous materials sites; their implementation is not expected to cause the sites' hazards to be exposed; therefore, a significant hazard to the public or the environment should not be created as a result of the proposed amendment. No impact is expected for Hazards and Hazardous Materials Impact VIII.d.

VIII.e) Management practices might be implemented on sites within an airport land use plan or close enough to a public airport or public use airport where impacts would be expected; however, implementation of management practices is not expected to pose a safety hazard for people residing or working in the proposed Project Area. No impact is expected for Hazards and Hazardous Materials Impact VIII.e.

VIII.f) Management practices might be implemented within the vicinity of a private airstrip; however, a safety hazard for people residing or working in the proposed Project Area should not result. No impact is expected for Hazards and Hazardous Materials Impact VIII.f.

VIII.g) Management practices are not expected to impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan. Potential impacts to Hazards and Hazardous Materials Impact VIII.g are considered less than significant.

VIII.h) Management practices are not expected to result in wildland fires because they, themselves do not contribute to increased fire risk; therefore, they are not expected to create conditions that are adequate to foster a wildland fire. Potential impacts to Hazards and Hazardous Materials Impact VIII.h are considered less than significant.

Table 10-5 Potential Hazards and Hazardous Materials Impacts and Associated Mitigation Measures

Management Practices Implemented to Comply with Proposed BPA	Potentially Significant Impacts	Mitigation Measures and Alternatives
Alternative pesticides might pose a hazard or contain hazardous materials.	▪ The routine transport, use, or disposal of hazardous materials or accident release of hazardous materials might occur. (Possible Hazards and Hazardous Materials Impacts a and b).	Mitigation Measure VIII.1: Avoid and mitigate the potential impacts of alternative pesticides on hazards and hazardous materials. • Follow all pesticide use and application requirements. • Properly transport, use, store, and dispose of pesticides.

Environmental resource Category	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
IX. HYDROLOGY AND WATER QUALITY. Would the Project:				
a) Violate any water quality standards or waste discharge requirements?	☐	☒	☐	☐
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 that 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 that results in flooding on- or off-site?	☐	☐	☒	☐
e) Create or contribute runoff water that exceeds the capacity of existing or planned storm water 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 that 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) The proposed amendment is designed to ensure that existing surface water quality impairments will improve through the implementation of management practices. Implementation of management practices or construction and maintenance operations implemented to comply with the proposed amendment have potential to affect hydrology or water quality.

IX.a) The proposed amendment is designed to improve water quality through the

implementation of management practices. Some management practices and/or associated construction, maintenance, and operations present the potential to violate water quality standards or waste discharge requirements. Mitigation measures are described in Table 10-6.

Pest management: Pest management practices, such as orchard sanitation, are not expected to result in a violation of any water quality standard or waste discharge requirement because such activities are not likely to involve irrigation or a discharge. No impacts are expected from pest management practices.

Based on the analysis in the staff report, likely replacement pesticides include abamectin, chlorpyrifos, chlorantraniliprole, diflubenzuron, dimethoate, fipronil, indoxacarb, malathion, methomyl, methoxyfenozide, pyriproxifen and spiromesifen, depending on which pesticides are approved for particular crops or application sites. Of these pesticides, chlorpyrifos already has 303(d) listings due to impairment of the aquatic life beneficial use in the Central Valley, although the majority of those listings are currently being addressed as a result of Basin Plan amendments addressing chlorpyrifos impairments. The Basin Plan currently contains water quality objectives for the protection of beneficial uses, including aquatic life and general provisions for the control of pesticide discharges from nonpoint sources. The proposed amendment includes provisions to assure that alternative pesticide use does not adversely affect water quality. The potential impacts to Hydrology and Water Quality Impact IX.a are expected to be less than significant because the amendment requires dischargers, in coordination with the Regional Water Board, USEPA, and DPR, to determine whether alternatives to pyrethroid pesticides are being discharged at concentrations that have the potential to cause or contribute to exceedances of applicable water quality objectives in order to promptly address emerging issues.

Pesticide application management: Pesticide application management practices such as turning off outward-facing airblast sprayer nozzles on the ends and outsides of rows, improving sprayer technologies, improving mixing and loading procedures, appropriately timing pesticide applications, and conducting more frequent calibration of sprayer equipment should benefit water quality by improving on-target applications and treatment rates; these practices are not expected to result in a violation of water quality standards or waste discharge requirements. The use of aerial drift retardants should also improve water quality by keeping pesticide applications on target. It is possible that some drift retardants could enter water bodies and cause impacts; therefore, mitigation measures are described. There is potential for some pesticide management practices to affect Hydrology and Water Quality Impact IX.a. Mitigation measures are described in Table 10-6.

Water management practices: Water management practices (e.g., irrigation water management, tailwater recovery systems, pressurized irrigation, and vegetated buffers) should benefit surface water quality by improving water application practices and reducing runoff. Irrigation water management and pressurized irrigation should improve both surface water quality and quantity and groundwater quality by applying water at a rate that allows for maximum plant consumption and minimum groundwater infiltration. Tailwater recovery systems collect surface runoff that might contain high concentrations of

pesticides and direct the water to a tailwater pond instead of to surface water. Tailwater recovery could increase infiltration, which could potentially result in impacts to groundwater. This potential impact is not of particular concern because none of the six pyrethroids are identified groundwater contaminants, however, several of the identified alternative pesticides have been identified as groundwater contaminants (Cal. Code Regs., tit. 3, § 6800); therefore the mitigation measures required by DPR for groundwater contaminants are described in Table 10-6. The potential impacts resulting from water management practices are expected to be less than significant with mitigation incorporated for Hydrology and Water Quality Impact IX.a. Mitigation measures are described in Table 10-6.

Urban discharger management practices: The management practices recommended for urban dischargers, such as education and outreach and pollution prevention measures, are unlikely to violate water quality standards or waste discharge requirements because these practices are likely to improve water quality and would be in compliance with NPDES permits.

IX.b) The implementation of water management practices (e.g., water conservation measures, installation of tailwater recovery ponds) might result in less groundwater recharge. The potential impacts resulting from water management practices are expected to be less than significant with mitigation incorporated for Hydrology and Water Quality Impact IX.b. Mitigation measures are described in Table 10-6.

IX.c) Water management practices (e.g., vegetated buffers, tailwater recovery, irrigation water management) could result in substantial changes in drainage patterns, the patterns would not increase erosion or siltation on or offsite or alter the course of a stream or river in a manner that would result in substantial erosion or siltation on- or off-site because these practices are implemented to reduce erosion and siltation; therefore, Hydrology and Water Quality Impact IX.c is expected to be less than significant.

IX.d) Water management practices (e.g., vegetated buffers, tailwater recovery, irrigation water management) could result in substantial changes in drainage patterns, but the patterns would not substantially increase the rate or amount of surface runoff in a manner that results in flooding on- or off-site because management practices will be engineered to reduce the rate and amount of surface runoff. Hydrology and Water Quality Impact IX.d is expected to be less than significant.

IX.e) Irrigation water management, pressurized irrigation, tailwater recovery systems, vegetated buffers, etc. are intended to reduce the volume and improve the quality of runoff; therefore, they are not likely to create or contribute runoff water that exceeds the capacity of existing or planned storm water drainage systems or provide substantial additional sources of polluted runoff. While the use of alternative products could result in additional sources of polluted runoff, regulatory processes exist through which such impacts would be mitigated. Hydrology and Water Quality Impact IX.e is expected to be less than significant with mitigation incorporated.

IX.f) Management practices are designed to improve water quality but some degradation of water quality could occur as summarized in previous subsections of the Hydrology and Water Quality section. The potential impacts to Hydrology and Water Quality Resources include “less than significant with mitigation incorporated”, “less than significant”, or “no impact”. Applicable mitigation measures are presented in Table 10-6.

IX.g) Management practices that will be implemented as a result of this amendment will not require the construction of housing, therefore, no impact is expected for Hydrology and Water Quality Impact IX.g.

IX.h) Management practices that will be implemented as a result of this amendment might be placed within a 100-year flood hazard area, however, the placed structures (e.g., pumps for tailwater recovery ponds, vegetated buffers) would be unlikely to significantly impede or redirect flood flows. Potential impacts are expected to be less than significant for Hydrology and Water Quality Impact IX.h.

IX.i) Management practices that will be implemented as a result of the proposed amendment are unlikely to cause flooding because they function to effectively slow and reduce storm water discharges and flooding; therefore, no impacts are identified for Hydrology and Water Quality Impact IX.i.

IX.j) Management practices and/or use of alternative pesticides is not expected to result in inundation by seiche, tsunami, or mudflow are not expected as a result of this amendment; therefore, no impacts are identified for Hydrology and Water Quality Impact IX.j.

Table 10-6 Potential Hydrology and Water Quality Impacts and Associated Mitigation Measures

Management Practices Implemented to Comply with Proposed BPA	Potentially Significant Impacts	Mitigation Measures and Alternatives
In order to prevent discharges of pyrethroid pesticides to surface waters, dischargers might implement water management practices and/or use alternative pesticides, or drift retardants.	▪ The infiltration of water with pesticides could negatively impact groundwater. (Possible Hydrology and Water Quality Impacts a and f) ▪ Changes in water management practices could cause impacts to groundwater recharge. (Possible Hydrology and Water Quality Impacts b)	Mitigation Measure IX.1: Avoid and mitigate for potential impacts to hydrology and water quality caused by water management practices as required in ILRP WDRs. ▪ Dischargers will work with the Central Valley Water Board and the DPR to design groundwater quality management plans to minimize waste discharge to groundwater from irrigated agricultural lands. The development of a groundwater quality management plan involves collection and evaluation of available groundwater data, identification of areas and constituents of concern, prioritization of the areas and constituents of concern, identification of the agricultural practices that may be causing or contributing to the problem, and those that should be implemented by dischargers to address the problem. The management plans will be reviewed by Central Valley Water Board staff, and approved only after implementation measures are found to be adequate to meet the requirements of the Basin Plan and the State Antidegradation Policy. ▪ In groundwater protection areas, the implementation of certain management practices is required by the DPR and the County Agricultural Commissioners for the use of 6800(a) pesticides (Cal. Code Regs, tit. 3, §6487). Mitigation Measure IX.2: Dischargers will work with the Central Valley Water Board, DPR, and County Agricultural Commissioners to manage impacts to groundwater supplies.
Dischargers might apply alternatives to pyrethroid pesticides (e.g., abamectin, chlorpyrifos, chlorantraniliprole, diflubenzuron, dimethoate, fipronil, indoxacarb, malathion, methomyl, methoxyfenozide, pyriproxifen and spiromesifen)	▪ Alternatives to pyrethroid pesticides could have a negative effect on water quality and aquatic organisms. (Possible Hydrology and Water Quality Impacts a, e, f)	Mitigation Measure IX.3: Dischargers should evaluate alternative pesticides for potential to result in groundwater contamination or violation of water quality standards through consultation with the Central Valley Water Board and DPR. Avoid and mitigate for potential impacts to hydrology and water quality caused by alternative pesticide use. ▪ As required by the Basin Plan amendment, determine whether alternatives to pyrethroid pesticides are being discharged at concentrations that have the potential to cause or contribute to exceedances of applicable water quality objectives. In groundwater protection areas, the implementation of certain management practices is required by the DPR and the County Agricultural Commissioners for the use of 6800(a) pesticides (Cal. Code Regs, tit. 3, §6487).

Dischargers might implement pesticide application management practices.	▪ Use of aerial drift retardants could impact water quality (Possible Hydrology and Water Quality Impacts a)	Mitigation Measure IX.4: Avoid and reduce mitigate for potential impacts to water quality caused by pesticide application management. ▪ Comply with label requirements ▪ The Water Board will consult DPR regarding the use of drift retardants and their potential impacts on surface water.

Environmental resource Category	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
X. LAND USE AND PLANNING. Would the Project:				
a) Physically divide an established community?	☐	☐	☐	☒
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) Implementation of the proposed amendment should not result in any changes in land use or planning (See II. Agricultural and Forestry Services).

X.a) Implementation of the proposed amendment will not physically divide an established community. No impact is expected for Land Use and Planning Impact X.a.

X.b) Implementation of the proposed amendment will not conflict with any applicable land use plan, policy, or regulation. No impact is expected for Land Use and Planning Impact X.b.

X.c) Alternative pesticides, water management activities, construction and operational activities, and pest control management practices are all unlikely to conflict with any applicable Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan because they are likely to be implemented in existing agricultural lands, and in urban areas. Potential impacts are expected to be less than significant for Land Use and Planning Impact X.c.

Environmental resource Category	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
XI. MINERAL AND ENERGY RESOURCES. Would the Project:				
a) Result in the loss of availability of a known mineral or energy 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) Implementation of management practices to comply with the proposed amendment would not result in the loss of any known mineral or energy resources. In most instances, practices will be implemented on previously disturbed agricultural and municipal areas which are unlikely to be sites with known surface mineral or energy resources or to be locally-important mineral resource recovery sites.

Environmental resource Category	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
XII. 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?	☐	☒	☐	☐
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) Management practices employed to satisfy the requirements of the proposed amendment might include a variety of construction activities to reduce runoff of pyrethroid pesticides. Use of heavy equipment, power tools, generators, and other equipment on irrigated lands could temporarily increase noise in the construction areas; as described in the ILRP-PEIR (ICF International 2010, 2011), these noises and/or vibrations are expected to have no impact or less than significant impacts with mitigation incorporated in the areas in which they are expected to occur. Mitigation measures are described in Table 10-7.

Table 10-7 Potential Noise Impacts and Associated Mitigation Measures

Management Practices Implemented to Comply with Proposed BPA	Potentially Significant Impacts	Mitigation Measures
Dischargers might generate noise during construction and operation of management practices.	▪ Noise impacts XII a. – f.	Mitigation Measure XII.1: Avoid and mitigate for potential impacts to noise caused by construction and /or operation of management features following guidance in the ILRP PEIR (ICF International 2010, 2011). • Growers will implement noise-reducing mitigation measures to ensure compliance with local noise standards, ordinances, and general plan noise elements. Reduce noise generated by individual well pumps.

Environmental Resource Category	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
XIII. 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) The proposed amendment will not result in changes or any actions that would directly or indirectly induce population growth in the area, displace existing housing, or displace people. Adopting these regulations does not ban or cancel uses of pyrethroids, and if people choose to stop using them in order to attain the water quality objectives, integrated pest management may be implemented or alternative pesticides are available for use. Therefore, no significant impacts are expected.

Environmental resource Category	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
XIV. PUBLIC SERVICES.				
a) Would the Project result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities or the 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) The implementation of the proposed amendment would not result in foreseeable significant impacts to public service, or lead to the necessity for additional public service facilities. Impacts to utilities and service systems are discussed below in XVII.

Environmental resource Category	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
XV. 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 that might have an adverse physical effect on the environment?	☐	☐	☐	☒

XV) Pyrethroid pesticides may be used in parks and recreational facilities, however, it is not anticipated that the proposed amendment would increase or decrease the use of recreational facilities, create a need for new recreational facilities, or result in any other foreseeable impact on recreational opportunities. As a result of this amendment, municipalities might alter their use of pyrethroid pesticides, choose to use alternative pesticides, or implement management practices to reduce runoff of pyrethroid pesticides, however, none of these are anticipated to result in a change in the use of recreational facilities.

Environmental resource Category	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
XVI. TRANSPORTATION / TRAFFIC. Would the Project:				
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 result 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) The proposed amendment should not have a significant or long-term impact on transportation and/or traffic. Increased short-term vehicular traffic might occur to install structures and there might be a small amount of increased traffic in the long-term to conduct monitoring. However, most structures intended to control pyrethroid pesticides runoff are also expected to address other pollutants that the discharger is already required to reduce, so in some cases the structures are in place or there are already plans to add these structures. Similarly, monitoring required to implement the proposed amendment would most likely be combined with monitoring that is already required. Management practices are not expected to result in changes in traffic or require changes in traffic infrastructure, affect level of service requirements, result in changes in traffic patterns, increase hazards due to design features, result in inadequate emergency access and/or parking capacity, or conflict with adopted policies, plans or programs.

Environmental resource Category	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
XVII. 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?	☐	☐	☐	☒
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) The proposed amendment does have requirements for municipal storm water dischargers and may result in requirements for municipal and domestic wastewater dischargers, so the project will likely result in impacts on these service providers, but any environmental impacts associated with the project requirements are expected to be less than significant. The estimated costs associated with the proposed amendment for municipal storm water dischargers and municipal and domestic wastewater dischargers are summarized in section 11.4 and detailed cost estimates are given in sections 9.1 and 9.3.

XVII.a) The project is a Basin Plan amendment to address water bodies impaired by pyrethroid pesticides by establishing numeric triggers for pyrethroids and an implementation program to achieve the numeric triggers. Section 5.6.3 of this staff report discusses whether the reasonable control of waste discharges is expected to

achieve the proposed numeric triggers. Section 7 discusses the waste discharge requirements that would be imposed on waste dischargers. Waste dischargers will be required to implement best management practices that will reduce source loading of pyrethroid pesticides and therefore reduce discharges of pyrethroid pesticides. Dischargers would not be required to upgrade treatment plants. Dischargers are expected to be able to comply with these requirements to implement best management practices.

XVII.b) The project would require implementation of best management practices, as necessary, and would not require that treatment plants expand or upgrade in order to comply with the regulations. New or expanded water or wastewater treatment facilities are not expected to be needed as a result of the proposed amendment, therefore no impacts are expected.

XVII.c) Storm water management entities might choose to construct new or expanded storm water drainage facilities in order to reduce discharges of pyrethroid pesticides. There are non-construction BMPs that storm water management entities could implement that will meet the requirements stemming from this proposed amendment, so it is not expected that storm water management entities will choose construction BMPs. However, if a storm water management entity chooses to construct new or expanded storm water drainage facilities, the impact are expected to be less than significant with mitigation incorporated. Mitigation measures associated with construction and operational activities are listed in Table 10-8.

XVII.d) New water sources and/or entitlements are not needed to implement the proposed project, therefore no impacts are expected.

XVII.e) The proposed project will not create an increase in demand for wastewater treatment.

XVII.f) The proposed project is not likely to create an increase in need for solid waste disposal.

XVII.g) The proposed project is not likely to create an increase in need for solid waste disposal, therefore compliance with federal, state, or local solid waste disposal statutes and regulations should not be affected by the proposed project.

Table 10-8 Potential Utilities and Service System Impacts and Associated Mitigation Measures

Management Practices Implemented to Comply with Proposed BPA	Potentially Significant Impacts	Mitigation Measures
Dischargers might generate noise during construction and operation of management practices.	▪ A storm water management entity might construct new or expanded storm water drainage facilities (Potential impact to Utilities and Service System c).	Mitigation Measure XVII.1: Avoid and mitigate for potential impacts to utilities and service systems caused by construction and/or operation of management features. (See mitigation measures for construction and/or operation of management features in Table 11-1 through Table 11-7.

Environmental resource Category	Potentially Significant Impact	Less Than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
XVIII. 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 or 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 probable future projects)?	☐	☒	☐	☐
c) Does the Project have environmental effects that will cause substantial adverse effects on human beings, either directly or indirectly?	☐	☐	☒	☐

The proposed amendment is designed to reduce pyrethroid pesticides discharges and result in the attainment of water quality objectives and allocations and to ensure that alternative pesticide use does not degrade water quality. The numeric triggers established by the proposed amendment are designed to eliminate deleterious impacts to aquatic life due to pyrethroid pesticides.

The proposed amendment will result in implementation of management practices designed to reduce pyrethroid pesticide discharges and result in attainment of the water quality objectives and allocations. Pyrethroid pesticide users might change management practices as a result of this amendment. The Board's evaluation indicates that the implementation of additional management practices could have limited impacts upon the physical environment, which are expected to be less than significant with the implementation of mitigation measures such as careful planning, design, consultation, and implementation. Mitigation measures can be incorporated into regulatory measures prescribed by the Board, such as waste discharge requirements and conditional

waivers, or can be imposed by other regulatory agencies, such as local air quality management districts, the California Department of Pesticide Regulation, the California Department of Fish and Wildlife, or the California Air Resources Control Board. Properly designed and implemented pesticide control projects, conducted pursuant to regulatory measures prescribed by the Board and by other regulatory agencies, will mitigate and/or avoid any foreseeable significant adverse effects on the environment.

11.4 Economic Factors

Public Resources Code section 21159 requires that economic factors be considered as part of the environmental analysis. The Board expects that regulated entities, when selecting which management practice(s) to implement, will take into account the effectiveness, potential environmental impacts and mitigation measures, and the overall economic costs associated with implementing these practices.

The total estimated cost to MS4 dischargers is $32,882.50 per permit cycle (section 9.1). This estimated cost is not expected to cause widespread impacts, as it is relatively low in comparison to other costs associated with building and operating municipal storm water systems.

