Final

Programmatic Environmental Impact Report

for

Integrated Vector Management Practices

of the

Sutter-Yuba Mosquito & Vector Control District

Prepared for:

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EXECUTIVE SUMMARY

This Program Environmental Impact Report (PEIR) has been prepared to cover ongoing activities of the Sutter-Yuba Mosquito and Vector Control District (SYMVCD or "District"), an independent special district charged with protecting citizens of Sutter and Yuba Counties from vectors (i.e., insects or other organisms capable of harboring and transmitting agents of human diseases) and vector-borne diseases. Originally established in 1946 as the Sutter and Yuba Mosquito Abatement District, the District's name was changed to the Sutter-Yuba Mosquito and Vector Control District in 1993. The District currently provides services primarily to residents of Sutter County and the valley floor of Yuba County. The District is funded ad valorem from property taxes, at two cents per dollar.

The District has developed and adopted integrated vector management practices to guide control programs for targeted species. Species targeted by the District include many species within several genera of mosquitoes that are vectors of serious diseases, such as West Nile virus and Western equine encephalitis. The District also provides identification of and information to the public on other vector and nuisance species such as flies, cockroaches, ants, bedbugs, rats and bats. Integrated vector management practices include surveillance for vectors and disease, source reduction to limit breeding by vectors, education of the public in ways to aid source reduction and protect against disease-carrying vectors, and control of vector species using both chemical and biological agents.

SYMVCD uses a combination of physical inspections, trapping of mosquito species, and laboratory tests to establish the extent of vector populations and potential disease organisms. Information from field inspections is supplemented by contacts from the public about the presence and numbers of vectors and hosts. When vector populations surpass established thresholds and cannot be controlled with source reduction alone, the District applies chemical and/or biological control agents to reduce vector populations. Chemicals are rotated to reduce development of resistance in vectors and applied strictly according to label and safety requirements established by the US Environmental Protection Agency (USEPA) and the California Department of Pesticide Regulation. The District has applied for a general permit (Order No. 2011-002-DWQ; General Permit No CAG 990004) from the State Water Resources Control Board (SWRCB) for the application of mosquito insecticides to waterways and is a member of the Mosquito and Vector Control Districts' Monitoring Coalition, which has recently been instituted to monitor effects of chemical mosquito control on water quality. The District's program is overseen and monitored by the California Department of Public Health and the County Agricultural Commissioners.

CEQA/NEPA Process

Mosquito and vector control districts in California were established prior to the enactments of the National Environmental Policy Act (NEPA, 42 USC § 4321 et seq.) in 1969 and the California Environmental Quality Act (CEQA, Cal PRC §21000 et seq.) in 1970 and historically have been considered exempt from CEQA and NEPA analysis. However, recent federal court cases have raised questions about the potential effects upon rare and endangered species and water quality from habitat management activities and from pesticides. In 2001, the 9th Circuit Federal Court issued the first of three decisions (*Headwaters Inc. v. Talent Irrigation District*) that pesticides applied to waters of the United States constitute chemical wastes or biological materials under the Clean Water Act. This case resulted in the adoption of an order requiring National Pollution Discharge Elimination System (NPDES) permits for the public health use of larvicides (pesticides to kill larval mosquitoes) by the California State Water Resources Control Board. A 2009 6th District Federal Appeals Court decision (*National Cotton Council v. United States Environmental Protection Agency)* required NPDES permits for the use of pesticides to kill adult mosquitoes (adulticides) for public health.

The District is preparing this Program Environmental Impact Report (PEIR)/Environmental Impact Study (EIS) to serve as a basis for any future state or federal permits required for its operations and to disclose to the public the nature of the District's activities and their potential effects on the environment.

The CEQA/NEPA process was initiated by preparation of an Initial Study to determine if there were gaps in information on environmental issues and to assess the extent of potentially adverse environmental impacts. The Initial Study revealed that there are potential adverse impacts from the District's programs in the areas of air quality, biology, water quality, greenhouse gases, and hazardous materials; these areas are the focus of the program EIR/EIS.

Potential Areas of Controversy

Potential areas of controversy include concerns of the public about exposure to toxic chemicals, the effect of these chemicals on human health and health of rare and endangered wildlife and other organisms, and the potential effect of source reduction practices such as vegetation clearing on protected habitats and organisms.

Alternatives

Several alternatives to the current program are evaluated in this PEIR. Alternative 1, the "No Project" Alternative, is a continuation of the current programs of the District and is the preferred alternative.

The current District programs include the following main activities that are analyzed within this PEIR:

- Monitoring and estimating mosquito populations;
- Surveillance of West Nile virus and other arboviruses (viruses transmitted by arthropod vectors) in mosquitoes and sentinel chicken flocks;
- Biological control, including distribution of mosquitofish (*Gambusia affinis*) to the public for control of mosquitoes;
- Chemical treatment of mosquito populations with various larvicides (predominantly methoprene, water surface films, and bacterial larvicides) applied at ground level with truck-mounted or hand-held sprayers or aerially from small agricultural aircraft;
- Application of adulticides (insecticides to kill adult mosquitoes; predominantly synthetic pyrethroids, pyrethrins, and the organophosphates, malathion and naled) to rice fields, duck clubs, and other vector sources using ultra-low volume (ULV) sprayers mounted on trucks or from aircraft;

- Source reduction activities, including recommendations of best management practices (BMPs) for source reduction to landowners.
- Public education about disease risks and source reduction methods and responding to service requests made by the public.

The second alternative assessed a number of variations on eliminating or significantly reducing the application of chemical pesticides. Scenarios examined under this alternative included elimination of ULV application of adulticides only, discontinuation of aerial larvicide applications only, elimination of all ULV insecticide application by the District, and increased use of abatement proceedings to compel landowners to control mosquito sources using their own methods. None of the scenarios considered presented clear significant environmental benefits over the current program when weighed against the potential risks to human health by eliminating some or all of the chemical control of vectors. In addition, the amount of insecticides currently applied by the District for public health is a small fraction of the overall use of the same active ingredients in the District; therefore, eliminating chemical control by the District would not significantly decrease the amount of these insecticides in the environment. Finally, increased reliance upon private landowners to control mosquitoes could result in a net increase in insecticide usage due to differences in efficiency between trained professionals and private landowners.

Findings of Significance

The assessment for the Initial Study eliminated a number of areas of potential environmental effects because the project does not include new construction, significant changes in land form or land use, or significant changes in activities. The project, as proposed, is a continuation of ongoing policies and activities.

None of the District's operations or policies induces, facilitates or stimulates growth. No major changes in activities or practices are currently being considered that would create additional impacts under the preferred alternative.

The current insecticides used by the District are non-persistent compounds that degrade within a few hours to a few weeks when exposed to sunlight, moisture and soil. None of the active ingredients used by SYMVCD are expected to have significant adverse effects on human health when used as specified on the product labels as in the current vector control program. Based on studies by USEPA and several universities, there will be no cumulative impacts to human health with continued use of the insecticides at label rates and in the manner specified by USEPA. The District should continue to follow best management practices including application precision yielded by Global Positioning System (GPS) technology and drift prediction technology to avoid negative impacts to human health.

The organophosphate insecticides, malathion and naled, may contribute to existing impaired water quality of several water bodies within the District (Butte Slough, lower Feather River, Jack Slough, and Wadsworth Canal) if applied within 50 feet of these waters. The impact on water quality is considered less than significant with the mitigation stipulated below.

The air quality and greenhouse gas impacts of the SYMVCD will continue at below action threshold levels for the Feather River Air Quality Management District and are not cumulatively considerable.

No potentially significant impacts to urban and rural land uses would result from implementation of either Alternatives 1 or 2. The District's operations do not have a significantly incremental or cumulative impact upon public services.

While scientific literature suggests District activities are unlikely to adversely affect non-endangered wildlife or plants significantly, several activities of the District were identified as having potential to adversely impact rare and endangered species or endangered species' critical habitat or result in incidental take of listed species. Listed species in the District with the greatest potential to be affected by mosquito insecticides either directly or indirectly are invertebrates, small-bodied insectivores, amphibians and fish or other species dependent on aquatic habitats. Use of mosquitofish for biological control could result in accidental release of this non-native species into natural waterways, which could threaten endangered, threatened, or special-status species.

The following impacts were identified by this PEIR:

Impact WQ-1: Use of organophosphate chemicals, including naled and malathion, has the potential to contribute to existing water quality impairments.

Impact BIO-1: Use of the organophosphate insecticide, malathion, in areas adjacent to habitat of the Central Valley Steelhead and Central Valley Spring-run Chinook Salmon may adversely affect these species.

Impact BIO-2: Application of petroleum distillate oils in habitats where Black Rails or Western Spadefoot are present may significantly adversely impact these species or cause take and may impact other species of wetland nesting birds.

Impact BIO-3: Distribution of mosquitofish by SYMVCD to the public and subsequent unintended releases into natural environments have potential to adversely affect listed species of invertebrates, amphibians and/or fish in Sutter and Yuba Counties or result in incidental take.

Impact BIO-4: Vegetation management recommended in the District's Best Management Practices Manual may adversely affect listed wildlife (e.g., Black Rail, Yellow Warbler, Western Yellow-billed Cuckoo, Tricolored Blackbird, Giant Garter Snake and Western Spadefoot) and plants (e.g., Wooly Rose-mallow and Brownish Beaked-rush) if performed in occupied habitat of these species.

Impact BIO-5: Dredge or fill activities resulting from implementation of recommended BMPs occurring in wetlands or Waters of the United States could result in habitat degradation associated with water quality impacts and/or the need for permits from the US Army Corps of Engineers.

The following mitigations were developed to reduce the above impacts to less than significant levels.

<u>Mitigation Measure WQ-1: Organophosphate Limitations</u>

Organophosphate insecticides shall not be applied to or immediately adjacent to (within 50 feet) the waters listed in the SWRCB's most current 303(d) List of Water Quality Impaired Segments. The District shall remain up to date on the most current 303(d) list as part of normal District operations. Annual district or regional training sessions shall explicitly state this requirement. All applications of organophosphate pesticides shall be reviewed prior to application to ensure they are not applied in, or immediately adjacent to water bodies with existing organophosphate water quality limitations.

Mitigation Measure Bio-1: Malathion application practices and compliance with buffers.
The District shall continue to apply malathion only from the ground on the land side of levees to avoid drift into critical habitat of the Central Valley Steelhead and Central Valley Spring-run Chinook Salmon and shall comply with any buffers for vector control application of malathion that may be adopted by USEPA to protect listed salmonids.

Mitigation Bio-2: Prohibit petroleum distillate use within Black Rail and Western Spadefoot habitat.
The District shall develop and adopt a BMP that prohibits use of petroleum distillate oils within Black Rail and Western Spadefoot habitat to reduce the risk of impacts to these species.

Mitigation Measure Bio-3: Limit mosquitofish release to isolated artificial systems.
Mosquitofish shall only be introduced into isolated systems that are not connected to natural waterways to prevent inadvertent introduction of mosquitofish into natural ecosystems by the District. Determination of whether a system is isolated or not shall be made by District supervisory personnel. If a determination cannot be made regarding the connectivity of a system to natural waterways, the system shall not be treated with mosquitofish.

Mitigation Measure Bio-4: Avoid recommending BMPs that specify vegetation clearing in listed species habitats. Revise BMPs to include information on Endangered Species Acts and which species may be affected by vegetation clearing.
District personnel shall avoid recommending vegetation-clearing activities in areas supporting Woolly Rose-mallow, Wright's Trichocoronis, or any other plant species listed by state or federal Endangered Species Act listings, or CNPS List 1A, 1B, or 2, and habitat of Black Rail, Yellow Warbler, Western Yellow-billed Cuckoo, Tricolored Blackbird, Giant Garter Snake and Western Spadefoot. BMPs shall be revised to advise landowners that clearing vegetation may adversely affect rare and endangered species, if they are present, or their habitat and that landowners are prohibited from "taking" endangered species under the US and California Endangered Species Acts.

Mitigation Measure Bio-5: Establish annual rare and endangered species sensitivity training course for District operators.
Compliance with CDPR and USEPA's pesticide use limitations and buffers determined through interagency consultation with USFWS/NMFS should reduce impacts to rare and endangered species to a level that is less than significant. However, a difficulty in complying with pesticide use limitation is that "occupied habitat" is rarely well-known. As the District needs to operate within a wide variety of habitats, many of which harbor rare and endangered species, establishment of the training program

for personnel along with annual collaboration with USFWS and CDFG will help the District avoid potentially detrimental pesticides or practices in areas in which these species occur.

The District has begun to prepare a policy that requires consultation with and training by the USFWS and CDFG. The District will use power point presentations and develop guides to rare and endangered species habitats with resources from the agencies to use in the training. To aid in developing these guides and training, the SYMVCD shall regularly access and update both state and federal sources of listed species occurrence information, including information from CDFG's California Natural Diversity Database, CDPR's Endangered Species Protection Program and Pesticide Use Limitations, USFWS's Critical Habitat Portal for threatened and endangered species and any other reliable source of information accessible to staff. Guides and manuals are expected to be completed in 2011. Use of guides will help staff determine if pesticide application and vegetation maintenance are scheduled or recommended to be performed in areas known or suspected to support protected species. It will also allow review by supervisory staff prior to initiation to determine if a potential for adverse impacts is indicated. If adverse impacts are possible, work shall either be modified to avoid impacts or not initiated in those areas.

<u>Mitigation Measure Bio-6: Establishment of MOUs with CDGF and USFWS</u>
SYMVCD shall continue to consult CDFG and USFWS for assistance in minimizing or eliminating impacts on rare and endangered species from the District's activities throughout lands within the District. The District will enter into MOUs with these agencies that will define allowable incidental take from SYMVCD's program operations.

<u>Mitigation Measure Bio-7: Modification of Best Management Practices Manual to include references to federal wetland-fill permitting</u>
The District shall modify its current BMP Manual to include information regarding federal prohibition of dredge and fill activities and information relevant to permits for such activities, including:

- **Definition of federally jurisdictional wetlands**
- **Description of activities requiring federal review and/or permits**
- **Contact information for local and regional USACE and USEPA offices**

No significant unavoidable adverse impacts or significant irreversible environmental changes were identified by this PEIR.

ACRONYMS AND ABBREVIATIONS

$\mu g/m^3$	micrograms per cubic meter[1]
µm	microns
AB 32	The Global Warming Solutions Act of 2006
ac	acre[1]
AChE	acetylcholinesterase
AMCA	American Mosquito Control Association
ATV	all-terrain vehicle
BMP	best management practice(s)
Bs	*Bacillus sphaericus*
Bti	*Bacillus thuringiensis israelensis*
Cal FGC	California Fish and Game Code
Cal HSC	California Health and Safety Code
Cal/EPA	California Environmental Protection Agency
CALPIP	California Pesticide Information Portal
CAPCOA	California Air Pollution Control Officers' Association
CARB	California Air Resources Board
CCR	California Code of Regulations
CDC	Centers for Disease Control and Prevention
CDFA	California Department of Food and Agriculture
CDFG	California Department of Fish & Game
CDPH	California Department of Public Health
CDPR	California Department of Pesticide Regulation

[1] Note: Metric and English systems of measurement are both used within the document according to the convention of various federal and state agencies, from which data or information were obtained.

CDWR	California Department of Water Resources
CE	California encephalitis
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
CO_2	carbon dioxide
CVRWQCB	Central Valley Regional Water Quality Control Board
CWA	Clean Water Act
cu ft	cubic foot/feet
DDE	diclorodiphenyldicloroethylene
DDT	dichlorodiphenyltrichloroethane
EEE	Eastern equine encephalitis
EIR	Environmental Impact Report
EIS	Environmental Impact Study
ESRI	Environmental Systems Research Institute, Inc.
ESU	evolutionarily significant unit
FAO	Food and Agriculture Organization of the United Nations
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
fl oz	fluid ounces
FRAQMD	Feather River Air Quality Management District
ft	feet
gal	gallons
GAMA	Groundwater Ambient Monitoring & Assessment Program

GB-1111	Golden Bear Oil-1111
GC	Government Code
GHG	greenhouse gases
GIS	Geographic Information System
GPM	gallons per minute
GPS	Global Positioning System
HCP	Habitat Conservation Plan
hr	hour
IS	Initial Study
IEI	idiopathic environmental intolerance
IGE	immunoglobulin
IVM	Integrated vector management
IWMC	California Interagency Watershed Mapping Committee
kg	kilograms
l	liter
lbs	pounds
LC_{50}	lethal concentration for 50% of subjects
LD_{50}	lethal dose for 50% of subjects
LOC	levels of concern
MCL	maximum containment levels
mg	milligrams
MMWR	Morbidity & Mortality Weekly Report
MOU	Memorandum of Understanding
MSDS	material safety data sheets
MVCAC	Mosquito and Vector Control Association of California

NCCP	Natural Community Conservation Plan
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOx	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NPIC	National Pesticide Information Center
NPTN	National Pesticide Telecommunication Network
NRCS	Natural Resource Conservation Service
OP	organophosphates
oz	ounces
PBO	piperonyl butoxide
PEIR	Program Environmental Impact Report
PM	particulate matter
ppm	parts per million
PRESCRIBE	Pesticide Regulation's Endangered Species Custom Realtime Internet Bulletin Engine
PVC	polyvinyl chloride
ROG	reactive organic gases
RQ	risk quotient
SB	Senate Bill
SIP	State Implementation Plan
SLE	Saint Louis encephalitis
SOx	sulfur oxides
sq ft	square foot/feet
spp	species
ssp	subspecies

SVAB	Sacramento Valley Air Basin
SWRCB	State Water Resources Control Board
SYMVCD	Sutter-Yuba Mosquito and Vector Control District
tbl	tablespoon
TMDL	total maximum daily load
TOG	total organic gases
ULV	ultra-low volume
URBEMIS	Urban Emissions software
USACE	US Army Corps of Engineers
USC	United States Code
USEPA	US Environmental Protection Agency
USFWS	US Fish & Wildlife Service
var	variety
VEE	Venezuelan equine encephalitis
VOC	volatile organic compounds
WEE	Western equine encephalitis
WNV	West Nile virus

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1 Introduction

This Program Environmental Impact Report (PEIR) has been prepared to cover ongoing activities of the Sutter-Yuba Mosquito and Vector Control District (SYMVCD or "District"), an independent special district charged with protecting citizens of Sutter and Yuba Counties from vectors (i.e., insect or other organisms capable of harboring and transmitting agents of human disease) and vector-borne diseases. This PEIR was prepared using documents supplied by the District, as well as scientific literature on control methods and materials and their potential environmental impacts.

Mosquito and vector control districts operate under Division 3 (Pest Abatement) of the California Health and Safety Code (Cal HSC§ 2000-2910). The current law was approved in 2002 and contains explicit policy statements that were not included in the original 1939 statute. The opening provisions of the current law state that "surveillance, protection, abatement and control" are the primary purposes of these districts. Under Article 4, Powers, a district may exercise its powers to check for vectors and take any and all action to control vectors and vector-borne diseases, including abatement proceedings within the district and in adjoining lands from which vectors and vector-borne diseases may enter the district.

All districts have a Memorandum of Understanding (MOU) with the California Department of Public Health (CDPH) covering the use of pesticides. Districts file monthly reports on pesticide use with the local County Agricultural Commissioner and the regional Water Quality Control Board(s). These monthly reports are used to generate the annual reports filed with the CDPH and California Department of Pesticide Regulation (CDPR). The County Agricultural Commissioner conducts annual compliance inspections of each district, and the CDPH conducts inspections every other year or as time and budget allow.

Forty-three mosquito abatement and vector control districts were established and functioning in California prior to the enactments of the National Environmental Policy Act (NEPA, 42 USC § 4321 et seq.) in 1969 and the California Environmental Quality Act (CEQA, 14 CCR § 15126.6 (e)(3)(a)) in 1970. Eleven additional districts were formed after 1970. All were considered exempt from NEPA and CEQA. The surveillance activities of this district and other districts are considered data gathering and, therefore, exempt under § 15306, Article 19, of CEQA.