As detailed in section 9.2 of this report, the estimated annual additional cost to agriculture for monitoring was estimated to be $1.4 million. The annual cost to implement management practices was not considered an additional cost associated with this amendment (i.e., this cost was already considered in the development of the ILRP).

The total additional estimated cost to municipal and domestic wastewater dischargers is $18,690 per 5-year permit cycle (section 9.3). This estimated cost is not expected to cause widespread impacts, as it is relatively low in comparison to other costs associated with building and operating a municipal or domestic wastewater treatment plant.

11.5 Interagency Cooperation for Mitigation of Impacts

Many of the recommended mitigation measures are outside the jurisdiction of the Central Valley Water Board and will require interagency cooperation. Table 10-9 summarizes which mitigation measures will be imposed by the Central Valley Water Board and which measures should be imposed by other agencies.

Table 10-9 Agencies Responsible for Imposing Recommended Mitigation Measures

Mitigation Measure	Public Agencies with Jurisdiction
Mitigation Measure III.1: Avoid and mitigate for impacts to air quality caused by alternative pesticide use.	California Department of Pesticide Regulation Central Valley Water Board via long-term Irrigated Lands Regulatory Program
Mitigation Measure III.2: Avoid and mitigate for impacts to air quality caused by water management practices.	California Air Resources Board California Department of Pesticide Regulation Central Valley Water Board via long-term Irrigated Lands Regulatory Program Local air districts
Mitigation Measure III.3: Avoid and mitigate for air quality impacts caused by construction and/or operations of management features.	California Air Resources Board Local air districts in and surrounding the proposed Project Area
Mitigation Measure III.4: Avoid and mitigate for air quality impacts caused by pest management practices.	California Air Resources Board Local air districts in and surrounding the proposed Project Area
Mitigation Measure III.5: Avoid and mitigate for impacts to air quality caused by pesticide management practices.	California Air Resources Board Local air districts in and surrounding the proposed Project Area
Mitigation Measure: IV.1: Avoid and mitigate for potential impacts to biological resources caused by pest management practices.	Central Valley Water Board via long-term Irrigated Lands Regulatory Program Department of Pesticide Regulation
Mitigation Measure IV.2: Avoid and mitigate for potential impacts to biological resources caused by alternative pesticide use.	Department of Pesticide Regulation California Department of Fish and Wildlife Central Valley Water Board via long-term Irrigated Lands Regulatory Program
Mitigation Measure IV.3: Avoid and mitigate for potential impacts to biological resources caused by water management practices.	California Department of Fish and Wildlife Central Valley Water Board via long-term Irrigated Lands Regulatory Program
Mitigation Measure IV.4: Avoid and mitigate for potential impacts to biological resources caused by construction and/or operation of management features.	Central Valley Water Board via long-term Irrigated Lands Regulatory Program, NPDES storm water program, Water Quality Certification Program California Department of Fish and Wildlife United States Fish and Wildlife Service National Marine Fisheries Service Local agencies

Mitigation Measure V.1: Avoid and mitigate for potential impacts to cultural resources caused by construction and/or operation of management features.	Central Valley Water Board via long-term Irrigated Lands Regulatory Program California Native American Heritage Commission
Mitigation Measure VI.1: Avoid and mitigate the potential impacts of water management practices, pest management practices, and associated construction and operational on geology and soils.	Central Valley Water Board via long-term Irrigated Lands Regulatory Program and Water Quality Certification Program
Mitigation Measure VIII.1 Avoid and mitigate the potential impacts of alternative pesticides on hazards and hazardous materials.	Central Valley Water Board via long-term Irrigated Lands Regulatory Program Department of Pesticide Regulation County Agricultural Commissioners United States Environmental Protection Agency
Mitigation Measure IX.1: Avoid and mitigate for potential impacts to hydrology and water quality caused by water management practices.	Central Valley Water Board via long-term Irrigated Lands Regulatory Program California Department of Pesticide Regulation County Agricultural Commissioners
Mitigation Measure IX.2: Avoid and mitigate for potential impacts to hydrology and water quality caused by alternative pesticide use.	Central Valley Water Board via long-term Irrigated Lands Regulatory Program California Department of Pesticide Regulation County Agricultural Commissioners
Mitigation Measure IX.3: Avoid and mitigate for potential impacts to water quality caused by pesticide application management.	Central Valley Water Board via long-term Irrigated Lands Regulatory Program California Department of Pesticide Regulation
Mitigation Measure XII.1: Avoid and mitigate for potential noise impacts caused by construction and/or operation of management features.	Local agencies
Mitigation Measure XVII.1: Avoid and mitigate for potential impacts to utilities and service systems caused by construction and/or operation of management features.	Central Valley Water Board via long-term Irrigated Lands Regulatory Program, NPDES storm water program, Water Quality Certification Program California Department of Fish and Wildlife United States Fish and Wildlife Service National Marine Fisheries Service California Air Resources Board Local air districts in and surrounding the proposed Project Area Local agencies

11.6 Findings for Significant Effects

This section satisfies the requirement in 14 CCR 15091 that a public agency must make a written finding for each significant effect identified for a project, accompanied by a brief explanation of the rationale for each finding.

The potentially significant effect identified for the proposed Basin Plan amendment is a potential reduction in aquatic and wetlands habitat due to the implementation of measures that could eliminate or reduce agricultural runoff from some agricultural operations (possibly impacting habitats that depend on this agricultural runoff), which may result in potentially significant impacts to Biological Resources.

The finding for this potentially significant effect is:
Specific economic, legal, social, technological, or other considerations, including provision of employment opportunities for highly trained workers, make infeasible the mitigation measure or project alternative identified in the final SED (14 CCR 15091(a)(3)).

The potential mitigation measures, such as preserving riparian habitat where possible, providing alternative water, and purchasing mitigation bank or restoration credits, for this potential impact are not legally required for agricultural dischargers and it is not clear if mitigation measures would fully mitigate these impacts. Thus, mitigating potential adverse effects on riparian habitat to less than significant is infeasible.

11.7 Preliminary Staff Determination

On the basis of this evaluation and staff report, which collectively provide the required information:

- ☐ The proposed amendment could not have a significant effect on the environment, and therefore, no alternatives or mitigation measures are proposed.
- ☐ Although the proposed amendment could have a significant or potentially 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.
- ☒ The proposed amendment may have a significant or potentially significant effect on the environment, and therefore alternatives and mitigation measures have been evaluated. There are no feasible alternatives and/or mitigation measures available which will lessen the significant adverse impacts to a less than significant effect. See attached written report for a discussion of this determination.

11.8 Statement of Overriding Considerations

The proposed amendment is needed to improve water quality in the Sacramento River and San Joaquin River basins. For the water bodies that are currently considered impaired due to the effects of pyrethroid pesticides on aquatic life, the Regional Board is required to adopt a TMDL or impose other effective pollution control requirements to address the impairments pursuant to section 303(d) of the federal Clean Water Act. Without the proposed amendment, aquatic life in the proposed Project Area surface waters would likely remain impaired by discharges of pyrethroid pesticides or replacement pesticides. Although the proposed amendment will have an overall positive effect on the environment, adverse environmental effects could still result from the implementation of reasonably foreseeable management practices. Environmental Resource Categories that have potential to be impacted include:

- Air Quality (and Greenhouse Gas Emissions)
- Biological Resources
- Cultural Resources
- Hazards and Hazardous Materials
- Geology and Soil Resources
- Hydrology and Water Quality
- Utilities and Service Systems

The vast majority of the identified potential impacts can be mitigated to less than significant levels with the implementation of feasible mitigation measures. Most measures taken to mitigate possible impacts to biological resources and hydrological resources fall under the jurisdiction of the Central Valley Water Board, therefore, the Regional Water Board can oversee the implementation of these mitigation measures. Mitigation of air quality pollutants, including greenhouse gas emissions, falls under the jurisdiction of the California Air Resources Board and local air districts, which can impose mitigation measures to ensure that no significant air quality impacts occur. Impacts to cultural resources caused by implementing measures to comply with the proposed amendment would be mitigated by project proponents in accordance with section 15091(a)(1) of the State CEQA Guidelines.

The Regional Board’s Substitute Environmental Document identified just one category of impacts from the proposed project with unavoidable, potentially significant effects on the environment. The potentially significant and unavoidable impacts include a reduction in aquatic and wetlands habitat due to the implementation of measures that will eliminate or reduce agricultural runoff from some agricultural operations (possibly impacting habitats that depend on this agricultural runoff).

The economic impacts of the proposed amendment are relatively small, as most measures are already required pursuant to existing regulatory programs (e.g., the Regional Board's Irrigated Lands Regulatory Program). The proposed amendment is needed to fulfill legal requirements imposed on the Regional Board by the federal Clean Water Act. Remedying the impairments in surface waters imparts environmental and social benefits, such as the enhancement of aquatic habitats and drinking water. Mitigation measures imposed by the proposed amendment are well within the technological capabilities of all regulated dischargers. Furthermore, the only habitat that has potential to be impacted by the adoption of the proposed amendment is expected to be habitat dependent on agricultural flows that discharge runoff containing pyrethroid pesticides and other pesticides and contaminants, which in many cases is sub-optimal wildlife habitat.

For the above reasons, the Regional Board finds that the substantial and significant benefits to aquatic life, water quality, and air quality outweigh the unavoidable potentially significant adverse environmental impacts that could occur as a result of the proposed amendment.

12 PUBLIC PARTICIPATION AND AGENCY CONSULTATION

This section describes public participation in the development of the proposed amendment, as well as consultations with other agencies.

CEQA scoping meeting

30 October 2012: The CEQA scoping meeting and public workshop on the Central Valley Pyrethroid Pesticides TMDL and Basin Plan amendment was held in Rancho Cordova. Attendance at the meetings was moderate with approximately 25 people total attending the meeting. Attendees came primarily from state agencies, pesticide manufacturers, agricultural coalitions, wastewater treatment plants or related organizations, storm water organizations. Following the meeting, written comments were received from eight stakeholders and stakeholder representatives.

Public stakeholder meetings

Stakeholders who attended represented municipalities, wastewater treatment plants, agricultural coalition groups, agricultural growers associations, pesticide manufacturers, local districts, state government agencies (Department of Pesticide Regulation, Department of Fish and Wildlife), federal government agencies (US EPA Region 9, National Oceanic and Atmospheric Administration Fisheries), private consultants with interest in pesticides analysis and toxicity testing, and the state and federal water contractors. Following the November 2014 meeting, written comments were requested and received from 10 stakeholders.

5 October 2016: 22 stakeholders and three Regional Board staff attended.
26 September 2016: 24 stakeholders and three Regional Board staff attended.
1 June 2016: 27 stakeholders and three Regional Board staff attended.
19 January 2016: approximately 20 stakeholders and three Regional Board staff attended.
30 November 2015: 20 stakeholders and three Regional Board staff attended.
5 May 2015: 19 stakeholders and three Regional Board staff attended.
7 November 2014: 24 stakeholders and two Regional Board staff attended.
22 October 2014: 23 stakeholders and two Regional Board staff attended.
22 September 2014: 19 stakeholders and three Regional Board staff attended.

Public workshops

Three public workshops were held to inform the Board about the development of the proposed Basin Plan amendment. Public comments were taken at each meeting.

18 August 2016
23 June 2016

19 February 2016

Other meetings

8 January 2013: A meeting we held with vector control stakeholders to explain the Basin Plan amendment project and discuss if there would be any effects on vector control operations.

16 January, 17 April, 9 October 2013 and 18 February, 4 May 2015: Meetings were held with the Pyrethroid Working Group (PWG), an industry consortium of pyrethroid pesticides manufacturers, primarily for the PWG to share recent pyrethroid research with staff. The purpose of the meeting on 18 February 2015 was to discuss new toxicity and partition coefficient data for pyrethroid pesticides that was generated as part of the U.S. EPA registration review of pyrethroids. This data was subsequently used by staff to re-calculate water quality criteria and develop default partition coefficients for the six pyrethroids that were used in the development of the proposed Basin Plan amendment.

27 January 2015: A meeting was held with representatives from the Central Valley Clean Water Association to discuss the draft Basin Plan amendment language that was released for the public stakeholder meeting held 22 October 2014. The discussion focused on potential implementation measures and monitoring and surveillance for municipal and domestic wastewater dischargers.

Agency consultation

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 Wildlife, California Department of Public Health, and U.S. Environmental Protection Agency.

On 26 June 2012, a meeting was held between staff of the Central Valley Water Board and DPR. The meeting was held to advise DPR of the development of a pyrethroids Basin Plan amendment and to solicit DPR’s input.

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APPENDIX A

Evaluation of Potential Pyrethroid Concentration Goals

This Appendix contains the detailed evaluations of the eight pyrethroid concentration goal alternatives that were not further considered based on the five initial evaluation factors. The eight alternatives discussed in this Appendix are:

1. No change – Use of existing Basin Plan guidance;
2. California Department of Fish and Wildlife (CDFW) interim water quality criteria;
3. 2010/11 University of California Davis method water quality criteria;
4. Pyrethroid Working Group (PWG) combined species sensitivity distribution for acute toxicity of pyrethroids to arthropods;
5. Australia/New Zealand trigger;
6. Canadian interim freshwater quality guidelines;
7. Dutch maximum permissible concentrations;
8. USEPA Office of Pesticide Programs aquatic life benchmarks.

The five initial evaluation factors are given below and the scoring for each concentration goal alternative is summarized in Table 5-5 (reproduced below).

- Data sources and calculation method were clearly identified so that sources can be checked for quality and errors
- Availability of both acute and chronic criteria to ensure protection from both short-term and longer exposures
- Availability for the six pyrethroids of interest
- Comparison of values to toxicity values for the most sensitive species in the data sets (*Hyalella azteca*)
- Consistency across the basin, with the project goals, with other regulations, and criteria derivation methodologies.

The evaluation of each concentration goal alternative is discussed in the following sections of this Appendix.

Table A-1 Aqueous pyrethroid concentration goal alternatives and evaluation factors

Alternative	Transparent data source and calculation	Acute and chronic values available	Values available for all 6 pyrethroids	Chronic values are below *H. azteca* LC_{50}s	Consistency in basin, with project goals, etc.
No change - Basin Plan guidance	Yes	No	Yes	Yes	No
No pyrethroids	Yes	No	Yes	Yes	No
CDFW interim criteria	Yes	Yes	No	No	Yes
2010/11 UCD criteria	Yes	Yes	No	Yes for 3, no for 2 pyrethroids	Yes
1st percentile 2015 UCD criteria	Yes	Yes	Yes	Yes	Yes
5th percentile 2015 UCD criteria	Yes	Yes	Yes	Yes for 5, equal for 1 pyrethroid	Yes
2.5 percentile 2015 UCD criteria	Yes	Yes	Yes	Yes	Yes
2015 via USEPA method	Yes	Yes for 1, no for 5 pyrethroids	No	Yes for the 1 chronic criteria available	Yes
PWG SSD values	No	No	Yes	No	Yes
Australia/New Zealand trigger	No	No	No	No	No
Canadian interim guideline (chronic)	Yes	No	No	Yes	No
Dutch maximum permissible conc. (chronic)	No	No	No	Yes for 2, no for 1 pyrethroid	No
USEPA OPP aquatic life benchmarks	Yes	Yes	Yes	No	No

A.1 No Change – Use of Existing Basin Plan Guidance

The Basin Plan currently contains narrative water quality objectives regarding pesticides and toxicity. The Central Valley Water Board uses available guidelines and criteria to interpret existing narrative water quality objectives. The Central Valley Water Board has not established any criteria to interpret compliance with its narrative toxicity and pesticide water quality objectives specifically for pyrethroids. Under this alternative, the Board would continue to utilize existing Basin Plan guidance for the protection of beneficial uses. Existing Basin Plan guidance in the implementation section of the Basin Plan states:

"For most pesticides, numerical water quality objectives have not been adopted. USEPA 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."

Attainment of water quality objectives is evaluated during 303(d) assessment, in which available monitoring data are compared to water quality objectives to determine if a water body is attaining applicable objectives and if it is impaired based on a particular constituent. To assess narrative water quality objectives, numeric evaluation guidelines are chosen based on guidance in the Listing Policy (SWRCB 2005) and the applicable Basin Plan. Some regulatory programs also have numeric values to assess whether discharges are causing or contributing to exceedances of narrative water quality objectives. The Basin Plan states that the Central Valley Water Board will use the best available technical information to evaluate compliance with narrative objectives pertaining to pesticides, and will consider one-tenth of the 96-hour LC_{50} 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, are to be evaluated to determine whether lower concentrations are required to interpret narrative objectives. These types of information are recommended for consideration because water quality criteria and other guidance are not typically available for many pesticides. For pyrethroids, water quality criteria and other guidance are available for interpreting narrative objectives and these alternatives are discussed in the following sections.

The 96-hour LC_{50}s of the most sensitive organism for each of the six pyrethroids and one-tenth of those LC_{50} values are summarized in Table A-2. On the current (2012) 303(d) list for the Central Valley Region, one-tenth of the lowest LC_{50} was used for evaluation guidelines for bifenthrin and cis-permethrin, using older data than shown in Table A-2 (SWRCB 2010). The evaluation guidelines used for those listings were 0.00093 μg/L for bifenthrin and 0.033 μg/L for cis-permethrin. However, newer toxicity data are now available for all the pyrethroids, and water

quality criteria recently became available for five pyrethroids (Fojut et al. 2012), and these criteria have been used by Regional Boards to interpret narrative objectives for pyrethroids more recently (CRRWQCB 2014).

Under this option, the numeric values to interpret narrative water quality objectives and/or establish goals in effluent for protection of beneficial uses could change as toxicity data and other technical information are updated. This alternative would not be consistent with the overall project goal of providing clear requirements for the control of pesticide discharges. Additionally, this alternative would not meet the project goal of addressing impaired waters through TMDLs or other alternatives, as these require specific numeric goals. The no change option will not be further considered because it does not provide consistent numeric values for pyrethroids throughout the basin, and will not meet the overall project goal.

Table A-2 One-tenth of the lowest LC_{50} for six pyrethroids.

Pesticide	*Hyalella azteca* 96-hour LC_{50} (ng/L)	1/10 96-hour LC_{50} (ng/L)
Bifenthrin	0.5[a]	0.05
Cyfluthrin	0.55[b]	0.055
Cypermethrin	0.56[c]	0.056
Esfenvalerate	0.85[d]	0.085
Lambda-cyhalothrin	0.3[e]	0.03
Permethrin	7[f]	0.7

[a]Bradley 2013a, [b]Bradley 2013b, [c]Bradley 2013c, [d]Bradley 2013d, [e]Bradley 2013e, [f]Bradley 2013f.

A.2 No Pyrethroids in the Water Column

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 that detectable levels of pyrethroids in the water column would not be allowed. State and federal antidegradation policies allow for the presence of pyrethroids if that presence is consistent with maximum benefit to the people of the state, does not unreasonably affect present and anticipated beneficial uses, and does not result in water quality less than that prescribed in existing policies (State Water Board Resolution 68-16 and 40 CFR 131.12).

The Central Valley Water Board could make a determination that allowing the presence of any pyrethroids in surface waters is not to the maximum benefit of the people of the state, which would serve as the basis for a no pyrethroids objective. Alternatively, the Central Valley Water Board could determine that

allowing the presence of some pyrethroids is consistent with the maximum benefit to the people of the state, but that the concentration consistent with the maximum benefit is less than the highest concentration that would be protective of beneficial uses.

However, as long as pyrethroids remain registered for widespread use, completely eliminating all discharge of pyrethroids would require cessation or an unfeasible level of treatment of all MS4 and POTW discharges and either cessation or an infeasible level of treatment for agricultural discharges or cessation of agricultural pyrethroid uses. Therefore this alternative does not meet the overall project goal of reasonable protection of beneficial uses, so it will not be further considered.

A.3 CDFW Interim Criteria

The California Department of Fish and Wildlife (formerly the California Department of Fish and Game) completed a hazard assessment of the pyrethroids bifenthrin, cypermethrin, esfenvalerate, and permethrin (Siepmann and Holm 2000). This assessment used the USEPA methodology for deriving numeric water quality criteria (USEPA 1985). The USEPA methodology provides guidelines for reviewing 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. The method aims to protect aquatic organisms and their uses by restricting concentrations to levels at or below the criteria.