There have, however, been questions raised by federal agencies and federal appeals court cases about potential effects upon rare and endangered species and water quality from pesticides. In 2001, the 9^{th} Circuit Federal Court issued the first of three decisions *(Headwaters Inc. v. Talent Irrigation District*) that pesticides applied to waters of the United States constitute chemical wastes or biological materials under the Clean Water Act (CWA, 33 USC § 1251 et seq.). This decision resulted in the adoption of an order requiring National Pollution Discharge Elimination System (NPDES) permits for the public health agencies' use of larvicides, i.e., pesticides to kill larval mosquitoes, by the California State Water Resources Control Board (SWRCB). A 2009 6^{th} District Federal Appeals Court decision (*National Cotton Council v. United States Environmental Protection Agency; USEPA*) required NPDES permits for the use of pesticides to kill adult mosquitoes (adulticides) for public health.

This PEIR is designed to provide detailed information and assessments on the operations of the District, including its use of pesticides and source reduction methods, which may include habitat management. The SWRCB is in the process of completing a General Permit for the application of all pesticides to surface waters. This permit includes ultra-low volume (ULV) application of adulticides in addition to the larvicides that are already covered by the current permit.

1.1 CEQA/NEPA Process

CEQA was initiated during the development of NEPA to provide a full disclosure process for public projects in California. The District is preparing this Environmental Impact Report (EIR)/Environmental Impact Study (EIS) to serve as a basis for any future state or federal permits required for their operations and to disclose to the public the nature of the District's activities and their potential effects on the environment.

The process was initiated by reviewing the District's records and documents and preparing an Initial Study (IS) checklist to determine if there were gaps in information on environmental issues. The checklist revealed several areas that require additional information to assess the extent of potentially adverse environmental impacts. The IS was submitted to the State Clearinghouse for distribution to state and federal agencies. Additionally, the District sent copies to local agencies not on the State's list of responsible and trustee agencies.

This document is a combined EIR/EIS, in which the project description is included as the preferred alternative and compared to possible alternative actions.

1.2 Notice of Preparation

A Notice of Preparation for this EIR was prepared and filed with the State Clearinghouse in early May and ran until June 6, 2011. Copies were forwarded to the Sutter County Agricultural Commissioner, the Sutter County Public Health Department, the Yuba County Agricultural Commissioner and the Yuba County Health & Human Services Department. Responses were received from the Native American Heritage Commission and the California Department of Fish and Game (CDFG).

1.3 Scope of the Environmental Assessment

1.3.1 Potentially Significant Impacts

The District's files and area records were examined to establish the potential for significant adverse impacts. An Initial Study was prepared and determined that there were several areas of potential impacts, which included air quality, biology, water quality, greenhouse gases, and hazardous materials. These areas of potential impact are analyzed in greater detail in this PEIR.

1.3.2 Impacts Not Found to be Significant

Sufficient information was found during the preparation of the Initial Study to determine that there were no adverse impacts to aesthetics, agricultural resources, cultural resources, geology/soils, mineral resources, noise, population/housing, public services, recreation, transportation/traffic, and utilities/service systems.

1.3.3 Potential Areas of Controversy

In recent years, there has been a resurgence of concern and even fear about the potential effect of pesticides sprayed or deposited in urban areas on human and environmental health. Concerns have included the toxicity and carcinogenicity some of these chemicals present to humans, as well as the potential for exposure to chemicals directly from aerosol sprays (fogging) and indirectly through their deposition on lawn furniture and vegetable gardens. Additional concerns have been expressed about potential impacts to rare and endangered species and beneficial insects, such as honeybees and dragonflies, from the use of these pesticides.

Some people have voiced skepticism about the extent and severity of West Nile virus (WNV) and other mosquito-borne diseases, as the majority of human infections are mild or even asymptomatic. They consider the extra efforts exerted by vector control districts because of WNV and additional control measures taken after WNV was diagnosed in humans as wasteful and unnecessary.

1.4 Sutter-Yuba Mosquito & Vector Control District's Purpose and Objectives

The SYMVCD is responsible for controlling mosquitoes and other vectors within Sutter and Yuba Counties. The District uses preventative methods to lower mosquito populations to levels that reduce the probability of disease transmission, and its programs integrate several methods to control mosquitoes.

Physical Control: The District may physically modify the environment, primarily waters in which larvae occur, to prevent, limit, or reduce mosquito production, and/or order landowners to remove or reduce mosquito breeding sources. Examples of this measure include improving drainage of irrigated lands and emptying containers, tires, swimming pools and other such manmade breeding areas that collect water and provide habitat for larvae.

Biological Control: The District makes use of natural enemies to manage mosquito populations including the mosquitofish, *Gambusia affinis,* and the microorganisms, *Bacillus thuringiensis israelensis and Bacillus sphaericus*.

Chemical Control: The District applies natural and manmade compounds, including organophosphates, juvenile growth inhibitors, synthetic pyrethrins, and surfactants, to suppress mosquito numbers.

Public Education: Educational programs by the District support its mission to control mosquitoes and mosquito-borne diseases by teaching the public about disease threats and ways they can contribute to mosquito control as well as protect themselves against disease.

1.5 Mosquito and Vector Control in California

California has thousands of acres of seasonally flooded lowlands, marshes, and wetlands and a long history of impacts caused by hordes of biting mosquitoes. According to archeological and anthropological studies, Native Americans seasonally moved away from coastal and lowland areas to avoid unlivable conditions caused by these insects. Even tribes inhabiting mountain environments had to contend with springtime snow pool and floodwater mosquito hatches (Patterson 2009). In the 1850s, Gold Rush era miners and settlers flocking to California were subjected to large populations of biting mosquitoes and the repercussions of their transmitted pathogens as more people immigrated into the state.

The first attempts to control mosquitoes in California began early in the 20th century in salt marshes in the San Francisco Bay area at San Rafael (1904) and Burlingame (1905), directed by University of California professors (Gray 1912). Canals and ditches were constructed to drain marshes in an attempt to rid mosquitoes of breeding habitat. By 1909, the deaths of 112 people from malaria focused further attention on mosquito control. William B. Herms of the University of California, sponsored by the Southern Pacific Railway, led an education and demonstration program on malaria and control of *Anopheles* mosquitoes (a large and widespread genus of mosquitoes known to carry malaria). The first anti-malaria program was started in 1910 in Penryn and Oroville in the Sacramento Valley. This program and other early research demonstrating that control of mosquito-borne diseases could be managed led to the Mosquito Abatement Act of 1915. The Mosquito Abatement Act of 1915 was later amended and is contained within the California Health Safety Code (Cal HSC§2000-2910).

The Mosquito Abatement Act gave local governments the power to obtain revenues and to form special districts for the purpose of protecting the public from the hazards of biting mosquitoes and vector-borne diseases. A small group of districts were formed the same year, and there are now approximately 65 mosquito control districts in California. In 1935, legislation was passed authorizing pest abatement districts, with powers and legal bases similar to mosquito districts but providing for abatement of "any plant, animal, insect, fish or other matter or material" deemed a pest.

In 1946, the California Department of Public Health (then Department of Health Services) created a Bureau of Vector Control in the Environmental Management Branch and staffed it with experts who helped form new mosquito abatement districts. The Branch also provided technical services that included disease surveillance and research studies throughout California.

1.5.1 District History

The Sutter-Yuba Mosquito Abatement District was formed in 1946, with the first recorded meeting of an assembled board on February 25, 1946. In March 1993, the Board of Trustees passed a resolution to change the name of the District from the Sutter-Yuba Mosquito Abatement District to the Sutter-Yuba Mosquito and Vector Control District to reflect the expansion of services and responsibilities to include other vector surveillance and control activities (SYMVCD 1993).

The Sutter-Yuba Mosquito and Vector Control District serves 706 square miles (452,213 acres), including 486 square miles of Sutter County excluding the Sutter Buttes and 220 square miles of Yuba County valley floor from the western county line east to Loma Rica and the goldfields and southwest into Camp Far West; Beale Air Force Base is excluded. Cities within the District's boundaries include Yuba City, Marysville, Wheatland, Live Oak and unincorporated communities on the valley floor (Figure 1-1, Figure

1-2). The estimated population for both counties as of January 1, 2005, was 155,679, but that number has increased since then. Agriculture is the principal land use in the District; wetlands and marshlands are abundant. Irrigated agriculture, especially rice, and natural and artificially regulated marshes generate large numbers of mosquitoes.

The District office and yard is located at 701 Bogue Road in Yuba City, California. The District is governed by a Board of Trustees consisting of seven members who are appointed by the city/county they serve. A permanent staff of 11 employees is augmented by 18 seasonal and summer employees. Managers and staff are certified in mosquito and vector control by the California Department of Public Health. A fleet of surveillance and specialty vehicles are maintained to conduct surveillance and treatment of mosquitoes and vector sources.

The District is a member of both the Mosquito and Vector Control Association of California (MVCAC) and the American Mosquito Control Association (AMCA). The District works in cooperation with such agencies and institutions as other California mosquito abatement and mosquito and vector control districts, the local health departments, County Agricultural Commissioners' Offices, the University of California labs and research departments, and the California Department Public Health. SYMVCD is also part of the Sutter and Yuba County Africanized Honeybee Task Force in anticipation of the bee's possible entry into the region. The District provides information and educational resources to inform the public about mosquitoes and other disease-carrying vectors, offering assistance and equipment when funding is a constraint to the district and the public.

SYMVCD is funded ad valorem through property taxes at 2 cents per tax dollar and has no other source of income.

1.5.2 Regulatory Setting

Mosquito and vector control districts are independent special districts specifically created for the purpose of improving public health through control of vectors and vector-borne diseases. As independent special districts, they are governed by boards of trustees made of members appointed from local cities and counties. The activities of mosquito and vector control districts are regulated by a variety of local, state and federal agencies and laws.

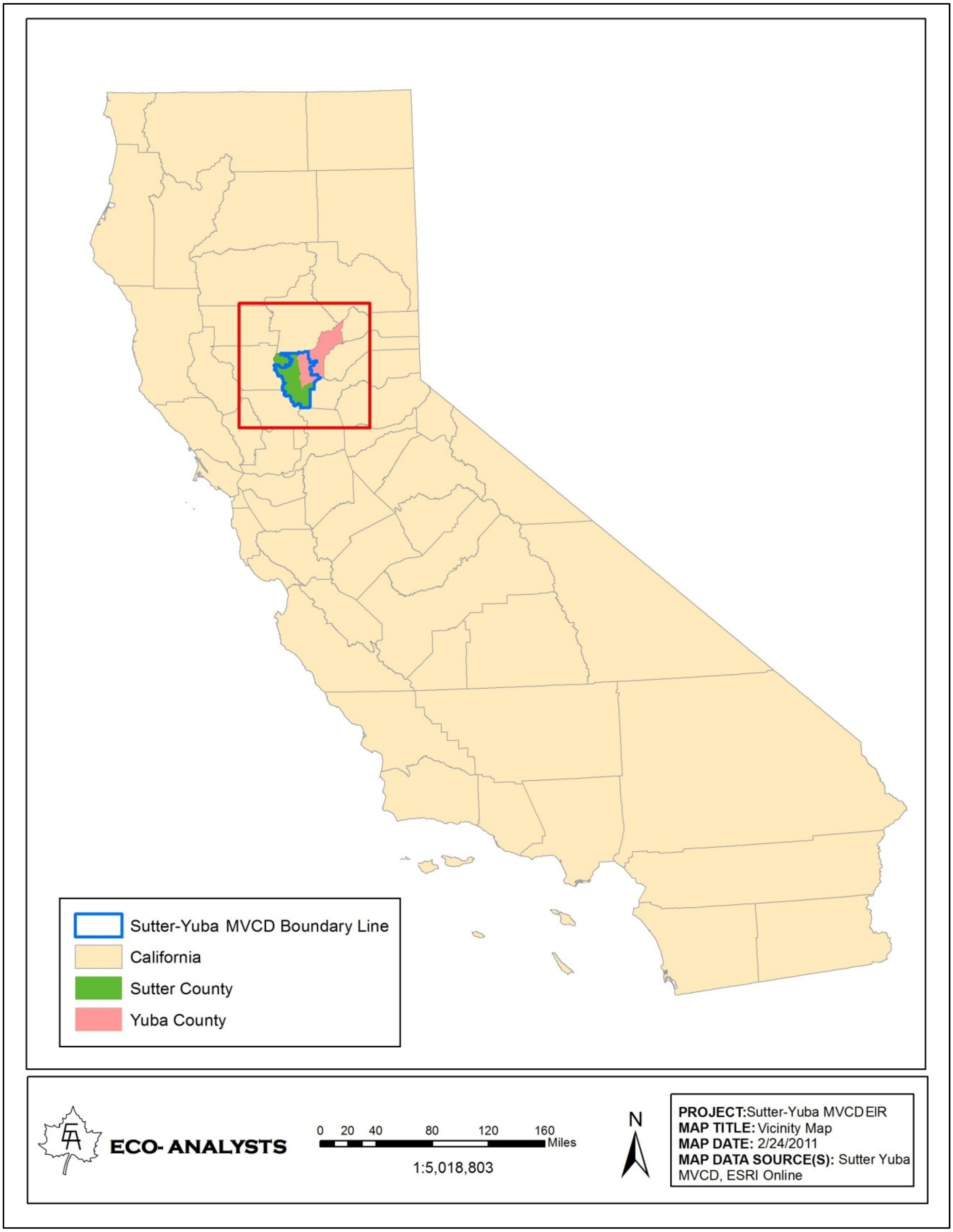

Figure 1-1. Vicinity map.

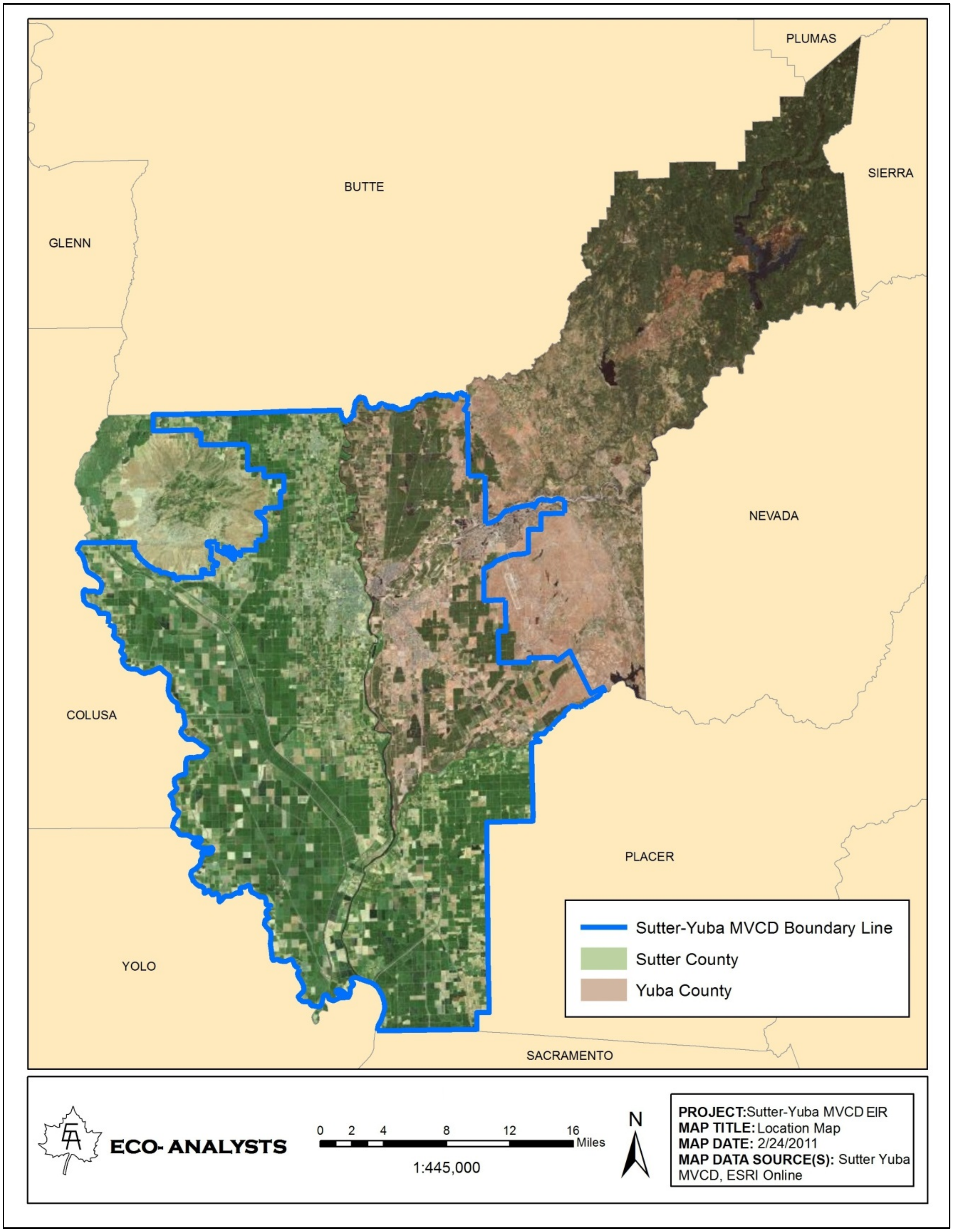

Figure 1-2. SYMVCD boundary.

The original laws governing mosquito abatement districts were first codified in 1939 and were revised most recently in 2004. Once enacted, these laws are translated into specific regulations and are included in the California Code of Regulations (CCR). State laws related to vector control district activities, including pesticide use, are created by the California legislature. Recent legislative actions include Senate Bill 1723, Pesticide Container Recycling, which became a regulatory act on January 1, 2010. Mosquito and vector control districts also have certain regulatory functions through surveillance, public education and, if necessary, the issuance of abatement orders. Districts may issue abatement orders to compel uncooperative property owners or managers either to reduce mosquito sources such as dirty pools and ponds or to pay for the costs of control by districts.

Use of pesticides by vector control districts in California is regulated by the US Environmental Protection Agency (USEPA), the California Environmental Protection Agency (Cal/EPA), the California Department of Public Health (CDPH), the California Department of Pesticide Regulation (CDPR), the State Water Resources Control Board (SWRCB), regional water quality control boards and the County Agricultural Commissioners.

1.5.2.1 USEPA - Federal Insecticide, Fungicide, and Rodenticide Act

The USEPA, in cooperation with California state agencies, registers or licenses pesticides for use in the United States through authority granted by the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA, 7 USC §136 et seq.). Aspects of these agencies' work involve evaluating potential new pesticides and uses, providing for special local needs and emergency situations, reviewing the safety of older pesticides, registering producers of pesticides, implementing pesticide field programs aimed at education of users of pesticides and enforcing existing pesticide regulation by working with the State. USEPA is responsible for the language on pesticide labels.

1.5.2.2 Cal/EPA- California Environmental Quality Act

CEQA was enacted in 1970 to protect environmental resources within the State of California. The law requires state and local agencies to follow a protocol of analysis and public disclosure of environmental impacts of proposed projects and to adopt all feasible measures to mitigate those impacts. CEQA applies to both projects and programs of government agencies. Cal/EPA is the agency charged with developing, implementing, and enforcing California's environmental laws, including CEQA. Within Cal/EPA, CDPR is the department responsible for regulating all aspects of sales and use of pesticides within California.

1.5.2.3 California Department of Pesticide Regulation

As the primary responsibility of CDPR is the regulation of pesticide use and its potential impacts on water, air, soil, and biological organisms, CDPR has a number of Memoranda of Understanding with other agencies responsible for the health of the environment, such as the California Air Resources Board (CARB), State Water Resources Control Board (SWRCB), and the CDFG to ensure a coordinated approach to pesticide regulation. CDPR conducts preliminary rulemaking activities, such as research and stakeholder workshops, and prepares proposed actions including notice, regulation text, reasons for regulation, and costs to state and local government and the economic impact on business. CDPR also frequently engages in consultations with other agencies and chairs advisory committees such as the Pesticide Registration and Evaluation Committee and the Pest Management Advisory Committee.

1.5.2.4 California Department of Public Health

CDPH and vector control agencies maintain a cooperative agreement obligating signatory agencies to certain practices that promote safe and effective vector control and ensure that all state and federal pesticide use requirements are met. Among the current requirements of the agreement are regular and proper calibration of all application equipment and maintenance of calibration records, maintenance of comprehensive pesticide application records, submission of monthly pesticide use reports, reporting of any suspected adverse effects upon non-target organisms or property from pesticide applications, employee certification through and maintenance of continuing education, and regular compliance inspections by the County Agricultural Commissioner.