The USEPA method uses toxicity test data from a variety of taxonomic and functional groups, and the available species act as surrogates for other untested species. There are eight required taxa in this method: 1) the family Salmonidae (class Osteichthyes), 2) a second family in the class Osteichthyes, 3) a third family in the phylum Chordata, 4) a planktonic crustacean, 5) a benthic crustacean, 6) an insect, 7) a family in a phylum other than Arthropoda or Chordata, and 8) a family in any order of insect or any phylum not already represented. Because these data represent a variety of taxa and functions, the resulting criteria should protect the aquatic ecosystem. The criteria are derived by using a species sensitivity distribution (SSD) approach. The criteria are met if the one-hour average concentration of the constituent does not exceed the CMC and the four-day average concentration does not exceed the CCC more than once every three years, on average.

There were insufficient data available for CDFW to calculate any type of criteria for bifenthrin or esfenvalerate. The bifenthrin acute data set contained three of the eight required taxa, while the chronic data set contained only one of the eight taxa requirements. Only four of the eight taxa requirements were met for acute esfenvalerate data and one of eight were available for chronic data.

For cypermethrin, seven of the eight required taxa were available, with the missing taxon being a phylum not already represented. Because this missing taxon was not expected to be particularly sensitive to pyrethroids, CDFW calculated an interim acute criterion, or CMC, of 0.002 μg/L with the incomplete data set. Similarly, an interim freshwater CMC of 0.03 μg/L was calculated for permethrin based on a data set that fulfilled seven of the eight taxa requirements. A final saltwater CMC of 0.001 μg/L was calculated because all eight of the taxa requirements were fulfilled for saltwater species. Chronic criteria were not calculated for cypermethrin and permethrin because there were insufficient data.

In summary, the CDFW hazard assessment concluded that there were insufficient data to derive criteria for bifenthrin and esfenvalerate, according to the data requirements of the USEPA method. Relatively more data were available for cypermethrin and permethrin, but these data sets were still incomplete, thus CDFW derived interim acute criteria for these compounds. Numeric criteria are only available for cypermethrin and permethrin under this alternative. This alternative does not provide both acute and chronic values, only has values for two of the six pyrethroids, and were based on a data set that did not include newer, extremely relevant studies. The newer data indicate these criteria may not be fully protective of beneficial uses as some criteria are well above the LC_{50}s for the sensitive species *Hyalella azteca*. Since criteria based on more current, complete data sets are available, these values will not be further considered for use as pyrethroid concentration goals.

A.4 2010/11 UC Davis Water Quality Criteria

In 2010 and 2011, UC Davis derived water quality criteria for five pyrethroids, which are summarized below from Fojut et al. (2012). USEPA recently promulgated a TMDL for Oxnard Drain 3 in Ventura County, California for bifenthrin using the UC Davis chronic criterion of 0.6 ng/L as the numeric target (USEPA 2011). They chose this value to be protective of aquatic life in both aqueous and sediment matrices. The UC Davis acute and chronic criteria for bifenthrin, cyfluthrin, and lambda-cyhalothrin were also used as numeric targets in the Central Coast Water Quality Control Board's Santa Maria Watershed TMDL for Toxicity and Pesticides (Meertens 2014). The Santa Maria Watershed

TMDL also included additive toxicity targets for the identified pyrethroids in sediment.

The UC Davis methodology is unique from USEPA methodology in that when data show that toxicity can occur at a lower concentration than the acute or chronic criteria derived with the 5th percentile value, the method guidance is to ensure protection by adjusting the criteria downward to the 1st percentile (or lower 95% confidence interval of the 5th percentile, whichever is higher). The adjustment to the 1st percentile is not required by USEPA policy or guidance. The USEPA aquatic life criteria methodology (USEPA 1985) utilizes the 5th percentile for calculation of criteria to estimate a level that would be protective of aquatic life beneficial uses. The USEPA methodology specifies that important species with toxicity values near or below the criteria should be considered, but does not specify a method of adjusting the criteria for these toxicity values.

This alternative provides acute and chronic values for five of the six pyrethroids of interest and would be consistent with other recent regulations in California; however, these criteria were based on a data set that did not include newer, extremely relevant studies. The newer data indicate these criteria may not be fully protective of beneficial uses as some criteria are well above the LC_{50}s for the sensitive species *Hyalella azteca*. Since criteria based on a more current, complete data set are available, this alternative will not be further considered.

- Bifenthrin (Fojut et al. 2012): The acceptable acute data set contained eight species mean acute values, which were used to calculate an acute freshwater criterion of 4 ng/L using the 5th percentile of a log-logistic SSD. The acceptable chronic data set contained two species mean chronic values, but neither could be paired with appropriate acute data. The chronic criterion was calculated with the default acute-to-chronic ratio of 12.4, which resulted in a chronic freshwater criterion of 0.6 ng/L for bifenthrin.

- Cyfluthrin (Fojut et al. 2012): Eight species mean acute values were available to calculate an acute freshwater criterion of 0.3 ng/L using a log-logistic SSD. There were three species mean chronic values, which were paired with corresponding acute data to calculate a cyfluthrin ACR of 10.27. This ACR was used to calculate a chronic freshwater criterion of 0.05 ng/L. The criteria were calculated using the 1st percentile of the log-logistic distribution because the criteria based on the 5th percentile were not protective of the most sensitive species in the data set.

- Cypermethrin (Fojut et al. 2012): The acceptable data set contained 14 species mean acute values, which were used to derive a freshwater acute criterion of 1 ng/L with a Burr Type III SSD. There was only one species mean chronic value available, so default ACRs were included to derive the chronic freshwater criterion of 0.2 ng/L. The criteria were calculated using the 1st percentile of the Burr III distribution because the criteria based on the 5th percentile were not protective of the most sensitive species in the data set.

- Lambda-cyhalothrin (Fojut et al. 2012): There were 20 species mean acute values in the acceptable data set, which resulted in an acute freshwater criterion of 1 ng/L using the 5th percentile of a Burr Type III SSD. There were two species mean chronic freshwater values and a saltwater chronic value that were paired with corresponding acute data to calculate a lambda-cyhalothrin ACR of 4.73. This ACR was used to calculate a freshwater chronic criterion of 0.5 ng/L.

- Permethrin (Fojut et al. 2012): There were 19 species mean acute values and an acute freshwater criterion of 10 ng/L was derived using the 5th percentile of a Burr Type III SSD. There were three species mean chronic values in the acceptable data set, but none could be paired with appropriate acute data to calculate ACRs. One saltwater chronic value was paired with corresponding acute data and that ACR was combined with two default ACRs to result in an ACR of 8.96. This ACR was used to calculate a chronic freshwater criterion of 2 ng/L.

A.5 Pyrethroid Working Group combined species sensitivity distribution for acute toxicity of pyrethroids to arthropods

The Pyrethroid Working Group (PWG) is an industry consortium of pyrethroid registrants (manufacturers) that works collaboratively to produce research and assessments on pyrethroids to meet pesticide registration requirements of USEPA and DPR. As part of an ecological risk assessment for the USEPA registration review of pyrethroids (section 2.4.5), the PWG produced a species sensitivity distribution for acute toxicity to arthropods with data from nine pyrethroids (Giddings et al. 2014). This assessment includes the six pyrethroids identified in the proposed Bain Plan amendment.

To create a combined pyrethroids species sensitivity distribution, acute toxicity data for 107 arthropod species were normalized to a single scale so they could be plotted together. The acute toxicity data for nine pyrethroids were normalized to *Hyalella azteca* equivalents by dividing the LC_{50} for a given species and

pyrethroid by the LC_{50} for *Hyalella azteca* for that same pyrethroid. The *Hyalella azteca* equivalents were plotted and a logistic regression SSD was fit to the data. The 5th percentile of this distribution (HC5) was determined to be 5.31 *Hyalella azteca* equivalents (Giddings et al. 2014). Some of the toxicity data is not available to the public or by request from the USEPA, so not all of the toxicity data used could be verified or checked for quality.

The PWG report did not derive water quality criteria, but water quality criteria can be calculated based on an HC5. Following the general guidelines of the USEPA method (USEPA 1985), acute water quality criteria were calculated by dividing the 5th percentile value (HC5) by 2. For this calculation, the HC5 based on *Hyalella azteca* equivalents was first converted to a concentration for each of the six pyrethroids, and then that concentration was divided by 2 (Table A-3).

The PWG SSD approach only provides acute water quality criteria and does not address chronic effects on aquatic organisms. The water quality criteria generated from the combined pyrethroids SSD would not be protective of several species based on the data used in the assessment, including the sensitive species *Hyalella azteca* (i.e., the water quality criteria are higher than the LC_{50}s for these organisms). This approach did not derive chronic criteria or consider chronic effects.

Because this approach does not provide chronic criteria and resulting values are not protective of several know species based on LC_{50}s, it may not provide adequate protection for aquatic life beneficial uses. Since this alternative did not provide chronic criteria, was less likely to provide adequate protection of beneficial uses, and was not based on data that could be verified for accuracy, these values will not be further considered for use as pyrethroid concentration goals.

Table A-3 Calculation of water quality criteria based on PWG combined pyrethroid SSD.

Hyalella azteca equivalents HC5[a]: 5.31 (4.16-6.79)			
	HC5 concentration (μg/L)	Acute water quality criteria (HC5/2) (μg/L)	Acute water quality criteria (ng/L)
Bifenthrin	0.00266	0.0013	1.3
Cyfluthrin	0.0029	0.0015	1.5
Cypermethrin	0.0059	0.0030	3.0
Esfenvalerate	0.0045	0.0023	2.3
λ-cyhalothrin	0.0016	0.00080	0.8
Permethrin	0.037	0.019	19

[a]*Hyalella azteca* equivalents HC5 and *Hyalella azteca* LC_{50} from Giddings et al. 2014.

A.6 Australia/New Zealand trigger

There is a trigger value of 1 μg/L available for esfenvalerate. The data source and methodology for determining this value is not readily available in the report in which the trigger is cited (ANZECC/ARMCANZ 2000), thus this value will not be further considered for use as a pyrethroid concentration goal.

A.7 Canadian Interim Freshwater Quality Guidelines

Environment Canada has reported an interim freshwater quality guideline for permethrin of 4 ng/L (CCME 2006). This interim freshwater quality guideline was derived using a chronic toxicity value of 0.042 μg/L for the stonefly *Pteronarcys dorsata* (Anderson 1982). This chronic toxicity value was multiplied by a safety factor of 0.1 to derive the interim freshwater guideline of 4 ng/L (0.0042 μg/L). The freshwater quality guideline is referred to as “interim” because the minimum data requirements were not met to derive a full water quality guideline. High quality toxicity values were available from a chronic fish study and a chronic invertebrate study, however, high quality chronic toxicity values were missing for a second fish species, a second class of invertebrates, and an algae. The Canadian interim freshwater quality guideline for permethrin will not be further considered because only a chronic value is available for one of six pyrethroids.

A.8 Dutch Maximum Permissible Concentrations

The Dutch environmental agency has derived what could be considered chronic criteria for several pyrethroids, which they term maximum permissible concentrations (MPCs). Because chronic data for four species (the minimum data sets for the Dutch method) were not available for any of the pyrethroids they assessed, the MPCs were derived by dividing the lowest toxicity value by an

assessment factor (Crommentuijn et al. 2000). In the Dutch method, the magnitude of the assessment factor is dependent on the available toxicity data. If a NOEC for chronic toxicity is available, it is divided by an assessment factor of 10, if acute toxicity values are available that fulfill the minimum data set, the lowest value is divided by a factor of 100. If the minimum data set is not available and no chronic data is available, then the lowest acute toxicity value is divided by a factor of 1000 to determine the MPC. The toxicity values and the magnitude of the assessment factors used to derive the MPCs for bifenthrin, cypermethrin and permethrin are not described in the Dutch environmental agency reports or publications. Because of the lack of readily available information regarding the data used to derive the MPCs, these values will not be further considered for use as pyrethroid concentration goals.

A.9 USEPA Office of Pesticide Programs Aquatic Life Benchmarks

USEPA Office of Pesticide Programs (OPP) aquatic life benchmarks are available for all six priority pyrethroids, as well as several other pyrethroids. These benchmarks were derived in order to assist states in interpreting pesticide monitoring data, but were not intended for use as water quality criteria (USEPA 2012a). Acute aquatic life benchmarks for fish and invertebrates are derived by multiplying the most sensitive, scientifically acceptable acute toxicity endpoint identified by USEPA OPP for a given taxon by a level of concern of 0.5. Chronic aquatic life benchmarks are equal to the most sensitive chronic toxicity value identified by USEPA OPP, which is typically a no-observed adverse effect concentration (NOAEC). Acute benchmarks for plants are equal to the short-term EC_{50}.

The most sensitive benchmarks for all six pyrethroids are the chronic invertebrate benchmarks are given in Table A-4. Acute and chronic USEPA OPP aquatic life benchmarks are available for all six pyrethroids, but the chronic benchmarks exceed *Hyalella azteca* LC_{50}s for five of the pyrethroids. USEPA also explains that the OPP aquatic life benchmarks are not intended for use as water quality criteria, so this alternative would not be consistent with USEPA guidance. Thus, this alternative will not be further considered.

Table A-4 US EPA Office of Pesticide Program aquatic life benchmarks (USEPA 2012a).
All concentrations in ppb (μg/L).

Pesticide	Fish		Invertebrates		Nonvascular Plants
	Acute	Chronic	Acute	Chronic	Acute
Bifenthrin	0.075	0.04	0.8	0.0013	n/a
Cyfluthrin	0.034	0.01	0.0125	0.0074	>181
Cypermethrin	0.195	0.14	0.21	0.069	n/a
Esfenvalerate	0.035	0.035*	0.025	0.017	n/a
Lambda-cyhalothrin	0.105	0.031	0.0035	0.002	>310
Permethrin	0.395	0.0515	0.0106	0.0014	68

*Because the lowest chronic NOAEC available was higher than the acute LC_{50}, the chronic fish benchmark was estimated using an acute-to-chronic ratio of 2.0 applied to the LC_{50} of 0.07 ppb for rainbow trout. The acute-to-chronic ratio was calculated from an acute LC_{50} and chronic NOAEC for fathead minnow. (USEPA 2008)

APPENDIX B

Ambient & Discharge Data Set Comparison to Potential Concentration Goals

This Appendix includes a data set for 109 samples collected in the Sacramento-San Joaquin Delta from receiving waters (creeks and rivers), storm drains, agricultural drains, and wastewater treatment plant effluents (Weston and Lydy 2010), which contained pyrethroid chemistry data, bioavailability parameter data, and corresponding toxicity data. Dr. Weston provided the detailed data including particulate organic carbon, dissolved organic carbon, and whole water pyrethroid concentrations, as well as the corresponding results for each sample from 96-hour water column *Hyalella azteca* toxicity tests. The DOC data were generated by using a syringe filter in the field and the POC data were generated by taking a concurrent whole water sample and filtering through a glass fiber filter in the laboratory.

This environmental data set was used to calculate the freely dissolved pyrethroid pesticide concentrations using Equation 3 and the partition coefficients presented in Table 5-3. The freely dissolved pyrethroid concentrations were calculated and then considered additively using the acute and chronic additivity formulas given in Equation 7 and Equation 8 with the water quality criteria based on the 1st, 2.5, and 5th percentiles derived using the UC Davis method, given in Table 5-4. The concentration goal units calculated with the additivity formulas and the estimated freely dissolved concentrations were then compared to the toxicity test results associated with the data set. The data provided by Dr. Weston as well as the calculations of the freely dissolved pyrethroid concentrations and the acute and chronic concentration goal units are provided in Table B-1, Table B-2, Table B-3, and Table B-4.

The data presented is environmental toxicity data, which demonstrates the natural variability in any environmental system. Since full toxicity identification evaluations were not performed on the samples, other constituents besides pyrethroids that may have contributed or caused toxicity in the individual samples

could not be identified (e.g., seven samples in the data set tested toxic to *H. azteca*, but contained no detectable pyrethroids).

While the results of this environmental analysis cannot conclusively identify protective pyrethroid concentration goals, this analysis does provide evidence that the combination of the proposed chronic concentration goals, the default partition coefficients and the additivity formula reasonably identify pyrethroid concentrations likely to contribute to toxic effects on aquatic organisms. When evaluating how well the proposed concentration goals identify samples likely to have toxic effects, the fact that these were ambient samples and other constituents may have also contributed to toxicity and the range of sorptive properties of suspended solids and DOC should be considered.

In this data set of 109 samples, 40 samples tested as toxic to *Hyalella azteca* compared to the control response (37%) and 69 tested as not toxic (63%). Of the 40 samples that were toxic to *H. azteca,* pyrethroids were not detected in 7 samples (6% of total, 18% of toxic samples), indicating that other constituents were likely the cause of toxicity in these samples. Pyrethroids were detected in 33 samples that tested toxic to *H. azteca* (30% of total), indicating that it is likely that pyrethroids contributed or caused the toxicity in these samples. Pyrethroids were not detected in 54 of the samples that were not toxic to *H. azteca* (50%). Pyrethroids were detected in 15 samples that were not toxic to *H. azteca* (14%).

A comparison of data from toxicity testing and chemical analysis in discharges and ambient waters to the 5th percentile UC Davis criteria shows that 9 of 40 toxic samples (23% of toxic samples, 27% of toxic samples containing pyrethroids) exceed the acute 5th percentile concentration (Figure B-1) and 25 of the 40 toxic samples (60% of toxic samples, 72% of toxic samples containing pyrethroids) exceed the chronic 5th percentile concentration (Figure B-2). In Figure B-1 and Figure B-2, the exceedance threshold based on acute and chronic 5th percentile concentrations, respectively, is marked with a vertical line. Points that are on the right side of the vertical line exceed the concentration goal. Since other toxicants are likely present, it would not be reasonable to expect that all toxic samples would be above the concentration goals, particularly in the 7 toxic samples in which no pyrethroids were detected. Of the 69 non-toxic samples, pyrethroids were only detected in 15 samples, and with the bioavailability calculation, three of these exceeded the chronic 5th percentile concentration and none exceeded the acute 5th percentile concentration. This may indicate that default partition coefficients underestimate the binding of the particulate and dissolved organic matter in these samples.

Similarly, if the concentration goal was based on the 2.5 percentile criteria, 19 of 40 toxic samples (48% of toxic samples, 58% of toxic samples containing pyrethroids) exceed the acute 2.5 percentile concentration (Figure B-3) and 31 of 40 toxic samples (78% of toxic samples) exceed the chronic 2.5 percentile concentration (Figure B-4). In Figure B-3 and Figure B-4, the exceedance threshold based on acute and chronic 2.5 percentile concentrations, respectively, is marked with a vertical line. Points that are on the right side of the vertical line exceed the potential concentration goal. None of the non-toxic samples that contained pyrethroids exceed the acute 2.5 percentile concentration and 6 of the 69 non-toxic samples (8% of non-toxic samples) exceed the chronic 2.5 percentile concentration. Of the 69 non-toxic samples, pyrethroids were only detected in 15 samples, and with the bioavailability calculation, six of these exceeded the chronic 2.5 percentile concentration. This may indicate that default partition coefficients underestimate the binding of the particulate and dissolved organic matter in these samples.

For both the 5th and 2.5 percentile, the chronic concentrations would result in more of the toxic environmental samples being identified as exceedances of the potential concentration goals. In addition, the chronic concentrations would also result in more of the non-toxic environmental samples being identified as exceedances, but the number of non-toxic samples identified as exceedances is lower than the number of toxic samples identified as not exceeding the potential concentration goals—which may again point to inherent variability of environmental samples.

While the comparisons to the ambient information cannot be use to select specific numeric goals due to the inherent variability in natural systems, the evaluations do show that increasing concentrations of pyrethroids appear to contribute to toxicity in ambient waters and that the proposed 5th percentile concentration goals capture points when pyrethroids may be contributing to toxicity. Figure B-2 compares the staff recommended chronic, 4-day average trigger, to toxicity test results of similar duration (96-hour acute toxicity test). As shown in the figure, as pyrethroid concentrations increase towards the trigger, toxicity testing results reflect the increased risk to the test organism. It must also be noted that toxic results below the trigger are not directly indicative of a failure of the trigger, but may be an indication of unknown constituents contributing to toxicity within the sample. Figure B-1 provides the same data set in comparison with the staff recommended acute (1-hour average) trigger value. This is a conservative comparison, as the 96-hour toxicity test duration is much longer

than a 1-hour average exposure. The utility of these comparisons is limited, but it clearly shows the potential effects of increasing pyrethroid concentrations in effluent and receiving waters and the importance of implementing this recommended control program.

This data set also illustrates how acute and chronic triggers work together to provide protection of beneficial uses. Aiming long-term levels (e.g., 4-day) at the chronic criteria or below will minimize potential effects. However, a higher amount is acceptable for short durations.

Figure B-1 Environmental samples with calculated bioavailability and additivity compared to the acute 5th percentile concentration goal.

The sum of concentration goal units (Sum CGU) is calculated with Equation 7 and the acute 5th percentile exceedance threshold is marked with a vertical line.

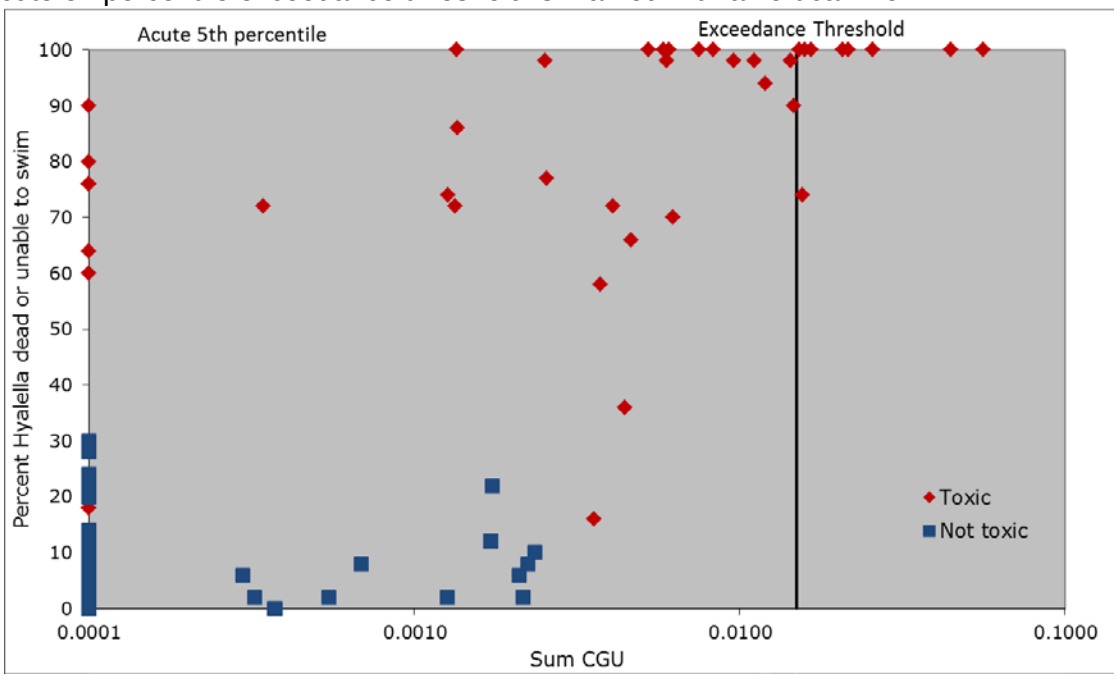

Figure B-2 Environmental samples with calculated bioavailability and additivity compared to the chronic 5th percentile concentration goal.

The sum of concentration goal units (Sum CGU) is calculated with Equation 8 and the chronic 5th percentile exceedance threshold is marked with a vertical line.

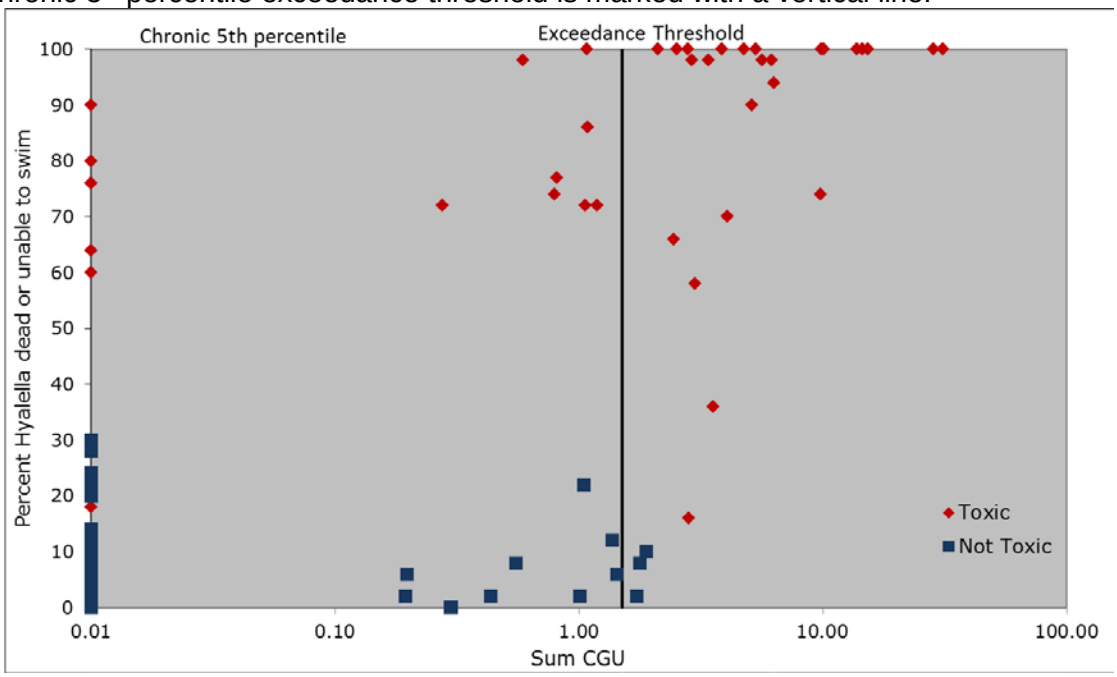

Figure B-3 Environmental samples with calculated bioavailability and additivity compared to the acute 2.5 percentile concentration goal.

The sum of concentration goal units (Sum CGU) is calculated with Equation 7 and the acute 2.5 percentile exceedance threshold is marked with a vertical line.

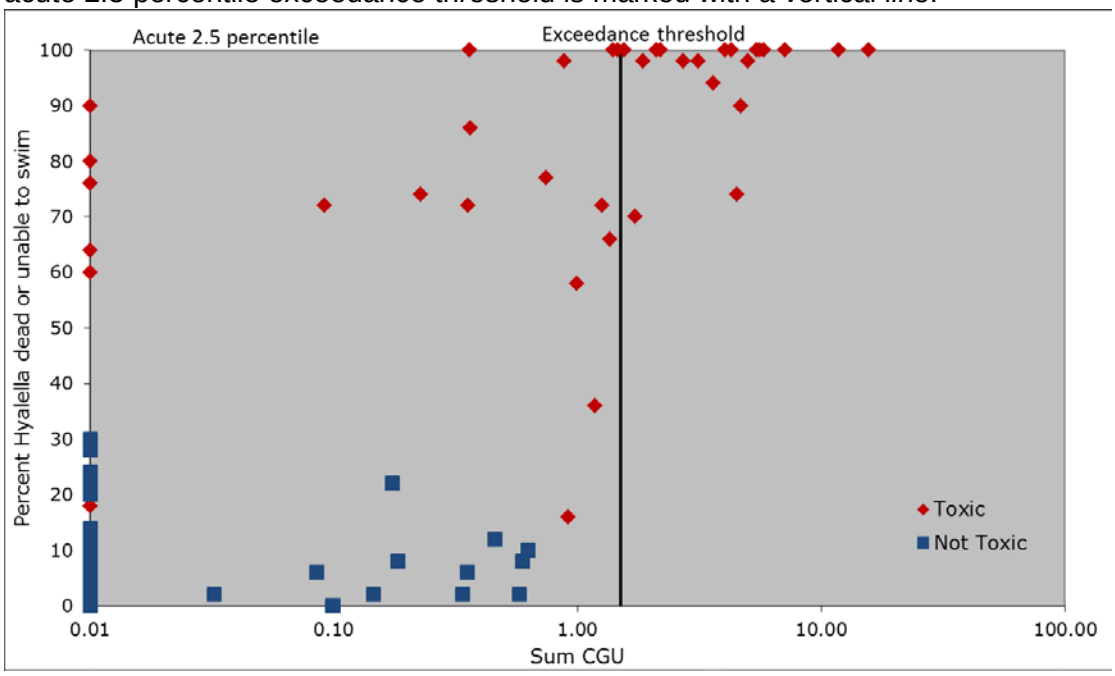

Figure B-4 Environmental samples with calculated bioavailability and additivity compared to the chronic 2.5 percentile concentration goal.

The sum of concentration goal units (Sum CGU) is calculated with Equation 8 and the chronic 2.5 percentile exceedance threshold is marked with a vertical line.

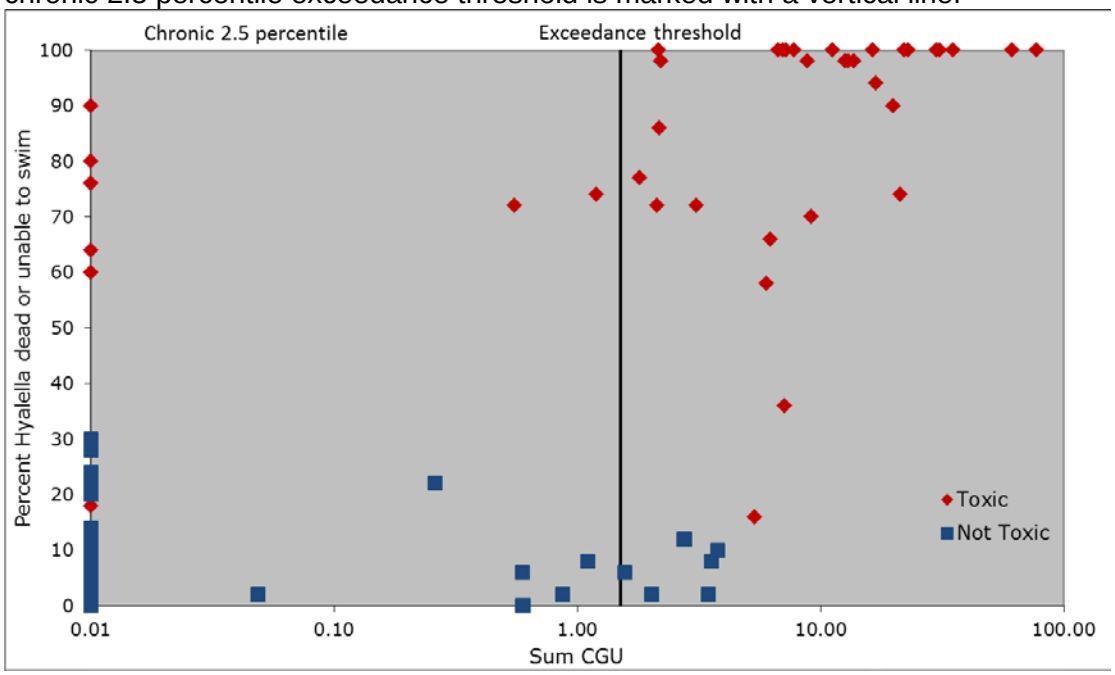

Table B-1 Station information, sample date, particulate and organic carbon, and toxicity test results.

Pink highlighting on the toxicity test results indicates that the result was significantly different than the control. TSS: total suspended solids, POC: particulate organic carbon, DOC: dissolved organic carbon, %C: percentage carbon.

Source Type	Location	Sta. #	Smpl date	TSS (mg/L)	POC (mg/L)	DOC (mg/L)	%C of TSS	% mortality	% impaired
POTWs	Sacramento	SA-POTW	5/27/2008	7.7	5.643	10.840	73.3	64	72
		SA-POTW	7/15/2008	7.8	3.111	10.760	39.9	12	77
		Field dup	7/15/2008	7.3	3.322	10.380	45.5	12	72
		SA-POTW	9/22/2008	7.0	3.658	10.37	52.3	44	74
		SA-POTW	11/2/2008	20.0	2.040	11.81	10.2	40	90
		SA-POTW	2/18/2009	2.5	1.482	9.963	59.3	4	90
	Vacaville	VA-POTW	9/22/2008	4.0	0.554	8.582	13.9	15	22
		VA-POTW	11/2/2008	5.0	0.711	8.519	14.2	48	64
		VA-POTW	2/16/2009	3.0	0.692	7.037	23.1	4	36
	Stockton	ST-POTW	7/15/2008	2.8	0.792	8.521	28.3	6	6
		ST-POTW	9/22/2008	4.5	0.602	7.624	13.4	5	5
		ST-POTW	1/23/2009	2.0	1.731	7.787	86.6	12	12
		ST-POTW	4/8/2009	4.6	0.964	8.342	21.0	2	2
Storm Drains	Sump 104	SA-104	7/15/2008	1.5	0.503	5.166	33.5	46	98
		SA-104	9/22/2008	2.5	0.769	4.911	30.8	40	58
		SA-104	11/1/2008	36.5	7.474	8.414	20.5	80	94
		SA-104	2/18/2009	17.6	1.456	6.549	8.3	76	98
	Sump 28	SA-28	5/27/2008	14.0	0.785	3.852	5.6	100	100
		SA-28	7/15/2008	3.0	0.365	3.569	12.2	4	8
		SA-28	9/22/2008	1.5	0.290	3.117	19.3	12	12

Source Type	Location	Sta. #	Smpl date	TSS (mg/L)	POC (mg/L)	DOC (mg/L)	%C of TSS	% mortality	% impaired
		SA-28	11/1/2008	182.5	8.930	9.685	4.9	72	98
		SA-28	2/18/2009	108.2	6.300	4.135	5.8	72	100
	Vacaville drn	VD	11/1/2008	165.5	4.675	6.572	2.8	74	100
		Field dup	11/1/2008	83.0	4.848	4.407	5.8	54	100
		VD	3/3/2009	14.7	2.092	2.193	14.2	66	100
	Weston Rnch	WR	5/27/2008	1.0	0.538	5.154	53.8	34	70
		Field dup	5/27/2008	1.2	0.705	8.065	58.8	54	86
		WR	7/15/2008	1.5	0.424	4.319	28.3	36	76
		WR	9/22/2008	4.5	0.930	4.509	20.7	84	100
		WR	12/15/2008	12.0	2.033	6.995	16.9	82	100
		WR	2/18/2009	66.8	1.626	3.096	2.4	28	100
	Legion Park	LP	5/27/2008	4.8	3.223	4.763	67.1	2	2
		LP	7/15/2008	7.6	1.059	5.202	13.9	2	2
		LP	9/22/2008	6.0	0.808	4.588	13.5	10	16
		LP	12/15/2008	38.0	9.914	20.04	26.1	100	100
		LP	2/18/2009	43.8	3.850	4.678	8.8	20	100
	Morada Lane	ML	5/27/2008	65.8	11.424	13.470	17.4	36	72
		ML	7/15/2008	125.0	11.868	9.026	9.5	8	66
		ML	9/22/2008	6.0	1.178	3.474	19.6	100	100
		ML	12/15/2008	26.0	2.921	7.619	11.2	90	100
		ML	2/18/2009	115.9	4.762	3.383	4.1	98	100
Ag Drains	Andrus Island	AID	5/15/2008	13.3	3.305	20.625	24.8	4	4
		AID	6/24/2008	21.7	2.584	9.638	11.9	6	6
		AID	8/4/2008	13.3	2.525	16.690	19.0	2	20
		AID	8/21/2008	18.0	2.161	12.830	12.0	0	0

Source Type	Location	Sta. #	Smpl date	TSS (mg/L)	POC (mg/L)	DOC (mg/L)	%C of TSS	% mortality	% impaired
		AID	2/17/2009	13.2	1.732	28.480	13.1	2	2
		AID	4/8/2009	16.5	2.189	20.120	13.3	6	6
	Empire Tract	ETD	5/15/2008	12.5	2.632	39.140	21.1	10	10
		ETD	6/24/2008	11.7	1.616	11.340	13.8	6	6
		ETD	8/4/2005	1.0	0.937	19.060	93.7	2	2
		ETD	8/21/2008	5.5	1.097	15.310	19.9	0	0
		ETD-FD	8/21/2008	6.5	0.987	15.710	15.2	0	0
		ETD	1/23/2009	10.4	2.330	24.930	22.4	4	8
		ETD	4/8/2009	14.4	2.568	28.170	17.8	2	2
	Lower Roberts	LRD	5/15/2008	27.3	2.484	8.480	9.1	0	0
		LRD	6/24/2008	85.0	5.300	12.880	6.2	0	0
		LRD	8/21/2008	63.0	4.285	8.771	6.8	0	2
		LRD	1/22/2009	134.5	10.974	14.025	8.2	6	10
		LRD	2/17/2009	125.0	8.450	11.57	6.8	0	0
		LRD	4/8/2009	64.0	4.143	10.12	6.5	6	6
		LRD-FD	4/8/2009	61.0	3.927	11.14	6.4	2	4
	Merritt Island	MID	5/15/2008	16.0	1.155	5.980	7.2	4	4
		MID	6/24/2008	5.3	1.898	4.268	35.8	0	0
		MID	8/21/2008	25.5	1.016	2.970	4.0	0	0
		MID	1/23/2009	18.1	0.744	4.275	4.1	8	8
		MID	2/17/2009	17.2	0.749	4.132	4.4	0	0
	New Hope	NHTD	5/15/2008	38.0	1.676	3.752	4.4	4	4
		NHTD	6/24/2008	86.7	4.057	7.926	4.7	0	0
		NHTD	1/23/2009	21.8	1.597	4.752	7.3	2	10
		NHTD	2/17/2009	20.8	1.955	5.450	9.4	0	0

Source Type	Location	Sta. #	Smpl date	TSS (mg/L)	POC (mg/L)	DOC (mg/L)	%C of TSS	% mortality	% impaired
		NHTD	4/8/2009	24.2	4.462	6.723	18.4	2	2
	Ryers Island	RID	5/15/2008	14.0	1.290	5.130	9.2	2	2
		RID	6/24/2008	16.7	1.550	4.698	9.3	2	4
		RID	8/4/2008	10.0	1.384	4.452	13.8	4	4
		RID	8/21/2008	20.5	1.710	4.460	8.3	8	8
		RID	1/23/2009	35.5	2.351	18.220	6.6	20	28
		RID	2/17/2009	47.0	2.102	16.680	4.5	12	14
	Victoria Island	VID	5/15/2008	34.0	2.615	7.250	7.7	8	8
		VID	6/24/2008	99.2	6.046	9.090	6.1	0	0
		VID	8/4/2008	89.3	5.245	6.041	5.9	96	98
		VID	8/21/2008	90.0	4.900	6.058	5.4	4	4
		VID	1/23/2009	99.0	4.605	7.857	4.7	28	98
		VID	4/8/2009	68.0	6.476	7.602	9.5	6	6
	White Slough	WSD	5/15/2008	164.4	18.870	8.572	11.5	0	0
		WSD	6/24/2008	77.7	5.307	8.894	6.8	2	2
		WSD	8/4/2008	102.0	9.558	8.285	9.4	6	6
		WSD	8/21/2008	33.5	5.063	9.109	15.1	2	2
		WSD	1/23/2009	21.1	2.731	16.05	12.9	8	8
		WSD-FD	1/23/2009	19.0	2.465	17.08	13.0	4	4
		WSD	2/17/2009	76.5	7.265	13.21	9.5	2	8
Rivers	Sacramento	SA-RVR	5/27/2008	9.6	0.606	1.904	6.3	22	22
		SA-RVR	7/15/2008	25.2	0.681	1.952	2.7	4	10
		SA-RVR	9/22/2008	10.5	0.668	2.423	6.4	5	7
		SA-RVR	11/1/2008	13.0	0.331	2.013	2.5	28	30
		SA-RVR	2/16/2009	20.4	0.546	2.125	2.7	22	60

Source Type	Location	Sta. #	Smpl date	TSS (mg/L)	POC (mg/L)	DOC (mg/L)	%C of TSS	% mortality	% impaired
		SA-RVR	2/18/2009	184.3	3.071	3.286	1.7	10	12
		SA-RVR	3/3/2009	53.2	1.010	4.902	1.9	4	8
		SA7	2/23/2009	48.4	0.962	4.490	2.0	8	18
	American	SA4	3/3/2009	2.6	0.216	1.883	8.3	30	76
		SA4	3/18/2009	2.4	0.224	1.887	9.3	18	20
		SA5	2/23/2009	3.2	0.252	2.365	7.9	60	80
	San Joaquin	SJV	5/15/2008	34.4	1.895	7.468	5.5	0	0
		SJV	8/4/2008	70.0	2.598	3.070	3.7	4	4
		SJV	12/15/2008	10.0	0.359	2.753	3.6	2	22
		SJV	1/23/2009	31.2	0.761	2.928	2.4	18	22
		ST1	2/18/2009	17.2	0.693	3.732	4.0	4	22
		ST6	1/22/2009	3.5	0.418	4.121	11.9	14	24
	Ulatis Creek	V5	2/13/2009	27.0	1.587	2.593	5.9	16	74
	Alamo Creek	V6	2/13/2009	26.7	1.686	3.790	6.3	36	100

Table B-2 Whole water pyrethroid concentrations.
Bif: bifenthrin, lcy: lambda-cyhalothrin, esf: esfenvalerate, per: permethrin, cyf: cyfluthrin, cyp: cypermethrin.