1.5.2.5 State Water Resources Board/Regional Water Quality Control Boards

The State Water Resources Control Board, another branch of Cal/EPA, and the nine regional water quality control boards of California are the state and regional agencies responsible for managing the quality of water within California waterways under the authority of the Porter- Cologne Act of 1969 (Cal WC § 13000 et seq.). The vector control agencies of California must submit detailed monthly reports of their pesticide use to these agencies. In addition, vector control agencies hold General Permits for the application of larvicides through the federal National Pollution Elimination Discharge System established by the Clean Water Act and administered by SWRCB within California.

1.5.2.6 County Agricultural Commissioners

The County Agricultural Commissioners have offices within the California Department of Food and Agriculture (CDFA) and are the primary enforcement agents for state pesticide laws and regulations. California's Food and Agricultural Code § 11501 sets forth the general purposes of the legal code that fundamentally authorizes California's pesticide regulatory program:

- To provide for the proper, safe, and efficient use of pesticides essential for production of food and fiber and for protection of the public health and safety.
- To protect the environment from environmentally harmful pesticides by prohibiting, regulating, or ensuring proper stewardship of those pesticides.
- To assure agricultural and pest control workers of safe working conditions where pesticides are present.
- To permit agricultural pest control by competent and responsible licensees and permittees under strict control of the Department of Pesticide Regulation and the County Agricultural Commissioners.
- To assure consumers and users that pesticides are properly labeled and appropriate for the use designated by the label and that state or local governmental dissemination of information on

pesticide uses of any registered pesticide product is consistent with the uses for which the product is registered.

- To encourage the development and implementation of pest management systems, stressing application of biological and cultural pest control techniques with selective pesticides when necessary to achieve acceptable levels of control with the least possible harm to the public health, non-target organisms, and the environment.

Vector control agencies within California submit detailed monthly reports to the County Agricultural Commissioners' Offices and are subject to compliance inspections.

In addition to these regulations directly regulating the use of pesticides, District programs and activities are also subject to a number of other state and federal environmental laws, such as the California Environmental Quality Act, the National Environmental Policy Act, and state and federal Endangered Species Acts (7 USC § 136, 16 USC § 1531 et seq.; Cal. FGC § 2050-2069, respectively) and Clean Air Act (42 USC § 4201 et seq.). Because vector control districts activities may affect water, plants and animals and other components of the environment, they may hold various Memoranda of Understanding with state and local agencies responsible for managing the environment. In addition, vector control districts may operate within areas covered by habitat conservation plans (HCPs) and natural community conservation plans (NCCPs), which may impose special constraints to activities within local areas.

2 ALTERNATIVES

2.1 ALTERNATIVE 1: NO PROJECT (FULL IMPLEMENTATION OF THE CURRENT PROGRAM AND POLICIES)

Under CEQA, Title 14 of the California Code of Regulations [14 CCR § 15126.6 (e)(3)(A)], "When the project is a continuation or revision of an existing land use or regulatory plan, policy or operation, the "no project" alternative will be the continuation of the existing plan, policy or operation into the future." Thus, under the "no project" alternative of this PEIR, the District's Board of Trustees would renew the current program and continue to implement or modify it in the future.

2.1.1 INTEGRATED VECTOR MANAGEMENT POLICIES AND PRACTICES

The District uses integrated vector management (IVM) techniques to guide its comprehensive control programs. IVM includes surveillance for vectors and diseases, source reduction, public education and chemical and biological control. IVM establishes thresholds for the initiation of physical and chemical control based on numbers and species of vectors and the presence or absence of infective agents.

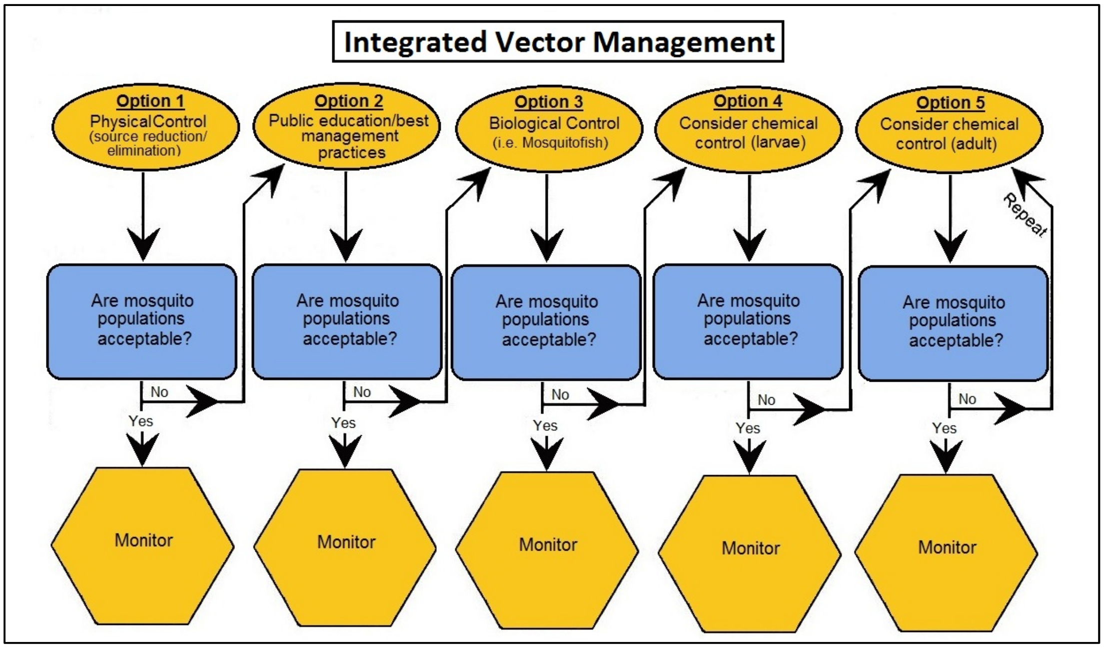

Figure 2-1. Integrated vector management flow diagram. Source: Butte County Mosquito and Vector Control District 2011.

2.1.2 *Vector Species Controlled*

The only species controlled by the SYMVCD at the present time are various species of mosquitoes that breed within the District. The District has conducted surveillance on ticks in the past and educates the public on a variety of vector-borne diseases, the vectors that transmit them and other nuisance organisms, including Africanized honeybees.

2.1.2.1 Mosquitoes

Mosquitoes are prehistoric insects with narrow abdomens, long thin antennas, and slender wings. Females feed on blood with a set of needle-like organs in the proboscis. The majority of mosquito species lay eggs on top of stagnant water. Their development consists of four aquatic larval stages and an aquatic pupal stage (Kwasny et al. 2004). Larvae support their development by feeding on micro-organisms in the water. After the pupal stage, mosquitoes surface from the water to complete their metamorphosis. Development averages from 3 to 12 days depending on environmental factors and species (Kwasny et al. 2004). Factors that affect development are light, temperature, humidity, weather and soil. Warmer temperatures speed development; different species have light and humidity preferences for optimum development. Weather affects habitat availability and behavior, and soil and substrates supply nutrients and affect water chemistry (Durso 1996). Mosquitoes breed in a wide variety of aquatic habitats from forest ponds to storm gutters.

There are 21 species of mosquitoes within the District's boundaries in Yuba and Sutter Counties; however, only a few are competent disease vectors. The species of greatest current concern are *Culex tarsalis* and, secondarily, *Culex pipiens,* because they are the main local vectors of viral encephalitis. The other species are capable of transmitting diseases only occasionally or incidentally, rarely under laboratory conditions, or not at all. The habitats of *Culex tarsalis* and *Culex pipiens* in Sutter and Yuba Counties consist mainly of manmade structures. The most important breeding habitats in order of importance are rice fields, irrigation and drainage ditches, wildlife areas, sewer treatment ponds, irrigated pastures, runoff and seepage, abandoned swimming pools, catch basins, ornamental ponds, underground vaults, and diverse other habitats that support breeding by mosquitoes.

Table 2-1. Mosquito species within the SYMVCD.

Scientific name	Habitat
Aedes dorsalis	Brackish and saline waters of intertidal marshes
Aedes melanimon	Agricultural and waterfowl habitats of the Central Valley
Aedes nigromaculis	Irrigated pastures
Aedes sierrensis	Tree holes or containers with moist vegetation
Aedes sticticus	Leaf-filled potholes and depressions filled with water from snow-melt swollen rivers
Aedes vexans	Wooded waterways and pastures
Aedes washinoi	Freshwater marshes, river pools
Anopheles franciscanus	Creeks, lakes, ponds, freshwater marshes
Anopheles freeborni	Clear, fresh seepage water in sunlit or partly shaded pools; roadside ditches with grass; rice fields
Anopheles punctipennis	Clear, shaded pools along creeks and streams in foothill areas
Culex boharti	Natural creeks, freshwater marshes, lakes, ponds
Culex erythrothorax	Ponds, lakes, marshes and streams with cattails or tule
Culex pipiens	Polluted or foul water high in organic content
Culex stigmatosoma	Natural and manmade polluted habitats (water lagoons, sewer treatment ponds, etc.)
Culex tarsalis	Rain pools, marshes, rice fields, swimming pools, ponds, fresh water
Culex thriambus	Rock pools, isolated ponds, hoof prints along streams and creeks
Culiseta incidens	Natural and artificial depressions filled with rainwater or melted snow
Culiseta inornata	A wide variety of habitats, seepages, rain pools, ditches, salt marshes, etc.
Culiseta particeps	Cutoff pools and streams in wooded habitats
Coquillettidia perturbans	Freshwater permanent ponds, lakes and marshes in areas with emergent vegetation
Orthopodomyia signifera	Tree holes (willows, cottonwoods) containing water year round

The following life history information for mosquito species found within Sutter and Yuba Counties is summarized from Durso (1996) and the Alameda County Vector Control website (www.mosquitoes.org).

2.1.2.2 California Mosquito Life History Summaries

Aedes (*Ochlerotatus*) *dorsalis* breeds in brackish saline waters in intertidal marshes and around the edges of bays and lakes. Small populations occur within Central Valley. This species of mosquito feeds on cows, horses and humans. It is a vector of Western equine encephalitis (WEE), Saint Louis encephalitis (SLE) and California encephalitis (CE) group viruses.