Sta. #	Smpl date	ng/L bif	ng/L lcy	ng/L esf	ng/L per	ng/L cyf	ng/L cyp
SA-POTW	5/27/2008	2.73	0	0	0	0	0
SA-POTW	7/15/2008	0	3.48	0	12.24	0	0
Field dup	7/15/2008	0	6.42	0	14.23	0	0
SA-POTW	9/22/2008	0	0	3.69	17.17	0	0
SA-POTW	11/2/2008	0	0	0	0	0	0
SA-POTW	2/18/2009	0	0	0	9.39	0	17.03
VA-POTW	9/22/2008	0	0	0	0	0	0
VA-POTW	11/2/2008	0	0	0	0	0	0
VA-POTW	2/16/2009	6.26	0	0	0	0	0
ST-POTW	7/15/2008	1.41	0	0	7.88	0	0
ST-POTW	9/22/2008	0	0	0	0	0	0
ST-POTW	1/23/2009	4.76	0	0	0	0	0
ST-POTW	4/8/2009	3.97	0	0	0	0	0
SA-104	7/15/2008	1.89	0	0	0	0	2.61
SA-104	9/22/2008	3.83	0	0	0	0	0
SA-104	11/1/2008	19.9	3.27	0	0	3.12	12.33
SA-104	2/18/2009	8.38	3.13	0	10.46	0	0
SA-28	5/27/2008	2.27	6.16	0	0	0	0
SA-28	7/15/2008	1.56	0	0	0	0	0
SA-28	9/22/2008	0	0	0	0	0	0
SA-28	11/1/2008	22.37	1.05	0	14.02	3.78	10.35
SA-28	2/18/2009	3.8	1.69	0	18.36	6.87	0
VD	11/1/2008	25.46	0	0	8.98	2.41	8.45

Sta. #	Smpl date	ng/L bif	ng/L lcy	ng/L esf	ng/L per	ng/L cyf	ng/L cyp
Field dup	11/1/2008	31.46	1.84	0	31.04	4.70	5.67
VD	3/3/2009	29.77	2.61	0	25.69	11.01	0
WR	5/27/2008	3.95	0	0	1.87	0	1.23
Field dup	5/27/2008	1.96	0	0	0	0	0
WR	7/15/2008	0	0	0	0	0	0
WR	9/22/2008	0	1.96	0	5.56	3.46	0
WR	12/15/2008	0	0	0	0	10.9	0
WR	2/18/2009	25.72	2.30	0	24.99	13.97	10.71
LP	5/27/2008	1.00	0	0	0	0	0
LP	7/15/2008	0	0	0	2.41	0	0
LP	9/22/2008	3.31	0	0	1.48	0	0
LP	12/15/2008	19.13	0	0	45.77	14.46	0
LP	2/18/2009	6.73	0	0	10.22	9.56	0
ML	5/27/2008	7.76	0	0	0	0	0
ML	7/15/2008	10.46	2.08	0	7.9	3.17	4.86
ML	9/22/2008	1.30	0	0	0	0	0
ML	12/15/2008	18.42	0	0	18.52	14.97	0
ML	2/18/2009	29.63	2.78	0	30.46	7.40	7.79
AID	5/15/2008	0	0	0	0	0	0
AID	6/24/2008	0	0	0	0	0	0
AID	8/4/2008	0	0	0	0	0	0
AID	8/21/2008	0	0	0	0	0	0
AID	2/17/2009	5.84	0	0	0	0	0
AID	4/8/2009	0	0	0	0	0	0
ETD	5/15/2008	0	0	0	0	0	0
ETD	6/24/2008	0	0	0	0	0	0

Sta. #	Smpl date	ng/L bif	ng/L lcy	ng/L esf	ng/L per	ng/L cyf	ng/L cyp
ETD	8/4/2005	0	0	0	0	0	0
ETD	8/21/2008	0	0	0	0	0	0
ETD-FD	8/21/2008	0	0	0	0	0	0
ETD	1/23/2009	0	0	0	0	0	0
ETD	4/8/2009	0	0	0	0	0	0
LRD	5/15/2008	0	0	0	0	0	0
LRD	6/24/2008	1.36	0	0	0	0	0
LRD	8/21/2008	0	0	0	0	0	0
LRD	1/22/2009	0	0	0	0	0	0
LRD	2/17/2009	1.7	0	0	0	0	0
LRD	4/8/2009	0	0	0	0	0	0
LRD-FD	4/8/2009	0	0	0	0	0	0
MID	5/15/2008	0	0	0	0	0	0
MID	6/24/2008	0	0	0	0	0	0
MID	8/21/2008	0	0	0	0	0	0
MID	1/23/2009	0	0	0	0	0	0
MID	2/17/2009	0	0	0	0	0	0
NHTD	5/15/2008	0	0	0	0	0	0
NHTD	6/24/2008	0	0	0	0	0	0
NHTD	1/23/2009	0	0	0	0	0	0
NHTD	2/17/2009	0	0	0	0	0	0
NHTD	4/8/2009	0	0	0	0	0	0
RID	5/15/2008	0	0	0	0	0	0
RID	6/24/2008	0	0	0	0	0	0
RID	8/4/2008	0	0	0	0	0	0
RID	8/21/2008	0	0	0	0	0	0

Sta. #	Smpl date	ng/L bif	ng/L lcy	ng/L esf	ng/L per	ng/L cyf	ng/L cyp
RID	1/23/2009	0	0	0	0	0	0
RID	2/17/2009	0	0	0	0	0	0
VID	5/15/2008	0	0	0	0	0	0
VID	6/24/2008	0	0	0	0	0	0
VID	8/4/2008	0	17.46	1.1	0	0	0
VID	8/21/2008	0	0	0	0	0	0
VID	1/23/2009	0	3.18	0	0	0	0
VID	4/8/2009	0	0	0	0	0	0
WSD	5/15/2008	0	0	0	0	0	0
WSD	6/24/2008	0	0	0	0	0	0
WSD	8/4/2008	0	0	5.14	0	0	0
WSD	8/21/2008	0	0	0	0	0	0
WSD	1/23/2009	0	0	0	0	0	0
WSD-FD	1/23/2009	0	0	0	0	0	0
WSD	2/17/2009	3.01	0	0	0	0	0
SA-RVR	5/27/2008	0	0	0	0	0	0
SA-RVR	7/15/2008	1.37	0	0	0	0	0
SA-RVR	9/22/2008	0	0	0	0	0	0
SA-RVR	11/1/2008	0	0	0	0	0	0
SA-RVR	2/16/2009	0	0	0	0	0	0
SA-RVR	2/18/2009	2.71	0	0	0	0	0
SA-RVR	3/3/2009	0	0	0	0	0	0
SA7	2/23/2009	0	0	0	0	0	0
SA4	3/3/2009	0	0	0	0	0	0
SA4	3/18/2009	0	0	0	0	0	0
SA5	2/23/2009	0	0	0	0	0	0

Sta. #	Smpl date	ng/L bif	ng/L lcy	ng/L esf	ng/L per	ng/L cyf	ng/L cyp
SJV	5/15/2008	0	0	0	0	0	0
SJV	8/4/2008	0	0	0	0	0	0
SJV	12/15/2008	0	0	0	0	0	0
SJV	1/23/2009	0	0	0	0	0	0
ST1	2/18/2009	0	0	0	9.18	0	0
ST6	1/22/2009	0	0	0	0	0	0
V5	2/13/2009	10.44	2.19	0	2.49	0	0
V6	2/13/2009	17.92	0	0	5.95	6.56	0

Table B-3 Freely dissolved pyrethroid concentrations (ng/L).

C_{diss}: Estimated freely dissolved concentration, bif: bifenthrin, lcy: lambda-cyhalothrin, esf: esfenvalerate, per: permethrin, cyf: cyfluthrin, cyp: cypermethrin.

Sta. #	Smpl date	C_{diss} bif	C_{diss} lcy	C_{diss} esf	C_{diss} per	C_{diss} cyf	C_{diss} cyp
SA-POTW	5/27/2008	0.03	0.00	0.00	0.00	0.00	0.00
SA-POTW	7/15/2008	0.00	0.14	0.00	0.36	0.00	0.00
Field dup	7/15/2008	0.00	0.24	0.00	0.39	0.00	0.00
SA-POTW	9/22/2008	0.00	0.00	0.02	0.43	0.00	0.00
SA-POTW	11/2/2008	0.00	0.00	0.00	0.00	0.00	0.00
SA-POTW	2/18/2009	0.00	0.00	0.00	0.53	0.00	1.38
VA-POTW	7/15/2008	0.11	0.21	0.00	0.00	0.00	0.00
VA-POTW	9/22/2008	0.00	0.00	0.00	0.00	0.00	0.00
VA-POTW	11/2/2008	0.00	0.00	0.00	0.00	0.00	0.00
VA-POTW	2/16/2009	0.36	0.00	0.00	0.00	0.00	0.00
ST-POTW	7/15/2008	0.07	0.00	0.00	0.74	0.00	0.00
ST-POTW	9/22/2008	0.00	0.00	0.00	0.00	0.00	0.00
ST-POTW	1/23/2009	0.14	0.00	0.00	0.00	0.00	0.00
ST-POTW	4/8/2009	0.17	0.00	0.00	0.00	0.00	0.00
SA-104	7/15/2008	0.09	0.00	0.00	0.00	0.00	0.31
SA-104	9/22/2008	0.19	0.00	0.00	0.00	0.00	0.00
SA-104	11/1/2008	0.45	0.05	0.00	0.00	0.03	0.40
SA-104	2/18/2009	0.31	0.07	0.00	0.15	0.00	0.00
SA-28	5/27/2008	0.14	0.22	0.00	0.00	0.00	0.00
SA-28	7/15/2008	0.11	0.00	0.00	0.00	0.00	0.00
SA-28	9/22/2008	0.00	0.00	0.00	0.00	0.00	0.00
SA-28	11/1/2008	0.44	0.01	0.00	0.11	0.03	0.28
SA-28	2/18/2009	0.14	0.04	0.00	0.28	0.12	0.00

Sta. #	Smpl date	C_{diss} bif	C_{diss} lcy	C_{diss} esf	C_{diss} per	C_{diss} cyf	C_{diss} cyp
VD	11/1/2008	0.78	0.00	0.00	0.11	0.03	0.40
Field dup	11/1/2008	1.25	0.05	0.00	0.49	0.09	0.29
VD	3/3/2009	2.39	0.13	0.00	0.84	0.41	0.00
WR	5/27/2008	0.20	0.00	0.00	0.04	0.00	0.15
Field dup	5/27/2008	0.06	0.00	0.00	0.00	0.00	0.00
WR	7/15/2008	0.00	0.00	0.00	0.00	0.00	0.00
WR	9/22/2008	0.00	0.06	0.00	0.12	0.08	0.00
WR	12/15/2008	0.00	0.00	0.00	0.00	0.16	0.00
WR	2/18/2009	1.73	0.09	0.00	0.67	0.43	1.19
LP	5/27/2008	0.04	0.00	0.00	0.00	0.00	0.00
LP	7/15/2008	0.00	0.00	0.00	0.04	0.00	0.00
LP	9/22/2008	0.18	0.00	0.00	0.03	0.00	0.00
LP	12/15/2008	0.21	0.00	0.00	0.20	0.07	0.00
LP	2/18/2009	0.28	0.00	0.00	0.17	0.18	0.00
ML	5/27/2008	0.11	0.00	0.00	0.00	0.00	0.00
ML	7/15/2008	0.19	0.02	0.00	0.06	0.03	0.11
ML	9/22/2008	0.08	0.00	0.00	0.00	0.00	0.00
ML	12/15/2008	0.56	0.00	0.00	0.21	0.20	0.00
ML	2/18/2009	1.39	0.08	0.00	0.57	0.16	0.44
AID	5/15/2008	0.00	0.00	0.00	0.00	0.00	0.00
AID	6/24/2008	0.00	0.00	0.00	0.00	0.00	0.00
AID	8/4/2008	0.00	0.00	0.00	0.00	0.00	0.00
AID	8/21/2008	0.00	0.00	0.00	0.00	0.00	0.00
AID	2/17/2009	0.06	0.00	0.00	0.00	0.00	0.00
AID	4/8/2009	0.00	0.00	0.00	0.00	0.00	0.00
ETD	5/15/2008	0.00	0.00	0.00	0.00	0.00	0.00

Sta. #	Smpl date	C_{diss} bif	C_{diss} lcy	C_{diss} esf	C_{diss} per	C_{diss} cyf	C_{diss} cyp
ETD	6/24/2008	0.00	0.00	0.00	0.00	0.00	0.00
ETD	8/4/2005	0.00	0.00	0.00	0.00	0.00	0.00
ETD	8/21/2008	0.00	0.00	0.00	0.00	0.00	0.00
ETD-FD	8/21/2008	0.00	0.00	0.00	0.00	0.00	0.00
ETD	1/23/2009	0.00	0.00	0.00	0.00	0.00	0.00
ETD	4/8/2009	0.00	0.00	0.00	0.00	0.00	0.00
LRD	5/15/2008	0.00	0.00	0.00	0.00	0.00	0.00
LRD	6/24/2008	0.02	0.00	0.00	0.00	0.00	0.00
LRD	8/21/2008	0.00	0.00	0.00	0.00	0.00	0.00
LRD	1/22/2009	0.00	0.00	0.00	0.00	0.00	0.00
LRD	2/17/2009	0.03	0.00	0.00	0.00	0.00	0.00
LRD	4/8/2009	0.00	0.00	0.00	0.00	0.00	0.00
LRD-FD	4/8/2009	0.00	0.00	0.00	0.00	0.00	0.00
MID	5/15/2008	0.00	0.00	0.00	0.00	0.00	0.00
MID	6/24/2008	0.00	0.00	0.00	0.00	0.00	0.00
MID	8/21/2008	0.00	0.00	0.00	0.00	0.00	0.00
MID	1/23/2009	0.00	0.00	0.00	0.00	0.00	0.00
MID	2/17/2009	0.00	0.00	0.00	0.00	0.00	0.00
NHTD	5/15/2008	0.00	0.00	0.00	0.00	0.00	0.00
NHTD	6/24/2008	0.00	0.00	0.00	0.00	0.00	0.00
NHTD	1/23/2009	0.00	0.00	0.00	0.00	0.00	0.00
NHTD	2/17/2009	0.00	0.00	0.00	0.00	0.00	0.00
NHTD	4/8/2009	0.00	0.00	0.00	0.00	0.00	0.00
RID	5/15/2008	0.00	0.00	0.00	0.00	0.00	0.00
RID	6/24/2008	0.00	0.00	0.00	0.00	0.00	0.00
RID	8/4/2008	0.00	0.00	0.00	0.00	0.00	0.00

Sta. #	Smpl date	C_{diss} bif	C_{diss} lcy	C_{diss} esf	C_{diss} per	C_{diss} cyf	C_{diss} cyp
RID	8/21/2008	0.00	0.00	0.00	0.00	0.00	0.00
RID	1/23/2009	0.00	0.00	0.00	0.00	0.00	0.00
RID	2/17/2009	0.00	0.00	0.00	0.00	0.00	0.00
VID	5/15/2008	0.00	0.00	0.00	0.00	0.00	0.00
VID	6/24/2008	0.00	0.00	0.00	0.00	0.00	0.00
VID	8/4/2008	0.00	0.34	0.01	0.00	0.00	0.00
VID	8/21/2008	0.00	0.00	0.00	0.00	0.00	0.00
VID	1/23/2009	0.00	0.05	0.00	0.00	0.00	0.00
VID	4/8/2009	0.00	0.00	0.00	0.00	0.00	0.00
WSD	5/15/2008	0.00	0.00	0.00	0.00	0.00	0.00
WSD	6/24/2008	0.00	0.00	0.00	0.00	0.00	0.00
WSD	8/4/2008	0.00	0.00	0.02	0.00	0.00	0.00
WSD	8/21/2008	0.00	0.00	0.00	0.00	0.00	0.00
WSD	1/23/2009	0.00	0.00	0.00	0.00	0.00	0.00
WSD-FD	1/23/2009	0.00	0.00	0.00	0.00	0.00	0.00
WSD	2/17/2009	0.05	0.00	0.00	0.00	0.00	0.00
SA-RVR	5/27/2008	0.00	0.00	0.00	0.00	0.00	0.00
SA-RVR	7/15/2008	0.15	0.00	0.00	0.00	0.00	0.00
SA-RVR	9/22/2008	0.00	0.00	0.00	0.00	0.00	0.00
SA-RVR	11/1/2008	0.00	0.00	0.00	0.00	0.00	0.00
SA-RVR	2/16/2009	0.00	0.00	0.00	0.00	0.00	0.00
SA-RVR	2/18/2009	0.15	0.00	0.00	0.00	0.00	0.00
SA-RVR	3/3/2009	0.00	0.00	0.00	0.00	0.00	0.00
SA7	2/23/2009	0.00	0.00	0.00	0.00	0.00	0.00
SA4	3/3/2009	0.00	0.00	0.00	0.00	0.00	0.00
SA4	3/18/2009	0.00	0.00	0.00	0.00	0.00	0.00

Sta. #	Smpl date	C_{diss} bif	C_{diss} lcy	C_{diss} esf	C_{diss} per	C_{diss} cyf	C_{diss} cyp
SA5	2/23/2009	0.00	0.00	0.00	0.00	0.00	0.00
SJV	5/15/2008	0.00	0.00	0.00	0.00	0.00	0.00
SJV	8/4/2008	0.00	0.00	0.00	0.00	0.00	0.00
SJV	12/15/2008	0.00	0.00	0.00	0.00	0.00	0.00
SJV	1/23/2009	0.00	0.00	0.00	0.00	0.00	0.00
ST1	2/18/2009	0.00	0.00	0.00	0.23	0.00	0.00
ST6	1/22/2009	0.00	0.00	0.00	0.00	0.00	0.00
V5	2/13/2009	0.80	0.10	0.00	0.08	0.00	0.00
V6	2/13/2009	1.03	0.00	0.00	0.13	0.17	0.00

Table B-4 Concentration goal units calculated based on the 1st, 2.5, and 5th percentile UC Davis criteria.

		1st percentile		2.5 percentile		5th percentile	
Sta. #	Smpl date	CGU_{acute}	$CGU_{chronic}$	CGU_{acute}	$CGU_{chronic}$	CGU_{acute}	$CGU_{chronic}$
SA-POTW	5/27/2008	0.47	2.75	0.09	0.55	0.03	0.28
SA-POTW	7/15/2008	4.64	14.10	0.75	1.81	0.26	0.82
Field dup	7/15/2008	8.07	24.39	1.27	3.10	0.41	1.19
SA-POTW	9/22/2008	0.62	4.41	0.23	1.20	0.13	0.80
SA-POTW	11/2/2008	0	0.01	0	0	0	0
SA-POTW	2/18/2009	34.58	138.50	4.69	19.84	1.47	5.13
VA-POTW	9/22/2008	0	0.01	0	0	0	0
VA-POTW	11/2/2008	0	0.01	0	0	0	0
VA-POTW	2/16/2009	6.03	35.57	1.19	7.11	0.44	3.56
ST-POTW	7/15/2008	1.30	7.66	0.35	1.57	0.21	1.43
ST-POTW	9/22/2008	0	0.01	0	0	0	0
ST-POTW	1/23/2009	2.33	13.73	0.46	2.75	0.17	1.37
ST-POTW	4/8/2009	2.93	17.30	0.58	3.46	0.22	1.73
SA-104	7/15/2008	12.68	55.76	1.86	8.86	0.60	2.90
SA-104	9/22/2008	5.08	29.97	1.00	5.99	0.37	3.00
SA-104	11/1/2008	22.56	99.17	3.62	16.89	1.20	6.31
SA-104	2/18/2009	17.97	66.27	3.14	13.03	1.11	6.19
SA-28	5/27/2008	36.17	86.92	5.59	16.38	1.66	5.33
SA-28	7/15/2008	3.02	17.84	0.59	3.57	0.22	1.78
SA-28	9/22/2008	0	0.01	0	0	0	0
SA-28	11/1/2008	16.16	78.42	2.73	13.72	0.96	5.64
SA-28	2/18/2009	7.84	38.73	1.55	6.70	0.58	2.80
VD	11/1/2008	24.72	127.40	4.28	22.91	1.53	9.88

		1st percentile		2.5 percentile		5th percentile	
Sta. #	Smpl date	CGU_{acute}	$CGU_{chronic}$	CGU_{acute}	$CGU_{chronic}$	CGU_{acute}	$CGU_{chronic}$
Field dup	11/1/2008	31.99	163.32	5.84	30.07	2.16	13.84
VD	3/3/2009	59.90	324.63	11.85	61.14	4.45	28.42
WR	5/27/2008	10.17	51.14	1.73	9.17	0.62	4.05
Field dup	5/27/2008	1.85	10.89	0.36	2.18	0.14	1.09
WR	7/15/2008	0	0	0	0	0	0
WR	9/22/2008	12.32	41.01	2.19	7.23	0.75	2.52
WR	12/15/2008	6.02	42.12	1.40	7.02	0.53	2.11
WR	2/18/2009	89.01	441.16	15.73	77.11	5.63	31.22
LP	5/27/2008	0.74	4.37	0.15	0.87	0.05	0.44
LP	7/15/2008	0.03	0.19	0.03	0.05	0.03	0.19
LP	9/22/2008	4.55	26.87	0.91	5.38	0.36	2.82
LP	12/15/2008	6.61	41.59	1.46	7.80	0.61	3.85
LP	2/18/2009	9.56	61.89	2.11	11.23	0.83	4.76
ML	5/27/2008	1.81	10.67	0.36	2.13	0.13	1.07
ML	7/15/2008	8.08	36.28	1.36	6.24	0.47	2.46
ML	9/22/2008	1.83	10.82	0.36	2.16	0.14	1.08
ML	12/15/2008	18.80	118.55	4.05	22.13	1.59	10.07
ML	2/18/2009	39.78	196.48	7.11	35.17	2.57	15.30
AID	5/15/2008	0	0	0	0	0	0
AID	6/24/2008	0	0	0	0	0	0
AID	8/4/2008	0	0	0	0	0	0
AID	8/21/2008	0	0	0	0	0	0
AID	2/17/2009	1.71	10.10	0.34	2.02	0.13	1.01
AID	4/8/2009	0	0	0	0	0	0
ETD	5/15/2008	0	0	0	0	0	0

		1st percentile		2.5 percentile		5th percentile	
Sta. #	Smpl date	CGU_{acute}	$CGU_{chronic}$	CGU_{acute}	$CGU_{chronic}$	CGU_{acute}	$CGU_{chronic}$
ETD	6/24/2008	0	0	0	0	0	0
ETD	8/4/2005	0	0	0	0	0	0
ETD	8/21/2008	0	0	0	0	0	0
ETD-FD	8/21/2008	0	0	0	0	0	0
ETD	1/23/2009	0	0	0	0	0	0
ETD	4/8/2009	0	0	0	0	0	0
LRD	5/15/2008	0	0	0	0	0	0
LRD	6/24/2008	0.50	2.97	0.10	0.59	0.04	0.30
LRD	8/21/2008	0	0	0	0	0	0
LRD	1/22/2009	0	0	0	0	0	0
LRD	2/17/2009	0.51	2.99	0.10	0.60	0.04	0.30
LRD	4/8/2009	0	0	0	0	0	0
LRD-FD	4/8/2009	0	0	0	0	0	0
MID	5/15/2008	0	0	0	0	0	0
MID	6/24/2008	0	0	0	0	0	0
MID	8/21/2008	0	0	0	0	0	0
MID	1/23/2009	0	0	0	0	0	0
MID	2/17/2009	0	0	0	0	0	0
NHTD	5/15/2008	0	0	0	0	0	0
NHTD	6/24/2008	0	0	0	0	0	0
NHTD	1/23/2009	0	0	0	0	0	0
NHTD	2/17/2009	0	0	0	0	0	0
NHTD	4/8/2009	0	0	0	0	0	0
RID	5/15/2008	0	0	0	0	0	0
RID	6/24/2008	0	0	0	0	0	0

		1st percentile		2.5 percentile		5th percentile	
Sta. #	Smpl date	CGU_{acute}	$CGU_{chronic}$	CGU_{acute}	$CGU_{chronic}$	CGU_{acute}	$CGU_{chronic}$
RID	8/4/2008	0	0	0	0	0	0
RID	8/21/2008	0	0	0	0	0	0
RID	1/23/2009	0	0	0	0	0	0
RID	2/17/2009	0	0	0	0	0	0
VID	5/15/2008	0	0	0	0	0	0
VID	6/24/2008	0	0	0	0	0	0
VID	8/4/2008	33.30	79.29	5.01	12.67	1.43	3.39
VID	8/21/2008	0	0	0	0	0	0
VID	1/23/2009	5.90	13.20	0.89	2.21	0.25	0.59
VID	4/8/2009	0	0	0	0	0	0
WSD	5/15/2008	0	0	0	0	0	0
WSD	6/24/2008	0	0	0	0	0	0
WSD	8/4/2008	0.30	2.17	0.08	0.59	0.03	0.20
WSD	8/21/2008	0	0	0	0	0	0
WSD	1/23/2009	0	0	0	0	0	0
WSD-FD	1/23/2009	0	0	0	0	0	0
WSD	2/17/2009	0.93	5.51	0.18	1.10	0.07	0.55
SA-RVR	5/27/2008	0	0	0	0	0	0
SA-RVR	7/15/2008	3.19	18.84	0.63	3.77	0.24	1.88
SA-RVR	9/22/2008	0	0	0	0	0	0
SA-RVR	11/1/2008	0	0	0	0	0	0
SA-RVR	2/16/2009	0	0	0	0	0	0
SA-RVR	2/18/2009	2.33	13.76	0.46	2.75	0.17	1.38
SA-RVR	3/3/2009	0	0	0	0	0	0
SA7	2/23/2009	0	0	0	0	0	0

		1st percentile		2.5 percentile		5th percentile	
Sta. #	Smpl date	CGU_{acute}	$CGU_{chronic}$	CGU_{acute}	$CGU_{chronic}$	CGU_{acute}	$CGU_{chronic}$
SA4	3/3/2009	0	0	0	0	0	0
SA4	3/18/2009	0	0	0	0	0	0
SA5	2/23/2009	0	0	0	0	0	0
SJV	5/15/2008	0	0	0	0	0	0
SJV	8/4/2008	0	0	0	0	0	0
SJV	12/15/2008	0	0	0	0	0	0
SJV	1/23/2009	0	0	0	0	0	0
ST1	2/18/2009	0.17	1.05	0.17	0.26	0.17	1.05
ST6	1/22/2009	0	0	0	0	0	0
V5	2/13/2009	25.36	110.67	4.51	21.21	1.56	9.82
V6	2/13/2009	26.31	161.39	5.43	30.99	2.08	14.54

APPENDIX C

Category 4b Demonstration

USEPA regulations recognize that alternative pollution control requirements may obviate the need for a TMDL. Specifically, segments are not required to be included on the section 303(d) list if "[o]ther pollution control requirements (e.g., best management practices) required by local, State, or Federal authority" are stringent enough to implement applicable water quality standards (WQS) (see 40 CFR 130.7(b)(1)) within a reasonable period of time. These alternatives to TMDLs are commonly referred to as "Category" 4b determinations in reference to one of the classifications used in 303(d)/305(b) Integrated Reports. This Appendix provides the rationale for the State's Category 4b demonstration to USEPA for the five currently 303(d)-listed pyrethroids impairments being addressed in the proposed Basin Plan amendment.

An October 2006 USEPA memorandum (USEPA 2006) provides the recommended structure for addressing USEPA's expectations for Category 4b demonstrations. Category 4b demonstrations are expected to address the following six elements:

1. Identification of segment and statement of problem causing the impairment;
2. Description of pollution controls and how they will achieve water quality standards;
3. An estimate or projection of the time when WQS will be met;
4. Schedule for implementing pollution controls;
5. Monitoring plan to track effectiveness of pollution controls; and
6. Commitment to revise pollution controls, as necessary.

In addition, USEPA may request that the State provide further information supporting Category 4b determinations in order to demonstrate good cause not to include those segments on the 303(d) list of water bodies for which TMDLs are required. (40 CFR 130.7(b)(6)(iv)). In the analysis provided below, relevant sections of the October 2006 USEPA memorandum are shown in indented text, followed by the demonstration of how these expectations will be addressed upon adoption of the proposed amendment.

> *"States should submit their Category 4b demonstrations that address each of the six elements with their Section 303(d) list or Integrated Report submission. In general, the State's 4b demonstration should be submitted as a stand-alone document. In situations where data and information for a Category 4b demonstration are contained in existing documents developed under separate programs (e.g., NPDES permit, Superfund Record of Decision), the State should summarize relevant information in the Category 4b demonstration and reference the appropriate supporting documentation that provides that information. The supporting documentation should be included as part of the State's administrative record supporting the Category 4b determination."*

This Appendix summarizes the relevant information for the State's 4b demonstration and can be read as a stand-alone document showing how each of the six recommended elements for 4b submittals are addressed with references to appropriate sections of the Basin Plan amendment and staff report.

> ***"1. Identification of Segment and Statement of Problem Causing Impairment***
>
> ***Segment Description***
>
> *The demonstration should identify the impaired segment, including name, general location in the State, and State-specific location identifier. Also, the segment should be identified/georeferenced using the National Hydrography Dataset (NHD). The assessment information should be transmitted electronically through the Assessment Database (ADB)."*

The impaired segments being considered for a 4b classification are listed in Table C-1. These specific segments were identified to USEPA on the 2010 integrated report submittal to USEPA which included geo-referencing of the impaired segments, and compatibility with USEPA's Assessment Database.

> ***"Impairment and pollutant causing impairment***
>
> *The demonstration should identify the applicable water quality standard(s) not supported for each segment and associated pollutant causing the impairment."*

The water quality standards not being attained are the narrative toxicity and pesticide water quality objectives that are established in the Water Quality Control Plan for the Sacramento and San Joaquin River Basins. The specific

water body segments and pollutants causing the impairments being addressed in this Category 4b demonstration are summarized in Table C-1.

Table C-1 Water bodies and pollutants addressed by Category 4b

Water body segment	**Pollutant causing impairment**
Del Puerto Creek	Bifenthrin (water column), Pyrethroids (sediment)
Hospital Creek	Pyrethroids (sediment)
Ingram Creek (from confluence with Hospital Creek to Hwy 33 crossing)	Pyrethroids (sediment)
Ingram Creek (from confluence with San Joaquin River to confluence with Hospital Creek)	Pyrethroids (sediment)
Mustang Creek	Cis-permethrin (water column)

"Sources of pollutant causing impairment

The demonstration should include a description of the known and likely point, nonpoint, and background (upstream inputs) sources of the pollutant causing the impairment, including the magnitude and locations of the sources. In cases where some portion of the impairment may result from naturally occurring sources (natural background), the demonstration should include a description of the naturally occurring sources of the pollutant to the impaired segment."

The sources of pyrethroids to the impaired segments being considered are agricultural applications to fruit and nut trees, alfalfa, tomatoes and a variety of other crops. In these particular water bodies, there are no identified municipal and domestic storm water or wastewater sources. The only other potential source identified is discharges related to vector control applications. Only one of the six pyrethroids of concern is currently used for vector control and that is permethrin. Vector control applications are not likely a significant source in these agriculturally dominated water bodies considering they account for only 3% of all pyrethroid use in the Project Area (based on annual average from 2007-2011, CDPR 2013). In addition, a recent statewide study showed no residual toxicity in areas where permethrin was applied for vector control (Phillips et al. 2014). For these reasons, vector control applications are not considered a source causing impairments.

"2. Description of Pollution Controls and How They Will Achieve Water Quality Standards

Water quality target

The demonstration should identify a numeric water quality target(s) – a quantitative value used to measure whether or not the applicable water quality standard is attained. Generally, the pollutant of concern and the numeric water quality target are, respectively, the chemical causing the impairment and the numeric criteria for that chemical contained in the water quality standard. The demonstration should express the relationship between any necessary reduction of the pollutant of concern and the attainment of the numeric water quality target. Occasionally, the pollutant of concern is different from the pollutant that is the subject of the numeric water quality target (e.g., when the pollutant of concern is phosphorous and the numeric water quality target is expressed as dissolved oxygen (DO) criteria). In such cases, the Category 4b demonstration should explain the linkage between the pollutant of concern and the chosen numeric water quality target. In other cases, multiple indicators and associated numeric target values may be needed to interpret an individual water quality standard (e.g., multiple fish habitat indicators to interpret acceptable sediment levels). In cases where the impairment is based on non-attainment of a narrative (nonnumeric) water quality criterion, the Category 4b demonstration should identify one or more appropriate numeric water quality target levels that will be used to evaluate attainment of the narrative water quality criteria. The Category 4b demonstration should also describe the basis for selecting the numeric target levels."

The water quality targets for pyrethroids are the proposed acute and chronic additive pyrethroids numeric triggers. The numeric triggers contain maximum acute and chronic concentrations that are considered additively for the six pyrethroids of concern. Measured concentrations, or averages of measured concentrations when more than one sample is available during a 1-hour or 4-day averaging period, are compared to the defined water quality criteria. Additionally, if more than one pyrethroid is detected, they are considered additively as shown in Table IV-Z of the Proposed Basin Plan Amendment for Pyrethroid Pesticides.

"Point and nonpoint source loadings that when implemented will achieve WQS

The demonstration should describe the cause-and-effect relationship between the water quality standard (and numeric water quality target as

> *discussed above) and the identified pollutant sources and, based on this linkage, identify what loadings are acceptable to achieve the water quality standard. The cause-and-effect relationship may be used to determine the loading capacity of the water body for the pollutant of concern. However, a loading capacity may not be relevant in all circumstances. For example, a loading capacity would not be relevant in situations where the pollutant source will be completely removed. The demonstration should identify the loading capacity of the segment for the applicable pollutant or describe why determination of the loading capacity is not relevant to ensure that the controls are sufficient to meet applicable water quality standards. The demonstration should also contain or reference documentation supporting the analysis, including the basis for any assumptions; a discussion of strengths and weaknesses in the analytical process; and results from any water quality modeling or data analysis.*

The most sensitive endpoints to pyrethroids are direct toxic effects to aquatic invertebrates, which are directly related to acute and chronic concentrations in water (section 5, staff report). For this reason, the numeric triggers are defined in the proposed amendment as acute and chronic concentrations. These pesticides are not persistent, so their concentrations are directly a function of the concentrations being discharged upstream within the same time period that concentrations are measured. Attaining these triggers is directly a function of the acute and chronic concentrations in discharges to the impaired water bodies during in the time attainment is needed, and the time immediately subsequent to allow for travel time, which is on the order of days to hours for the impaired segments under consideration. Since this is a concentration-based program, the loading capacity for each of the segments being considered can be defined using the concentration times the flow to determine an allowable mass per time. If multiple pesticides are present, the additivity formula from the Basin Plan can be used to normalize to toxic equivalents, which can be multiplied times flow to determine an allowable loading in bifenthrin toxic equivalents per unit time.

Assuming these chemicals are conservative, the sum of the discharges times the flow for each segment would need to be less than the assimilative capacity for each segment. While the assimilative capacity varies for each of these segments during different flow conditions, the attainment of the assimilative capacity can be directly assessed by concentration measurements in the impaired segments.

"Controls that will achieve WQS

The demonstration should describe the controls already in place, or scheduled for implementation, that will result in reductions of pollutant loadings to a level that achieves the numeric water quality standard. The demonstration should also describe the basis upon which the State concludes that the controls will result in the necessary reductions."

As discussed in sections 7.2.3 of the staff report, there are many agricultural management practices that are effective at reducing offsite movement of pyrethroids into surface water. Although detailed information on the extent of implementation of runoff mitigation practices is not currently available, available information indicates that many of these practices are already used by a significant portion of the growers in the Central Valley (ICF International 2010, 2011). The major types of management practices available for reducing pyrethroids in agricultural discharges are:

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

As discussed in the staff report, viable pest control alternatives to pyrethroids are available that should be viable for both pest management and water quality protection, including mitigating potential effects of replacement products (section 7.2.3, staff report). When pesticides that pose significant risks to water quality, such as pyrethroids, are used, a broad range of pesticide application, vegetation management and water management practices are available to growers that can significantly reduce or eliminate pyrethroids discharges (Zhang et al. 2010).

Pesticide application practices include turning off outward facing airblast sprayer nozzles at the end of rows and on outside rows, 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 increase infiltration and/or decrease runoff and drift. Examples of these types of practices include planting cover crops, buffer strips, or allowing native vegetation to grow where they would reduce runoff rates and drift.

Water management practices include improvements in water infiltration and runoff control include increased irrigation efficiency and distribution uniformity, increased use of soil moisture monitoring tools, increased use of tailwater return systems, and vegetated drainage ditches.

All of these practices can result in significant reductions of the discharges of pyrethroids. Ultimately if necessary the practices include ones that completely eliminate irrigation return flows. Therefore these practices can result in the necessary reductions to achieve the numeric water quality standards. The practices utilized may vary from field to field but the regulatory requirements will ensure that the practices implemented will continue to be improved until the impairments are addressed.

Agricultural dischargers have completed several management plans for pyrethroids (see Appendix E). There are five examples in which pyrethroids were identified as a cause of an exceedance, which required dischargers to implement management plans for pyrethroids. Completion of a management plan indicates that management actions were implemented by agricultural dischargers that resulted in no further pyrethroid exceedances. Successful completion of pyrethroid management plans in other agricultural watersheds indicates that controls are available that will result in achieving water quality standards.

The water bodies being considered for 4b classification do not receive discharges from point sources, so controls are not described for these types of dischargers.

"Description of requirements under which pollution controls will be implemented

The demonstration should describe the basis for concluding that the pollution controls are requirements or why other types of controls already in place may be sufficient, as discussed below.

As discussed in the 2006 IR guidance, EPA will consider a number of factors in evaluating whether a particular set of pollution controls are in fact "requirements" as specified in EPA's regulations, including: (1) authority (local, State, Federal) under which the controls are required and will be implemented with respect to sources contributing to the water quality impairment (examples may include: self-executing State or local regulations, permits, and contracts and grant/funding agreements that require implementation of necessary controls); (2) existing commitments

made by the sources to implement the controls (including an analysis of the amount of actual implementation that has already occurred); (3) availability of dedicated funding for the implementation of the controls; and (4) other relevant factors as determined by EPA depending on case specific circumstances.

Since the overriding objective of the 4b alternative is to promote implementation activities designed to achieve water quality standards in a reasonable period of time, for all of the factors listed above, EPA will evaluate each 4b alternative on a case-by-case basis, including in particular the existence of identifiable consequences for the failure to implement the proposed pollution controls. Depending on the specific situation, "other pollution control requirements" may be requirements other than those based on statutory or regulatory provisions, as long as some combination of the factors listed above are present and will lead to achievement of WQS within a reasonable period of time. For example, established plans of government agencies that require attainment of WQS within a reasonable period of time may qualify even when their components include incentive-based actions by private parties. States may also choose to rely on controls that have already been implemented where there is sufficient certainty that implementation will continue until WQS are achieved and will not be reversed. Because the controls are already in place and achieving progress, EPA may consider such controls to be requirements even if their implementation did not occur pursuant to binding legal authority.

Pursuant to the Porter-Cologne Water Quality Control Act, the Central Valley Water Board has adopted Waste Discharge Requirements for all agricultural dischargers of in the Central Valley Region (Ag WDRs). Therefore all agricultural sources of pyrethroids to the water bodies for which numeric triggers are to be established in the proposed amendment, including all the segments shown in Table C-1, are regulated under state authority. Under the proposed amendment, the agricultural dischargers must have submitted management plans detailing specific practices that will be implemented within 60 days of the effective date of the proposed amendment (USEPA adoption). These management plans must detail specific management practices to be implemented to achieve water quality objectives as soon as possible but no later than 20 years.

"3. Estimate or Projection of Time When WQS Will Be Met

> *EPA expects that segments impaired by a pollutant but not listed under Section 303(d) based on the implementation of existing control requirements will attain WQS within a reasonable period of time.*
>
> *The demonstration should provide a time estimate by which the controls will result in WQS attainment, including an explanation of the basis for the conclusion. The demonstration should also describe why the time estimate for the controls to achieve WQS is reasonable. EPA will evaluate on a case-specific basis whether the estimated time for WQS attainment is reasonable. What constitutes a "reasonable time" will vary depending on factors such as the initial severity of the impairment, the cause of the impairment (e.g., point source discharges, in place sediment fluxes, atmospheric deposition, nonpoint source runoff), riparian condition, channel condition, the nature and behavior of the specific pollutant (e.g., conservative, reactive), the size and complexity of the segment (e.g., a simple first-order stream, a large thermally stratified lake, a density-stratified estuary, and tidally influenced coastal segment), the nature of the control action, cost, public interest, etc."*

As discussed above, management plans are required in the proposed amendment that must detail management practices to be implemented to achieve water quality objectives as soon as possible but no later than 20 years following adoption of the proposed amendment. Since the Board and agricultural stakeholders have identified these pesticides as a high priority, the Board expects these impairments should likely be resolved within a few years of adoption of the proposed amendment. Therefore the implementation of management practices is expected to begin shortly after the effective date of the proposed amendment, and attainment of water quality objectives is required within 20 years for all of the segments in Table C-1, but may occur sooner.