Aedes (Ochlerotatus) melanimon is found in the major inland valleys of California in irrigated pastures, alfalfa fields, and waterfowl areas. Hot weather can allow the larvae to develop quickly; larvae can reach the adult stage in as little as five days. Females are aggressive feeders at dusk and are a major nuisance near breeding sites. They are also known to travel 20 miles from larval breeding sites for food. Rabbits and cattle serve as the primary blood sources. This species also feeds on humans and is a vector of WNV, a secondary vector of WEE and a primary vector of California encephalitis in the Central Valley.

Aedes (Ochlerotatus) nigromaculis (the irrigated pasture mosquito) breeds primarily in intermittently flooded irrigated pastures. The Central Valley has the highest density of the species in California. New generations are produced during each irrigation period (generally March to November), causing peaks of populations in July and August. The aquatic life cycle stage varies from five to 16 days depending on the temperature of the water. Warmer waters increase the speed of development. Each female, due to her short lifespan, will lay one or two batches of 100-150 eggs in a lifetime. *Aedes (Ochlerotatus) nigromaculis* mainly feeds on the blood of domestic animals and humans at dusk but is also known to feed during the day. This species is a secondary or suspected vector of Western equine encephalomyelitis and California group encephalitis.

Aedes (Ochlerotatus) sierrensis (the western treehole mosquito) is present throughout northern California's Sierra Nevada Foothill communities. This species breeds in moist areas inside trees or in containers with leafy material. These mosquitoes are found in greatest abundance in the spring and stay active until summer. Late season rainfall, light, and certain temperatures can contribute to occurrence in the fall. *Aedes* (*Ochlerotatus sierrensis*) stays dormant in the egg or larval stage over winter. This species lays eggs in batches of 50-150 that hatch in 12 or more days. The larval stage may last from 10 days to several months. Females are small and aggressive feeders, feeding mainly on large mammals including humans. This species is the primary vector of heartworm in domestic dogs.

Aedes sticticus is distributed throughout Central Valley and breeds in leaf-filled potholes and depressions filled with water from rivers swollen with snow-melt. Females are persistent biters, feeding during daylight hours near breeding sites. They feed on large mammals including humans and are known to be a successful vector of SLE.

Aedes vexans (the inland floodwater mosquito) is widely distributed throughout the United States. Breeding occurs in woodland watercourses but occasionally also in open pastures. Females lay 100-180 eggs scattered in moist places left by receding or overflow pools. Larval development takes between eight and 46 days. Adults mate within two days after emergence and may disperse up to 10 miles in search of food. Females are vicious day and night biters, feeding on birds and large mammals including humans. In California, they are not considered to be vector of human disease and play a lesser role in the transmission of dog heartworm.

Aedes (Ochlerotatus) washinoi is found from the coast of California to the Sierra Nevada and Cascade Range foothills. Breeding occurs in freshwater ground pools, marshes, heavily shaded burrow pits, and river pools in upland areas. This species is abundant in late winter and early spring and has the ability to produce multiple broods a year but generally only produces one. Females bite during the day and are known to prey on humans. Nothing is known about this species' potential as a vector of disease.

Anopheles franciscanus is present in the Central Valley. Its natural breeding habitats include creeks, lakes, ponds, and freshwater marshes, though this species may also breed in stock ponds, agricultural drains, commercial seepage, and unlined channels. These mosquitoes lay dormant through winter in the adult stage. Their main food sources are rabbits, cattle, horses, domestic pets, rodents and chickens. Females are most active at dusk and rarely attack humans. This species is a known potential carrier of Main Drain virus and avian malaria and has been infected with *Plasmodium vivax* (a parasite that causes malaria in humans) under laboratory conditions.

Anopheles freeborni (the western malaria mosquito) is found throughout the state with the largest populations occurring in rice-producing areas of the Sacramento Valley. Breeding occurs in spring rain pools, river seepage areas, marshes, swamps, semi-permanent or permanent ponds in irrigated pastures, rice fields and drainage ditches. Females can produce up to 200 eggs. Development from egg to adult requires 20 or more days. *Anopheles freeborni* is an efficient malaria vector and is responsible for transmissions of human malaria in the northern part of the state. It will enter homes and animal shelters to bite at dawn and dusk. This species is a significant pest during the mid-summer and early fall in rice-producing areas of the Sacramento and Shasta Valleys. The species is a vector or possible vector of *Plasmodium vivax*, avian malaria, Venezuelan equine encephalitis (VEE), myxoma virus of rabbits, and SLE.

Anopheles punctipennis (the woodland malaria mosquito) occurs along the coastal and interior foothill areas of California. Breeding occurs in clear, shaded pools along creeks and streams in cool wooded areas. Adults do not stray too far from breeding sources to feed on large mammals. Their preferred hosts are cows, but they are also known to feed on horses, sheep, birds, cats and humans. Adult females are aggressive feeders at mid-day and dusk. This species has been successfully infected with human malaria parasites (*Plasmodium vivax, P. falciparum, P. malariae*) and is a carrier of dog heartworm.

Culex boharti is widespread in the lowlands and foothills of California. These mosquitoes breed in natural habitats including creeks, temporary pools, stormwater, freshwater marshes, and occasionally lakes and ponds. Adults feed on toads and are not known to bite humans. This species' vector potential is unknown.

Culex erythrothorax (the tule mosquito) is located in California foothills. The tule mosquito breeds in ponds, lakes, marshes, and streams with cattail or tule growths. This species is atypical in that it spends winter in a larval stage. Females consume the blood of a variety of hosts including humans and birds one to two hours after sundown and during the day in shaded areas. This species is a known carrier of the WNV, WEE, SLE, avian malaria, and Turlock viruses.

Culex pipiens (the northern house mosquito) is found in the Central Valley. Breeding occurs typically in permanent or semi-permanent foul or polluted waters. Sources include artificial containers, fish ponds, cesspools, septic tanks, catch basins, waste treatment ponds, dairy drains, log ponds, and improperly maintained swimming pools. Females lay between 120-200 eggs. Development can occur in six to 10 days. This species does not normally move far from its breeding sources. Birds are the principal blood meal source, but this species also feeds on humans. Females feed in the evening and at night. *Culex pipiens* is a known vector of WNV, WEE, SLE, and viruses of avian pox in California. In addition, it can transmit the parasite responsible for dog heartworm.

Culex stigmatosoma (the banded foul water mosquito) is found throughout California. This species breeds in natural and manmade habitats, but mainly in polluted waters. These mosquitoes breed year round but are most active during the summer. They can produce broods of up to 250 eggs and, under optimal conditions, the larvae develop within seven to 15 days. They feed primarily on birds and seldom attack humans. This species is a known vector of WEE, SLE, Turlock viruses, and avian malaria.

Culex thriambus is a rare species mainly present in the foothill and coastal areas around Central Valley. Breeding occurs in rock pools, isolated ponds, and hoof prints along streams and creeks. Its main food source is songbirds. This species' potential as a vector of disease is unknown.

Culex tarsalis is present throughout California. These mosquitoes breed in a variety of aquatic environments from fresh to contaminated water including rain pools, marshes, swimming pools, ponds, rice fields and other fresh water sources. They primarily feed at dusk on birds and mammals and are known to bite humans only occasionally. This species is a known vector for WNV, WEE, SLE, avian malaria, Turlock, Hart Park and Lokern viruses.

Culiseta incidens (the cool weather mosquito) is known to occur sporadically in the Central Valley. Natural depressions and artificial habitats filled with rain are breeding sites. Other examples of breeding sites are watering troughs, hoof print and ground pools. This species breeds in the fall, winter, and spring and is dormant through the summer. Females lay between 150-200 eggs in a brood. It generally takes around 17 days for eggs to develop into adult mosquitoes. This species feeds mostly on large domestic animals but is also known to feed on humans. No known diseases have been found in wild populations; however, very large populations of biting adults of this species can become a significant nuisance to residents living near wetlands areas.

Culiseta inornata (the large winter mosquito) is present throughout California. Populations are found in a wide variety of habitats, e.g., seepages, rain pools, ditches, canals, duck club ponds, and salt marshes. They are prevalent in spring and fall and are dormant in the summer. This species is tolerant of moderate levels of organic pollution and salinity. Females prefer to feed on large domestic animals and are known to bite humans. This species is a vector of a naturally occurring Jamestown Canyon virus.

Culiseta particeps breeds in small cutoff pools of streams and the shallow margins of filled pools in wooded habitats. This species' peak abundance is in April and May with low population levels in the summer. Peak feeding activity occurs one hour after sunset. Large domestic mammals and humans are prey (Schreiber 1989). This species' potential as a vector of disease is unknown.

Coquillettidia perturbans is found in the Central Valley. The larvae of this species have saw-shaped siphon tubes, which they use to attach to plants and obtain oxygen from hollow plant stems. The blood meal sources for adults are mammals, rabbits, birds, and humans.   This species is known to carry Eastern equine encephalitis (EEE) and VEE.

Orthopodomyia signifera is present in the Central Valley. These mosquitoes breed in tree holes that contain water year round, usually in willows and cottonwoods. They are present in tree holes from May to October. Their main food sources are birds, and they are not known to bite humans. This species is a known vector of EEE in populations located in Mexico and Alabama.

2.1.3 Vector and Disease Surveillance

Surveillance for mosquitoes and vector-borne diseases is the most time intensive activity of the District and entails a combination of physical inspections, trapping, and laboratory tests to establish the extent of vector populations and potential disease organisms. Information from field inspections is supplemented by contacts from the public about the presence and numbers of vectors and dead birds.

The District's vector control technicians check for vector species, control vectors with limited source reduction and by application of pesticides or biological controls, if warranted, and supply affected homeowners and landowners with information to assist them in reducing vector species and exposure to vector-borne diseases. Control strategies are based on the District's Mosquito-borne Virus Surveillance and Response Plan (2011), adopted from the California Department of Public Health plan (2011) of the same name.