> ***"4. Schedule for Implementing Pollution Controls***
> *The demonstration should describe, as appropriate, the schedule by which the pollution controls will be implemented and/or which controls are already in place."*

Upon adoption of the proposed amendment, management plans will be due from the agricultural discharges within 60 days that describe practices to be implemented to attain standards. Implementation of management practices to reduce discharges would be expected to begin upon completion of those management plans. All of these segments have management plans already in

place for pesticides and growers are implementing practices to reduce discharges, but the management plans may need to be revised to focus more specifically on pyrethroids.

> ***"5. Monitoring Plan to Track Effectiveness of Pollution Controls***
> *The demonstration should include a description of, and schedule for, monitoring milestones to track effectiveness of the pollution controls. The demonstration should describe water quality monitoring that will be performed to determine the combined effectiveness of the pollution controls on ambient water quality. If additional monitoring will be conducted to evaluate the effectiveness of individual pollution controls, EPA encourages States to include a description of these efforts as well. The demonstration should identify how and when assessment results from the monitoring will be reported to the public and EPA."*

The proposed amendment requires that the monitoring and reporting programs that address agricultural discharges to the impaired waters be designed to meet the following goals:

1) Determine whether receiving waters are attaining the Acute and Chronic Pyrethroid Triggers (Table IV-Z) by providing pyrethroid and dissolved and particulate organic carbon concentration data;

2) Determine whether receiving waters and bed sediments are attaining the narrative water quality objective for toxicity by providing *Hyalella azteca* toxicity test data;

3) Determine whether the implementation of management practices is sufficient to attain the Acute and Chronic Pyrethroid Triggers (Table IV-Z) in receiving waters.

4) Determine whether alternatives to pyrethroid pesticides are being discharged at concentrations that have the potential to cause or contribute to exceedances of applicable water quality objectives.

The proposed amendment also states that:

"With Executive Officer approval, representative monitoring programs, including coordinated regional or statewide monitoring programs, may be used to meet the monitoring requirements."

and

"Changes in monitoring frequency may result if information such as pesticide use data, pesticide registration status, allowable pesticide uses, use restrictions, management practices, runoff potential, or other monitoring studies indicates additional or less monitoring is needed to meet the monitoring requirements, which may include discontinuation of pyrethroid pesticides monitoring."

Expected monitoring is described in greater detail in section 8.2 of the staff report. Generally the goals for pyrethroids numeric triggers will be met by the monitoring of these pesticides in the subject segments during and following the times of applications of these products in upstream watersheds.

Specific monitoring and reporting programs for agricultural dischargers have been adopted by the Board pursuant to the Ag WDRs. These monitoring and reporting programs can be modified by the Executive officer if necessary to ensure that the goals adopted by the Board are met. All the agricultural dischargers provide annual monitoring reports and management plan update reports to the Board which will contain the data needed to meet the goals in the Basin Plan. These monitoring reports are publicly available documents that are posted on the Boards website. Additionally the monitoring data from the ILRP is routinely uploaded to the States California Environmental Date Exchange Network (CEDEN) database. The most recent monitoring data will also be included as lines of evidence for the pyrethroids in these segments in subsequent Integrated Report cycles so that USEPA will be able to assess the data as well.

> ***"6. Commitment to Revise Pollution Controls, as Necessary***
> *The demonstration should provide a statement that the State commits to revising the pollution controls, as necessary, if progress towards meeting water quality standards is not being shown. Also, the demonstration should identify how any changes to the pollution controls, and any other element of the original demonstration, will be reported to the public and EPA."*

The proposed amendment requires that if management plans are not resulting in attainment of standards, the Executive Officer will require the development of revised management plans. If standards are not attained through implementation of a single management plan for multiple dischargers, under the Ag WDRs

individual management plans can be required from each discharger to an impaired segment if necessary.

All the management plans submitted to the Board are publicly available documents that are posted on the Board's website. The most recent management plans will also be included as lines of evidence to support continued 4b designation for the pyrethroids listings in these segments in subsequent Integrated Report cycles, until such time as pyrethroids concentrations are no longer exceeding water quality standards in all of these segments.

References:

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USEPA. 2006. Memorandum from Diane Regas to USEPA Regional Water Division Directors entitled "Information Concerning 2008 Clean Water Act Sections 303(d), 305(b), and 314 Integrated Reporting and Listing Decisions." United States Environmental Protection Agency, Office of Wetlands, Oceans and Watersheds. Washington, D.C.

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APPENDIX D

NPDES permitted discharges within TMDL watersheds

This appendix summarized the national pollutant discharge elimination system (NPDES) permitted dischargers within watersheds for which pyrethroids TMDLs are proposed. The TMDL water bodies are Arcade Creek, Chicken Ranch Slough, Curry Creek, Elder Creek, Kaseberg Creek, Morrison Creek, Pleasant Grove Creek, Pleasant Grove Creek South Branch, and Strong Ranch Slough. The discharges include municipal storm water discharges, biological and residual pesticide discharges from vector control applications, storm water from California Department of Transportation, storm water discharges from construction and land disturbance activities, storm water discharges from industrial activities, and industrial wastewater discharges. Of these discharges, the only NPDES permittees known to be a significant source of pyrethroids are municipal separate storm sewer systems (MS4s) listed in section 6.1. The following analysis discusses the remaining discharges to examine their potential contributions to the pyrethroid impairments in these water bodies.

For the reasons described below, the point source dischargers listed in this Appendix are not known to discharge any pyrethroids or discharge insignificant amounts that would not need to be limited with a wasteload allocation in order for the pyrethroid TMDLs to be attained.

D.1 Statewide Permit for Biological and Residual Pesticide Discharges to Waters of the United States from Vector Control Applications, NPDES No. CAG990004

Only one of the six pyrethroids of concern is currently used for vector control and that is permethrin. Vector control applications account for only 3% of all pyrethroid use in the Sacramento River and San Joaquin River basins (based on annual average from 2007-2011, CDPR 2013). Vector control applications of permethrin may occur in the TMDL watersheds but they account for a much smaller proportion than use in these watersheds compared to structural pest control uses, which accounts for 47% of all pyrethroid use in the Project Area (based on annual average from 2002-2011, CDPR 2013). A recent statewide study that investigated the potential for vector control applications to cause toxic

effects to aquatic life showed no residual toxicity in areas where permethrin was applied for vector control (Phillips et al. 2014). Because the results of this study showed no toxic effects following vector control applications, the State Water Board determined that toxicity and residue monitoring do not need to be required under the statewide vector control NPDES permit. Because the statewide vector control NPDES permit requires that vector control operations will not cause or contribute to water quality objective exceedances and these applications represent an insignificant source of pyrethroids to impaired waters in the Project Area, no specific wasteload allocations for vector control sprays are included in the TMDLs.

D.2 Statewide Storm Water Permit for State of California Department of Transportation, NPDES No. CAS000003

Pyrethroids have very little use on rights-of-way because most applications to rights-of-way are for weed control and herbicides are used in these treatments, not insecticides such as pyrethroids. In 2014, the most recent year of pesticide use data available, less than 1 pound of pyrethroids was applied on rights-of-way in Sacramento and Placer counties, where the TMDL watersheds occur (CDPR 2014). Because so little pyrethroids are applied to rights-of-way, storm water discharges from California state highways are not expected to contribute a significant amount of pyrethroids to the TMDL watersheds and no specific wasteload allocations for CalTrans storm water discharges are included in the TMDLs.

D.3 General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities, NPDES No. CAS000002

The main use of pyrethroids in construction of new buildings is for pre-construction termite treatments in which pyrethroids may be applied to the soil subsurface prior to pouring concrete foundations. Because these are typically subsurface applications, the likelihood of storm water discharges is decreased. In addition, the 2012 DPR surface water regulations apply to these applications and when preconstruction termiticide treatments are done prior to precipitation the site must be covered with waterproof covering or the concrete slab must be poured over the treated soil. The DPR surface water regulations also prohibit these applications during rainfall. Because there is little likelihood that these types of applications contribute a significant amount of pyrethroids to the TMDL watersheds, no specific wasteload allocations are included for storm water discharges from construction and land disturbance activities. In addition, the proposed conditional prohibition would apply to these dischargers, so if any

future monitoring indicated that a discharge is exceeding the pyrethroid triggers, management practices would be required.

Due to their negligible contributions of pyrethroids to the TMDL water bodies, wasteload allocations are not included for the 141 dischargers within the TMDL watersheds currently with coverage under the General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities (Table D-1) or for any future discharger within the TMDL watersheds covered under this permit.

Table D-1 Waste dischargers within the TMDL watersheds covered under the Construction General NPDES Permit

Construction General Permit, NPDES No. CAS000002	
Waste Discharger ID	**Facility Name**
5S34C372569	Vineyard Creek Villages 4 and 5 Gerber Creek
5S34C371874	The Oaks at Carmichael
5S34C374353	Fair Oaks Boulevard
5S34C377656	Cypress Place
5S34C376287	Dignity Health MOB
5S34C373332	Applebees Citrus Heights
5S34C377231	Alta Sunrise
5S34C378621	Sylvan Middle School Demolition
5S34C370661	Northridge Grove
5S34C376828	Sheldon Crossroads
5S34C344219	Glenwood Unit #5
5S34C361784	First Baptist Church of Elk Grove
5S34C364597	8282 Dunisch Raod
5S34C376070	Fieldstone North
5S34C369047	Northwest Unit No 1
5S34C375838	Calistoga
5S34C375060	Capital Reserve
5S34C378290	Sacramento Regional County Sanitation District
5S34C376079	Sheldon Rd & Waterman Rd Intersection Improvments Project
5S34C374411	Fieldstone South and Hudson Basin
5S34C370271	Sheldon Park Estates
5S34C376705	8151 Sheldon Multi-Family Units
5S34C377241	Emerald Park Estates
5S34C377793	Shadowbrook Gardens
5S34C377453	Oakmont Fair Oaks
5S34C377272	Gum Ranch Unit No 1
5S34C375650	Meier Estates Subdivision
5S34C368972	The Village at Fair Oaks
5S34C369325	Talmont
5S34C377826	Truemper Way, Mather Airport
5S34C377729	Mather Airport TWY B
5S34C365759	Mather Airport Fuel Farm
5S34C372986	Almond East
5S34C378783	APG

Construction General Permit, NPDES No. CAS000002	
Waste Discharger ID	**Facility Name**
5S34C372539	Camden at Somerset Ranch
5S34C375514	Anatolia Elementary School
5S34C372567	Kensington Estate at Somerset Ranch
5S34C378855	Grant Line and Douglas Signal Project
5S34C375422	Douglas Road Widening
5S34C375459	Rancho Cordova Parkway
5S34C367831	Kavala Ranch
5S34C377288	CRPD Shooting Center Lead Reclamation Project
5S34C374509	Sunridge Villages 1 and 2
5S34C374245	Heron Landing Community Park
5S34C372375	Highland Grove at Somerset Ranch
5S34C375789	Sunridge Plaza
5S34C375959	Sherman Island Levee Improvement Project
5S31C376098	Divine Truck Facility
5S31C374818	Whitney Ranch Phase 2J
5S31C377876	Whitney Ranch 41A
5S31C366654	Two Oaks
5S31C378164	Stanford Ranch Congregate Care Facility
5S31C375929	Pebble Creek
5S31C376912	Placer Creek Corporate Center
5S31C377511	Wildcat Subdivision
5S31C369848	Whitney Ranch Phase 2C & 2D
5S31C374884	The Goddard School
5S31C365711	Stanford Ranch Parcel 69
5S31C377358	Spring Valley Phase 2
5S31C372402	Spring Valley Phase 1
5S31C378306	Ironwood
5S31C372606	Stanford Ranch Parcel 61
5S31C375628	LNG CNG Operations Center
5S31C370516	Whitney Ranch Unit 22
5S31C368160	Lot 2A Sunset West
5S31C372972	NCRSP Parcel 49
5S31C372401	Oakbriar F 23
5S31C378041	Roseville Self Storage
5S31C369713	HP Campus Oaks Phased Development Project
5S31C372135	Carrington at West Park
5S31C372975	Fiddyment Villages 9A2 19A2 19B2
5S31C366651	West Park Village 26
5S31C372901	Fiddyment Ranch Village 83 Open Space Bike Trail and Garden
5S31C373060	Fiddyment Villages 9A1 and 19A1 and 19B1
5S31C375556	The Falls Event Center Roseville
5S31C370715	Blue Oaks Commerce Center
5S31C376373	Manchester at Solaire
5S31C377686	Westbrook
5S31C370700	Westpark Phase 4
5S31C366786	Fiddyment Ranch Village F16
5S31C363006	Diamond Creek DC 31
5S31C367839	West Park 4 Villages 19a 19b 17c 17d 18B 18C

Construction General Permit, NPDES No. CAS000002	
Waste Discharger ID	**Facility Name**
5S31C375354	RCSD W70 Elementary School
5S31C372527	West Park Phase 4 North
5S31C367840	Ridgefield Villages 17E 18E 18F
5S31C366614	Fiddyment Ranch Village 15 A B C
5S31C374809	West Park Village 24
5S31C373318	West Park Phase 4 Vil 18A
5S31C372536	Fire Station No.1
5S31C366586	WestPark Village 15
5S31C366914	West Park Phase 3 Village 13
5S31C377331	Fiddyment F-13B1
5S31C373492	Fiddyment Ranch Village 9A Phase 1
5S31C372537	Solmere Village 5A 5B
5S31C373842	Diamond Creek II
5S31C377039	Westbrook Village 6
5S34C369541	Palisades Sierra Oaks
5S34C364814	Marquee
5S34C365452	Gurudwara Dasmesh Darbar
5S34C374340	US Cold Storage
5S34C377114	Sikh Temple
5S34C369590	Vinyard Community Center
5S34C376355	Abo Zayed Lane
5S34C377809	Vineyard Creek Unit 10
5S34C374141	Gerber Road Landfill
5S34C375850	Arden Way Redevelopment
5S34C375364	Waterman Road
5S34C369313	Wild Hawk South
5S34C374139	Willowood Cottages
5S34C373217	Lotus Casino
5S34C372640	Hanson Florin Zero Discharge
5S34C375202	Florin Road Widening
5S34C378728	The Procter & Gamble Mfg Co
5S34C373743	Bradshaw Christian School
5S34C378507	Chilis #1586
5S34C373929	Del Paso Nuevo Phase 5
5S34C365552	South Sacramento Corridor Phase 2 Project
5S34C371693	Vineyard Creek Units 2 and 3
5S34C351224	Coppertstone Villages II & III
5S34C377555	Shasta Park
5S34C374579	Maita Subaru
5S34C371694	Vineyard Creek Unit 1
5S34C373320	Elder Creek Phase II Improvements
5S34C375745	Citrus Estates
5S34C374634	Florin Creek Multi Use Basins
5S34C363975	Siemens
5S34C376378	Villa Terrassa
5S34C376069	South Sac Streams Florin Creek Franklin Bl to Hwy 99
5S34C370316	Unitarian Universalist Society of Sacramento
5S34C370680	Cristo Rey High School

Construction General Permit, NPDES No. CAS000002	
Waste Discharger ID	**Facility Name**
5S34C374803	Capital Corrugated
5S34C378724	Gerber Road Widening
5S34C368690	Caselman Ranch
5S34C378735	North Sac Streams Levee Improvement Project
5S34C370397	Chocker Calvine Road Commercial Project
5S34C378550	Fowler Estate Subdivision
5S34C369901	Garfoot Greens
5S34C371526	HBA Retail Center
5S34C370000	Evan Estates
5S34C376224	Sommerset Housing
5S34C376360	8640 thru 8680 Fruitridge Road

D.4 General Permit for Storm Water Discharges Associated with Industrial Activities, NPDES No. CAS000001

NPDES-permitted industrial storm water dischargers may use pyrethroids for structural pest control on their premises, either applying pyrethroids themselves or hiring a commercial pesticide applicator, however information is not available to know how many industrial facilities apply pyrethroids and how much pyrethroids they may apply. There is also no monitoring data to demonstrate whether or not industrial facilities are discharging pyrethroids in their storm water. Industrial storm water discharges make up a very small portion of the storm water discharges within the TMDL watersheds, with the majority of storm water being discharged by MS4s. Because there is no information that indicates that industrial dischargers are likely to contribute significantly to the pyrethroids impairments, wasteload allocations are not proposed for these dischargers. In addition, the conditional prohibition does apply to these dischargers so if any future monitoring indicated that a discharger is exceeding the pyrethroid triggers, management practices would be required. Wasteload allocations are not included for the 148 dischargers within the TMDL watersheds currently with coverage under the General Permit for Storm Water Discharges Associated with Industrial Activities (Table D-2) or future discharges within the TMDL watersheds covered under this permit.

Table D-2 Waste dischargers within the TMDL watersheds covered under the Industrial General NPDES Permit

Industrial General Permit, NPDES No. CAS000001	
Waste Discharger ID	**Facility Name**
5S34I010450	Jim Dobbas Inc
5S34I001765	Hanford Ready Mix Inc
5S34I023462	Cordeiro Vault Co Inc
5S34I015109	UPS Sacramento Gateway CAMAT

Industrial General Permit, NPDES No. CAS000001	
Waste Discharger ID	**Facility Name**
5S34I019077	Mather Aviation LLC
5S34I017423	Sacramento Mather Airport
5S34I019705	US Powder Coating Inc
5S34I021305	Southwestern Wire Inc
5S34I019428	Sacramento Rental LP
5S34I007295	Sacramento County North Area Recovery Station
5S34I025702	Recycling Industries Watt
5S34I018204	SJUSD Transportation
5S34I024907	NorCal Car Truck Wrecking
5S34I020011	Redline Performance Auto Dismantling & Sales Inc
5S34I026597	Truck Time Auto Wrecking
5S34I024662	All Chrysler Dodge Auto Wrecking
5S34I027028	KPN AUTO DISMANTLING
5S34I016150	All Hyundai Izuzu Auto Rec
5S34I023666	HP Motors
5S34I023777	European Recycling Inc
5S34I026268	Hat Auto Parts Recycling inc
5S34I024298	Acura Honda Dismantling Inc
5S34I016853	Teichert Aggregates Grantline
5S34I027004	ALL HONDA & NISSAN AUTO RECYCLING
5S34I025030	Exotic Auto Recycling Inc
5S34I026448	A P Auto Dismantler
5S34I025415	BAP Dismantling LLC
5S34I026869	Sac City Auto Parts inc
5S34I024507	DBA Specialized Subaru Parts
5S34I024889	Capital One Auto Dismantlers Inc
5S34I019532	AAA Dodge Truck
5S34I026872	EUROPEAN PARTS DEPOT
5S34I025203	Quality German Auto Recyling LLC
5S34I025198	West Coast American Auto Dismantling
5S34I001467	Folsom Cordova School District
5S34I027030	Import Auto Parts
5S34I026789	DELTA 1 AUTO DISMANTLING
5S34I026892	European Auto Recycling, Inc.
5S34I021265	GR Trucking LLC
5S34I023976	Economy Auto Dismantling
5S34I024264	Mercedes International
5S34I026792	All Trucks Recycling
5S34I024989	DBA BENZEEN AUTO PARTS
5S34I022363	MS Recycling
5S34I024672	Mercedes Original Parts LLC
5S34I023864	Euroline Auto Dismantler
5S34I023188	Reclamation District 1001
5S31I012876	Mallard Creek Inc
5S31I026249	United Natural Foods Incorporated
5S31I015746	Progress Vanguard Corporation
5S31I009124	JELDWEN Rocklin
5S31I019659	Pleasant Grove WWTP