2.1.3.1 Mosquito Larvae

Mosquito surveillance begins with mosquito control technicians and mosquito control aides inspecting known and possible mosquito production sources for larvae and pupae from late spring through the fall months each year in their assigned operational zones. The presence of larvae can be determined visually, especially in containers and very small pools, or by using a half-pint dipper to collect a sample for closer inspection and identification and then return it to the source. One or more dipper samples are taken at the edges of rice fields, irrigated pastures and swimming pools to establish the identity and approximate density of mosquitoes. Technicians and aides operate only within an assigned zone and focus on created water bodies to avoid contamination of water sources with invasive species from dipper use.

2.1.3.2 Adult Mosquitoes

Adult mosquito numbers are measured using 39 New Jersey light traps, CO_2/Centers for Disease Control and Prevention (CDC) traps and resting adult red boxes distributed within the District (Figure 2-2, Figure

2-3). In addition, the District evaluates the nuisance value of mosquitoes based on telephone calls from local residents.

A New Jersey light trap consists of a vertical metal cylinder with a conical roof that is fitted above the top of the cylinder. At the top of the underside of the roof is a light bulb, which attracts the mosquitoes to the trap. The entrance to the cylinder is covered with a mesh screen to exclude larger insects such as moths and beetles. Within the cylinder, a fan run by an electric motor sucks in mosquitoes that fly to the light. Below the fan is a fine mesh funnel that leads to the collection jar, which contains a killing agent. A ventilated paper or plastic cup is placed within the collection jar to separate the insects from the killing agent. In most cases, the trap is turned on by a timer just before dusk and turned off shortly after dawn (Reinert 1989).

The CDC trap is like the New Jersey light trap in that it captures mosquitoes with the down draft produced by a motor and fan, but the difference is it attracts mosquitoes with both light and carbon dioxide in the form of dry ice. The CDC trap design is also more light weight and portable using a battery power source, low ampere motor with a suction-type fan housed in a durable plastic cylinder, and a collection bag for holding captured adults. CO2/CDC traps sample a wider range of mosquito species and capture specimens alive making virus assays possible (McNelly 1989).

Resting red boxes, measuring 6 x 4 x 4 feet (Figure 2-4), are used to collect engorged female mosquitoes for population estimates and virus tests. Boxes are placed adjacent to developed residential, commercial or agricultural building areas to avoid their use for dumping or temporary human habitation. Samples are collected twice weekly. The number of mosquitoes removed for the box during the day by mechanical aspirator is expressed as the number per resting unit (Crans 1989). The District also has a half-size red box that is easier to handle and move than the full-sized ones, which it uses to sample locations for future placement of the larger resting traps.

Each week, collection samples from traps are identified and counted by personnel in the District entomology lab and are used to monitor population levels of known vector species. This information aids in determining control strategies, maximum and minimum periods for risk of exposure to disease, and specific areas in need of control efforts. Monitoring begins in late March and usually ends in November, with numbers and species of mosquitoes varying throughout the season. Monitoring mosquitoes on the Sutter National Wildlife Refuge is done by dip counts for larvae and by landing counts for adults in addition to New Jersey light traps.

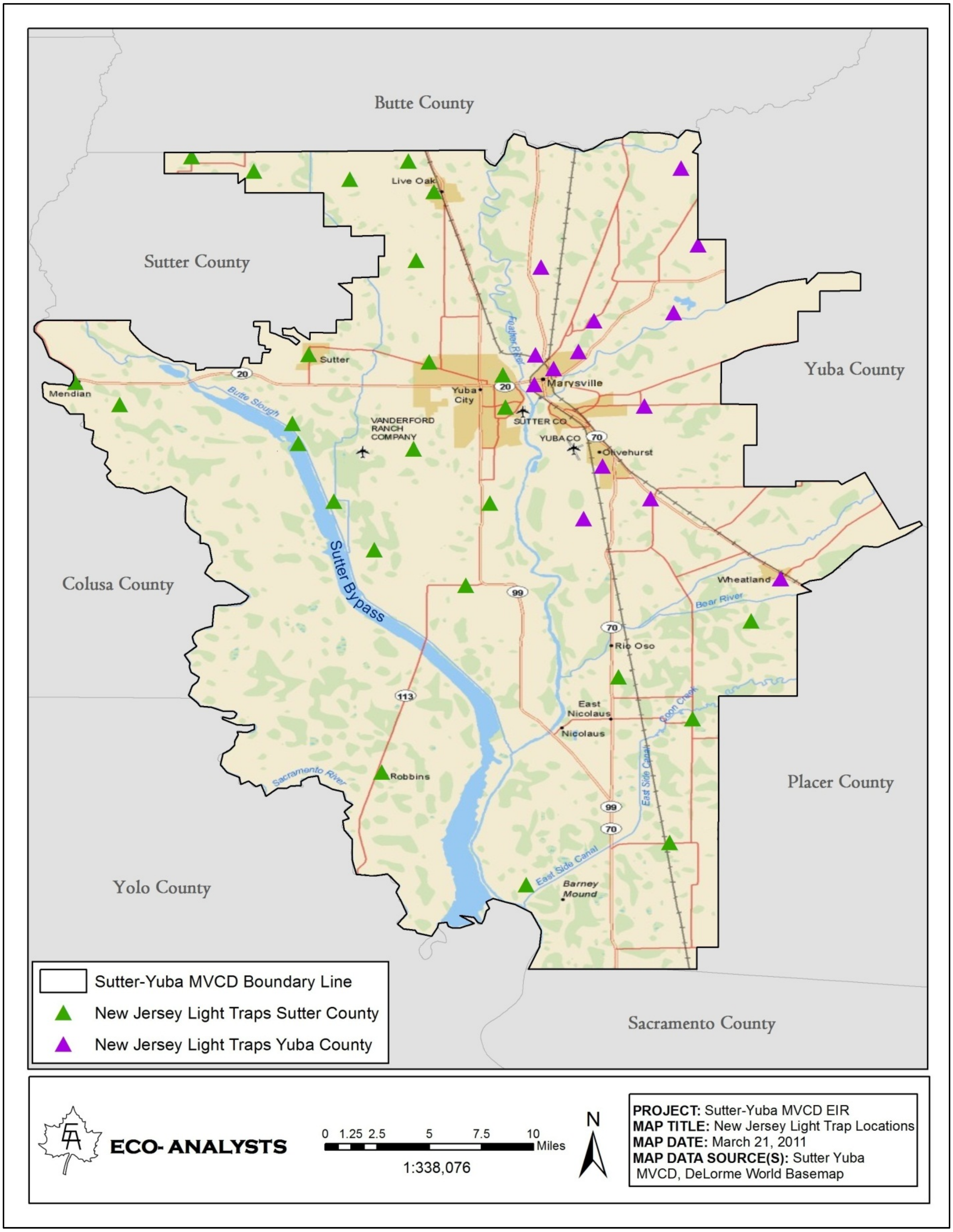

Figure 2-2. 2010 New Jersey Light Trap locations within the SYMVCD.

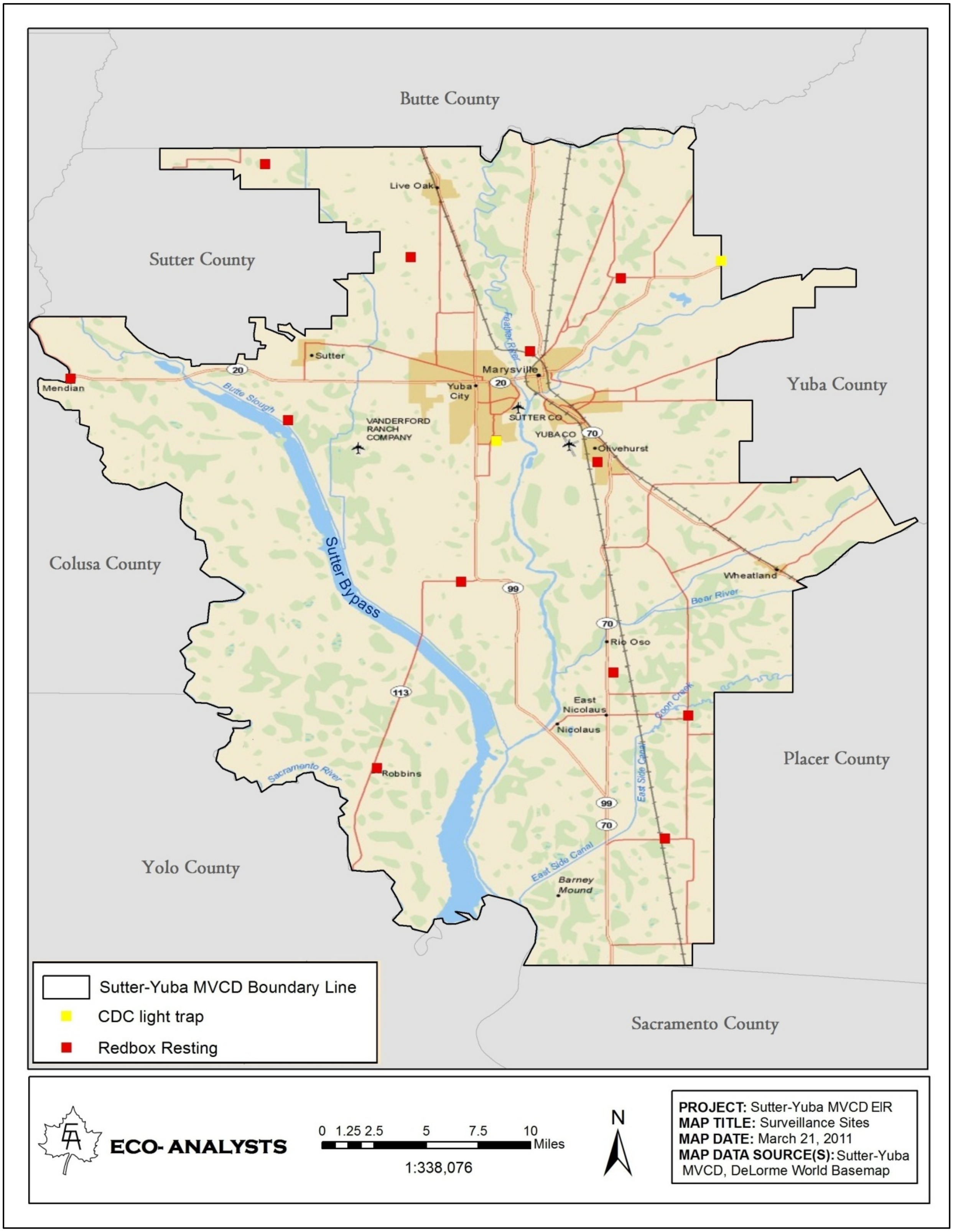

Figure 2-3. SYMVCD surveillance sites, 2010.