Industrial General Permit, NPDES No. CAS000001	
Waste Discharger ID	**Facility Name**
5S31I020737	Save Mart Supermarkets
5S31I026994	Lancaster Burns construction inc
5S31I006286	H B Fuller
5S31I020747	Sims Recycling Solutions INC
5S31I023169	TSI Semiconductors America LLC
5S31I021340	Roseville Energy Park
5S34I001460	Huhtamaki Inc
5S34I000283	Mitsubishi Rayon Carbon Fiber and Composites Inc
5S34I025279	Sierra Waste Recycling Transfer Station Inc
5S34I022883	NMI Industrial Holdings Inc
5S34I025497	Bud Line Trucking Inc
5S34I021903	Redi Gro Corp
5S34I022447	NWNA Sacramento
5S34I024376	Universal Service Recycling Inc
5S34I018100	Raynguard Protective Materials
5S34I023293	River City Waste Recyclers
5S34I017408	SCA Cogeneration II Project
5S34I019632	Procter Gamble Mfg Co
5S34I026776	Martins Auto Dismantler
5S34I020226	Cal Exposition Racing Stables
5S34I003087	Sac Val Disposal
5S34I007217	A A Concrete Supply
5S34I024404	Toledo Auto Dismantling
5S34I017353	J B Radiator Specialties Inc
5S34I026400	Forterra Pipe & Precast LLC
5S34I025443	US Rock Redi Mix LLC
5S34I021552	Elite Ready Mix LLC
5S34I017517	Pepsi Bottling Grp
5S34I009995	American Auto Wreckers
5S34I026602	AZ Auto Dismantler
5S34I020274	Atlas Disposal Industries LLC
5S34I026231	West Coast Sand and Gravel Inc Sacramento
5S34I025268	MDI Forest Products McClellan
5S34I017219	Lopez Ag Services
5S34I001826	Sun Shine Steel Ent Corp
5S34I025230	Bar None Auction
5S34I020961	HP Hood LLC
5S34I021051	California Pavement Maintenance
5S34I014772	Pacific Adhesives Comany Inc
5S34I021556	BG Delivery System Inc
5S34I016593	Elder Creek Transfer Recovery
5S34I025066	Cleanworld SATS
5S34I020493	Recycling Industries PI
5S34I021867	Golden State Crushing
5S34I026773	Setzer Forest Products Inc.
5S34I014344	Sacramento
5S34I026819	Omega Products International
5S34I012187	Safety Kleen

Industrial General Permit, NPDES No. CAS000001	
Waste Discharger ID	**Facility Name**
5S34I018652	Milgard Windows
5S34I022563	Jarden Home Brands Firelog
5S34I026405	Thatcher Company of California Sacramento
5S34I026485	Tex Chem Company dba KDS Nail Products
5S34I001815	Pick N Pull
5S34I023537	GR Trucking LLC
5S34I011689	Elk Grove Unified Sch Dist Tra
5S34I023749	All West Coachlines Inc
5S34I014852	Western Strategic Materials
5S34I023465	Sacramento Recycling and Transfer Station
5S34I023256	Capital City Recycling Inc
5S34I018962	Liqui Box Corp
5S34I024515	WM Recycle America, L.L.C.
5S34I026481	Telfer Pavement Technologies LLC
5S34I020561	Airgas USA LLC
5S34I012641	Siemens Industry Inc
5S34I004009	Cordova Truck Dismantlers
5S34I018229	AutoCore Radiator Manufacturing
5S34I025438	Cutting Edge Supply
5S34I012656	D T Fiberglass
5S34I005087	Twin Rivers USD Grand Ave Yard
5S34I003355	Air Product Chemicals
5S34I004109	Industrial Minerals
5S34I023247	WestRock CP LLC
5S34I025795	California Cascade Building Materials Inc
5S34I020501	Quikrete California LLC
5S34I026061	Capital Corrugated & Carton
5S34I010576	FedEx Ground SACR
5S34I023430	Mings Resource
5S34I023634	Recycling Services Alliance Sacramento
5S34I025110	Intex Forms Inc
5S34I025885	Davison Iron Works Inc
5S34I019100	Sacramento Rendering Companies
5S34I009866	Linde LLC
5S34NEC002376	Production Test
5S34NEC001878	Valdez Recycling
5S34NEC001738	Matheson Trucking Inc
5S34NEC001713	mtech dismantler
5S34NEC000138	PRECISION AUTO WRECKING
5S34NEC002644	gs auto dismantler
5S31NEC000752	Fed Ex AUNA
5S34NEC000406	Valspar Corp
5S34NEC001421	GSL Fine Lithographers
5S34NEC001982	DHL Express SMF
5S34NEC000012	Sunshine Pad and Foam Recycling
5S34NEC000447	Rubicon Brewing Company
5S34NEC002923	YNot Recycle LLC
5S34NEC002018	CLARCOR Industrial Air

D.5 Statewide Permit for Drinking Water System Discharges, NPDES No. CAG140001

Drinking water purveyors do not use pyrethroids in their water treatment processes and there is little likelihood that discharges from drinking water systems contribute a significant amount of pyrethroids to the TMDL watersheds. As such, no specific wasteload allocations are included for drinking water system discharges. In addition, the proposed conditional prohibition would apply to these dischargers so if any future monitoring indicated that a discharger is exceeding the pyrethroid triggers, management practices would be required. Due to their negligible contributions of pyrethroids to the TMDL water bodies, wasteload allocations are not proposed for NPDES-permitted drinking water system dischargers within the TMDL watersheds.

D.6 General NPDES Permit for Discharges from Utility Vaults and Underground Structures, NPDES No. CAG990002

Discharges from the de-watering of underground utility vaults are covered by a general NPDES permit and are considered minor discharges. There is little likelihood that discharges from utility vaults and underground structures contribute a significant amount of pyrethroids to the TMDL watersheds. As such, no specific wasteload allocations are included for discharges from utility vaults and underground structures. In addition, the proposed conditional prohibition would apply to these dischargers so if any future monitoring indicated that a discharger is exceeding the pyrethroid triggers, management practices would be required. Due to their negligible contributions of pyrethroids to the TMDL water bodies, wasteload allocations are not proposed for dischargers from utility vaults and underground structures covered under the general NPDES permit within the TMDL watersheds.

D.7 Individual NPDES Permittees

Four individual NPDES permittees discharge wastewater to Morrison Creek, which is one of the TMDL water bodies (Table D-3). Two of the permittees (The Boeing Company and AerojetRocketdyne, Inc.) discharge treated groundwater and there is very little likelihood that pyrethroids would be present in groundwater due to the strong tendency of pyrethroids to bind to soil. The two industrial wastewater dischargers (Procter & Gamble Manufacturing Company and Pacific Coast Sprout Farms, Inc.) do not report using pyrethroids in their industrial or manufacturing processes. In addition, the proposed conditional prohibition would apply to these dischargers so if any future monitoring indicated that a discharger

is exceeding the pyrethroid triggers, management practices would be required. Wasteload allocations are not proposed for the four dischargers within the TMDL watersheds currently with coverage under individual NPDES permits (Table D-3).

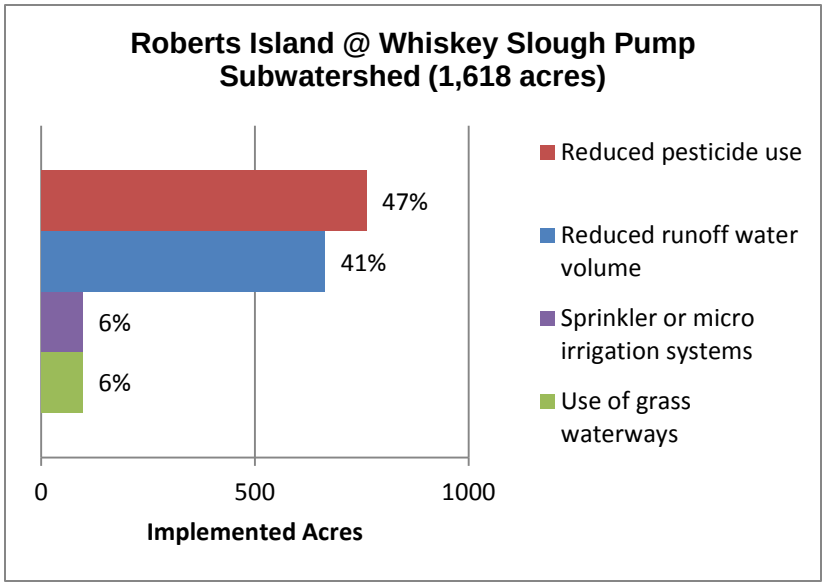
Table D-3 Waste dischargers within the TMDL watersheds covered under the Individual NPDES Permits

NPDES permit #	Discharger	Facility Name	Receiving Water
CA0004316	Procter & Gamble Manufacturing Company	Procter & Gamble Manufacturing Company Sacramento County	Morrison Creek
CA0082961	Pacific Coast Sprout Farms, Inc.	Pacific Coast Sprout Farms, Inc. Sacramento Facility	Morrison Creek by way of storm drain system
CA0084891	The Boeing Company	GET H-B, Southern Groundwater Study Area (SGSA) Groundwater Extraction and Treatment (GET), and Admin GET Systems	Morrison Creek
CA0083861	Aerojet Rocketdyne, Inc.	Groundwater Extraction and Treatment Systems ARGET, GET E/F, GET HA, GET J, GET KA, GET LA, GET LB, GET AB, White Rock GET, Sailor Bar Park Well, Chettenham, Golden State Water wells and Low-Threat Discharges	Morrison Creek

APPENDIX E

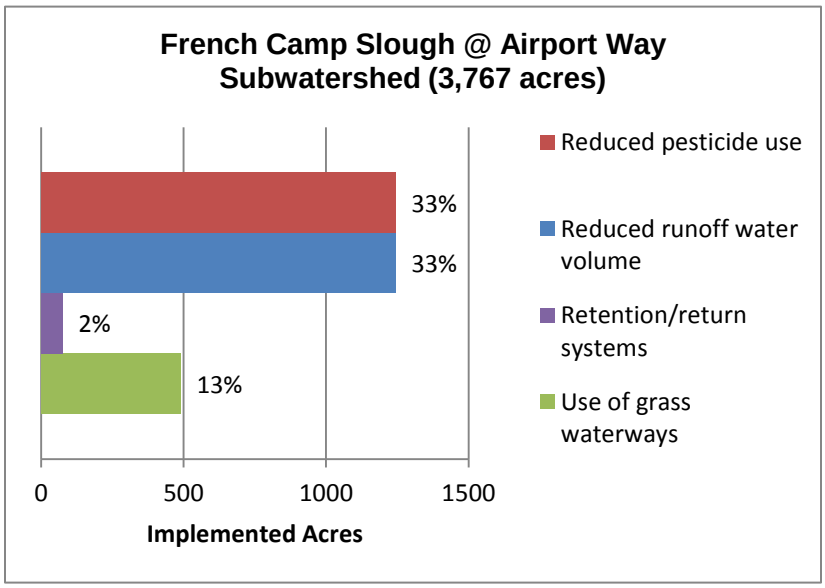
Irrigated Lands Regulatory Program: Pyrethroid Implications in Completed Management Plans

Since 15 March 2013, 7 management plans for toxicity have been completed in the Irrigated Lands Regulatory Program (ILRP) that had at least one exceedance where pyrethroids were documented as a potential cause. Table 1 identifies these management plans and indicates which of the exceedances can be, at least partially, attributed to pyrethroids. Pyrethroids are not regularly monitored under the ILRP Waste Discharge Requirements, but monitoring is required when additional sediment chemistry is triggered as a result of low species survival rates. Toxicity Identification Evaluation (TIE) testing and Pesticide Use Report (PUR) data from the California Department of Pesticide Regulation (DPR) can also be used to assess the cause of exceedances, so that the source can be identified and addressed with the implementation of applicable management practices. A summary of the management plan actions taken to address the exceedances at each site is provided below.



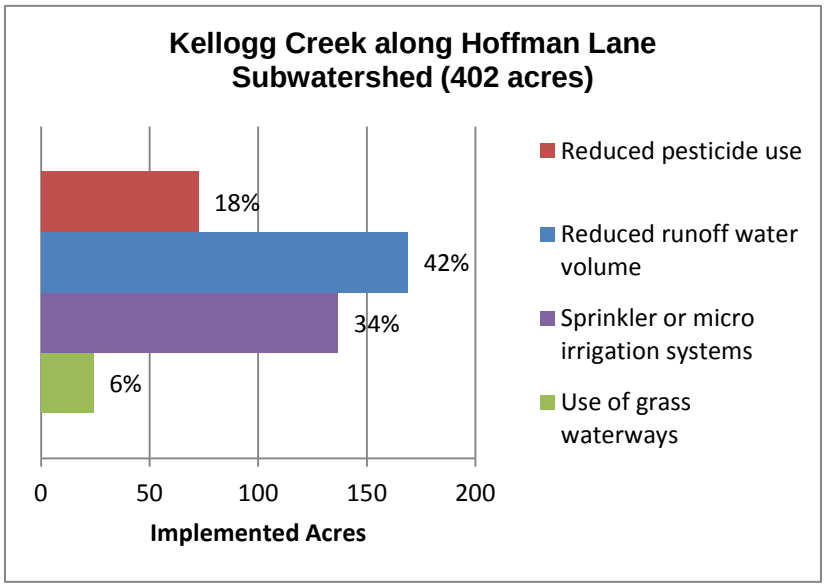
H. azteca toxicity in Roberts Island @ Whiskey Slough Pump

The first exceedance for *H. azteca* toxicity in Roberts Island @ Whiskey Slough Pump occurred in August 2006; the last occurred in September 2008. The Coalition began general outreach in 2007. Targeted outreach to 7 growers farming 1,618 acres began in 2013. Management practices utilized by targeted growers during the 2013 growing season were documented and the results are shown (left). The practices included grass waterways, reduced pesticide use, installation of sprinkler or micro irrigation, and irrigation management to reduce runoff volumes.



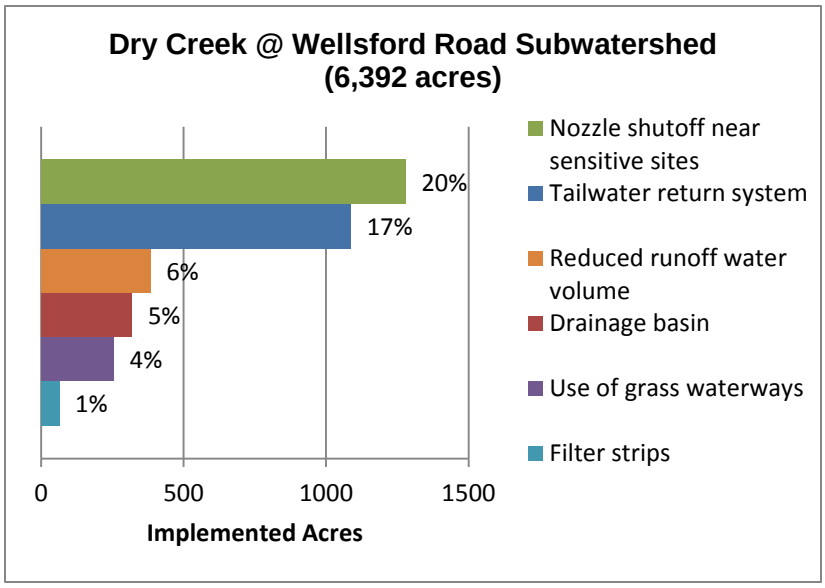
H. azteca toxicity in French Camp Slough @ Airport Way

The first exceedance for *H. azteca* toxicity in French Camp Slough @ Airport Way occurred in April 2006; the last occurred in October 2011. The Coalition began general outreach in 2007. Targeted outreach to 13 growers farming 3,767 acres began in 2011. Management practices utilized by targeted growers during the 2011 growing season were documented and the results are shown (left). The practices included grass waterways, reduced pesticide use, installation of retention/return systems, and irrigation management to reduce runoff volumes.



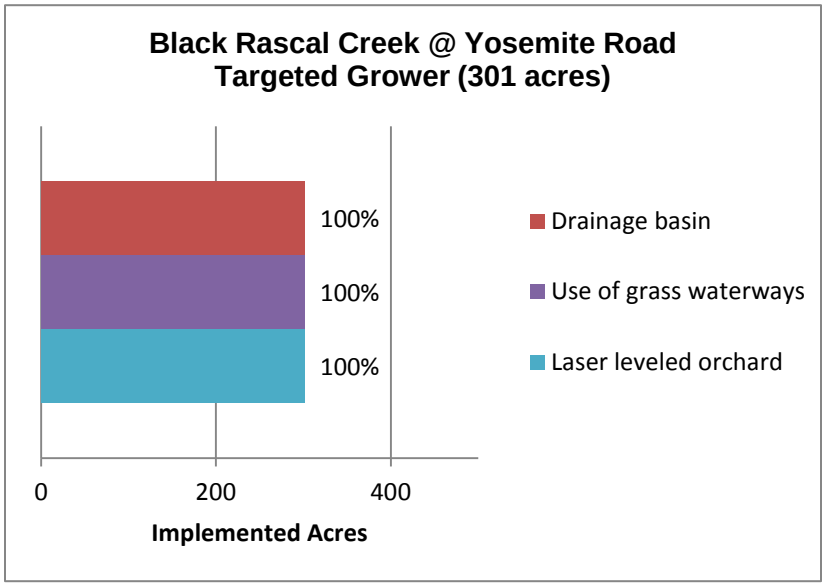
H. azteca toxicity in Kellogg Creek along Hoffman Lane

The first exceedance for *H. azteca* toxicity in Kellogg Creek along Hoffman Lane occurred in May 2005; the last occurred in October 2011. The Coalition began general outreach in 2007. Targeted outreach to 10 growers farming 402 acres began in 2012. Management practices utilized by targeted growers during the 2012 growing season were documented and the results are shown (left). The practices included grass waterways, reduced pesticide use, installation of sprinkler or micro irrigation, and irrigation management to reduce runoff volumes.



H. azteca toxicity in Dry Creek @ Wellsford Road

The first exceedance for *H. azteca* toxicity in Dry Creek @ Wellsford Road occurred in March 2008; the last occurred in September 2011. The Coalition began general outreach in 2007. Targeted outreach to 25 growers farming 6,392 acres began in 2008. Management practices utilized by targeted growers during the 2009 growing season were documented and the results are shown (left). The practices included nozzle shutoff, retention/return systems, grass waterways, reduced pesticide use, and irrigation management to reduce runoff volumes.



C. dubia toxicity in Black Rascal Creek @ Yosemite Road

The first exceedance for *C. dubia* toxicity in Black Rascal Creek @ Yosemite Road occurred in May 2007; the last occurred in August 2007. The Coalition began general outreach in 2007. Targeted outreach to a single grower farming 301 acres began in 2012. Management practices utilized by the grower during the 2012 growing season were documented and the results are shown (left). The practices included retention/return systems, grass waterways, and laser leveling.

Table 1. Management Plans with Pyrethroid Implications

Management Plan	Exceedances		Pyrethroids Implicated?	Requested	Approved	Management Practices?
	Date	Result* (survival)				
Delta: *C. dubia* toxicity in Mokelumne River @ Bruella Road	9/23/04	5%	TIE	11/13/12	3/15/13	Requested under Conditional Waiver. Targeted outreach and management practice details not in request.
	3/21/05	37%	--			
	6/21/05	37%	--			
	2/27/06	5%	--			
	3/10/06*	5%	--			
Delta: *H. azteca* on Roberts Island @ Whiskey Slough Pump	8/15/06	74%	--	8/6/15	12/18/15	Yes
	9/19/06*	12%	--			
	3/6/07	5%	PUR			
	3/29/07*	18%	PUR			
	8/13/08	83%	PUR			
	9/18/08*	85%	PUR			
Delta: *H. azteca* toxicity in French Camp Slough @ Airport Way	4/27/06	93.6%	--	8/6/15	12/18/15	Yes
	8/09/07	34%	--			
	3/18/08	94%	--			
	9/07/10	1%	SC			
	10/14/11	81%	--			
Delta: *H. azteca* toxicity in Kellogg Creek along Hoffman Lane	5/17/05	96.2%	--	8/6/15	12/18/15	Yes
	7/19/05	0%	--			
	9/20/05	59%	--			
	8/09/07	0%	--			
	8/31/07*	0%	--			
	3/18/08	29%	--			
	4/9/08*	72%	--			
	3/8/11	78%	SC			
	10/14/11	62%	SC			
ESJ: *C. dubia* toxicity in Highline Canal @ Lombardy Road	6/14/06	65%	--	11/7/12	10/15/13	Requested under Conditional Waiver. Targeted outreach and management practice details not in request.
	9/13/06	35%	--			
	2/28/07	56%	--			
	3/7/07*	0%	--			
	1/24/08	40%	TIE			
	1/30/08*	30%	--			
ESJ: *H. azteca* toxicity in Dry Creek @ Wellsford Road	3/4/08	88%	PUR	9/21/15	3/25/16	Yes
	8/28/08	73%	--			
	9/6/11	76%	SC			
ESJ: *C. dubia* toxicity in Black Rascal Creek @ Yosemite Road	5/29/07	20%	TIE	9/21/15	3/25/16	Yes
	7/24/07	0%	--			
	7/31/07*	0%	--			
	8/21/07	0%	--			
	8/28/07*	0%	--			

Notes:
* = resample event.
-- = pyrethroid-specific indicators not documented in the completion request
PUR = pyrethroid applications documented in Pesticide Use Report data in the period preceding the exceedance
SC = pyrethroids detected in sediment chemistry
TIE = pyrethroids implicated in the exceedance by Toxicity Identification Evaluation