Figure 2-4. Assistant technician, Jennifer Finitzer, collects adult mosquitoes from red box with vacuum.

2.1.3.3 Arbovirus Surveillance

Detection of arboviruses (viruses transmitted by arthropod vectors) is accomplished by collecting blood-fed female mosquitoes from seven walk-in red boxes and seven or more day resting sites in both counties. These mosquitoes are then identified in the District entomology lab to confirm that they are mosquito species capable of transmitting arboviruses to humans, horses, or other animals. The mosquitoes are then tested at the Center for Vector-Borne Diseases, University of California – Davis (UC Davis), for arboviruses.

The District also collects blood samples every two weeks from chickens in seven sentinel flocks located in Sutter and Yuba Counties (Figure 2-5). Blood samples from the chickens are sent for testing at the California Department of Public Health, Richmond Campus.

Dead birds reported to the District by the public in late spring and summer months are picked up by zone operators and brought to the UC Davis California Animal Health & Safety Laboratory for testing for the presence of arboviruses or antibodies. The District's website also allows residents to use a toll-free telephone number, 1-877-WNV-BIRD, to report sick or dead birds. An operator will collect and screen information. Arrangements, when warranted, will be made for a trained government official to collect the bird and send it out for testing.

2.1.4 Source Reduction

Source reduction, or "environmental management," of sites producing vectors was originally the primary method of control and remains an important part of vector control today. Source reduction involves physical manipulation of environmental conditions that favor production of vector species, primarily management of standing water to eliminate or reduce mosquitoes.

The classic method of reducing areas where mosquitoes breed involved draining or filling swamps and marshes once they were recognized as the sources of this group of disease vectors. The first recorded environmental management work in California for mosquitoes was performed by the University Experiment Station of UC Berkeley when its researchers assisted the Burlingame Improvement Club (San Mateo County) by recommending ditching and repair of dikes and tide flow gates in the reclaimed salt marsh areas adjacent to that city in 1904 (San Mateo County Mosquito and Vector Control District no date). This program was established to control the enormous numbers of aggressive salt marsh mosquitoes that affected the local populace.

In 1910, the town of Penryn in Placer County organized an anti-malaria campaign that focused on irrigation problems on local farms and the numerous drainage problems created by the Southern Pacific Railroad line that crossed the county. This was followed by a program established for the City of Oroville in Butte County, which had a malaria death rate three times that of Placer County (Patterson 2009).

Figure 2-5. Sentinel chicken flock locations in the SYMVCD, 2010.

Mosquito control was often a secondary effect of reclaiming fresh water marsh lands for agriculture or for residential and commercial development. These activities are now limited by the State of California and federal Clean Water Act regulations, although it is still possible in some instances to reduce mosquito populations by improving water circulation. Reclaimed marshes and standing water in irrigated agricultural areas produce enormous numbers of mosquitoes (predominantly the *Aedes* species), and the proliferation of mosquitoes in these aquatic features continues to be an ongoing issue for vector control agencies.

Urban development and associated drainage systems have added new sources of mosquito habitat that have increased over the past century. Poorly designed storm drain systems, vegetation-clogged ditches, above ground and underground detention basins, swimming pools, landscape pools, cemetery flower vases and abandoned tires and containers can all produce large numbers of mosquitoes. The absence of proper vector reduction strategies during the design and construction phases of state, local and private projects all contribute to mosquito production. Furthermore, if a thoughtful ongoing maintenance schedule is not implemented for aquatic features associated with these projects, this may greatly increase mosquito production. Detection of unmaintained swimming pools and the elimination of mosquito breeding in these and similar sources are a focus of the District's program.

While the change from flood to drip and sprinkler irrigation for orchard crops in Sutter and Yuba County has reduced mosquito generation related to crop production, the large acreages of rice (166,525 acres) and irrigated pasture (16,039 acres) in the two counties continue to be major sources of mosquitoes. The croplands and canal systems connected to them require large amounts of surveillance and time and materials for adequate control.

Current state and federal water laws prevent land owners or agencies from eliminating wetlands by drainage or filling. The Porter-Cologne Act in California and the federal Clean Water Act have been expanded to control effects upon surface waters, as well as provide the original protection for water quality.

SYMVCD does not do any physical management of vegetation or beds of natural waterways or wetlands. Instead, the District has adopted a Best Management Practices (BMP) Manual for the owners and residents of lands with potential mosquito breeding sources to provide guidance in preventing, limiting or eliminating production of mosquitoes. The basis for this manual was developed by the Central Valley Joint Venture's Mosquito Working Group, which included representatives from the MVCAC, California Department of Health Services, California Department of Fish and Game, US Fish and Wildlife Service (USFWS), Natural Resources Conservation Service (NRCS), UC Davis, Suisan Resource Conservation District, California Waterfowl Association, Ducks Unlimited and the Wildlife Conservation Board. In 2004, Kwasny et al. assembled the habitat management findings for managed wetlands, which were published by the US Bureau of Reclamation. Mosquito and vector control districts used these BMPs and have expanded them to cover management techniques for other natural, agricultural and urban habitats within each district.

A number of duck club owners in Sutter and Yuba Counties have signed Memoranda of Understanding with the District, using these BMPs to manage standing surface water on their properties. The District's website contains additional guidance for private homeowners to limit or prevent mosquito breeding on their parcels.

2.1.5 Chemical Control

The following discussion provides a historical overview of the major insecticides used in the control of mosquitoes in California and the US. The major active ingredients in the chemical larvicides and adulticides currently used by SYMVCD are presented along with information on primary application rates and methods of application. Biologically derived insecticides are discussed under biological control. It must be recognized that pesticides applied by public health agencies constitute less than one third of one percent of all pesticides used in California (Howard et al. 2010) and that impacts attributed to pesticide use are predominantly related to agricultural, structural and landscape activities.

2.1.5.1 Historical Background

In the US, there is a long history of attempting to control mosquitoes using larvicides. The first larvicide used in the United States was an unspecified oil recommended in the Philadelphia Daily Advertiser on August 23, 1873 (AMCA 1952). In 1892, LO Howard recommended the use of paraffin or kerosene oil on all mosquito breeding puddles. In 1940, the Rockefeller Foundation, in cooperation with the Brazilian Government, used a mixture of pyrethrum, carbon tetrachloride and kerosene as a supplement to copper arsenate for control of *Anopheles* larvae. Copper arsenate (or Paris Green) had been used as a larvicide successfully in the southern United States for malaria control but was replaced by pyrethrum-oil mixtures in fish ponds and ornamental pools and, in many other areas, by diesel oil or fuel oil plus an emulsifying agent (Rudd and Genelly 1956). This mixture covered three to eight times the surface area compared to oil without the emulsifier.

In 1943, the Bureau of Entomology and Plant Quarantine in Orlando, Florida, established the residual effects of DDT (dichloro diphenyl trichloroethane) as well as its effectiveness as a larvicide for *Anopheles* mosquitoes (Florida Coordinating Council on Mosquito Control 2009). DDT became widely used throughout the United States. Its use as both a mosquito larvicide and adulticide along with its widespread use as a pesticide on agricultural crops caused the rapid development of resistance of many insects including mosquitoes to this chemical, particularly in California and Florida (Rudd and Genelly 1956, Florida Coordinating Council on Mosquito Control 2009). Mosquito control agencies replaced it with more toxic chlorinated hydrocarbon relatives of DDT in many areas, but resistance of mosquitoes to these compounds also developed rapidly. Scientists soon recognized that the persistence of DDT and other chlorinated hydrocarbon compounds resulted in bioaccumulation in aquatic and terrestrial vertebrates, which eventually led to restrictions or complete elimination of the use of these chemicals in the US. While the use of DDT on crops has been virtually eliminated throughout the world, it is still used as a residual spray on buildings in high malaria infection areas in the tropics.

With the growing recognition of the environmental impacts of hydrochlorine use and restrictions on use in the US, other chemicals were sought as replacements for mosquito control, and use of organophosphate pesticides (OP), which are cholinesterase inhibitors, began to replace use of chlorinated hydrocarbons in the late 1950s and early 1960s (Rudd and Genelly 1956). One benefit of the organophosphates over earlier mosquito control compounds was their relatively rapid breakdown to less toxic or non-toxic substances when exposed to sunlight and moisture. Parathion was the first OP used in many mosquito control programs. It was effective at controlling mosquitoes and a large number of agricultural pests that were resistant to DDT and related organochlorine compounds. It is, however, potentially highly toxic upon contact with the skin or when inhaled. Resistance of mosquitoes to parathion began developing as well, and agencies began substituting malathion, a related chemical considered to be slightly toxic by USEPA (2006a) and originally used in mosquito control as both a larvicide and adulticide. It was effective as a larvicide because of its solubility in water, and its rapid degradation to non-toxic by-products was considered an environmental benefit. Carbaryl, a carbamate compound used in many regions of the world, became an alternative to OPs for mosquito control when this pesticide, originally used on lawns and gardens, was found to be very effective against mosquitoes. While very toxic for honeybees and parasitic wasps, it presents relatively low toxicity for mammals and birds (USEPA 2004). Another advantage of the carbamate insecticides is that they degrade rapidly in the environment after application and do not bioaccumulate (Fishel 2005, International Programme on Chemical Safety 1986). Several organophosphate insecticides are still currently used in mosquito control programs in the US, but primarily as adulticides rather than larvicides.

Number 2 diesel oil, the first widely used water surface field agent for mosquito larvae and pupae, was replaced with Golden Bear Oil (GB-1111), a petroleum distillate. GB-1111 is toxic to most air-breathing aquatic larvae and is most effective on the pupal stage of mosquitoes (Mulla and Darwazeh 1981). It is no longer manufactured, and mosquito districts in California are currently using up the remnants of their supplies. Agnique, an ethoxylated alcohol, was developed as an alternative to petroleum distillate oils. Agnique forms a monomolecular film, making it difficult for mosquito larvae and pupae to attach to the surface of water, resulting in drowning of these life-stages. It does not enter the water column and does not appear to affect other aquatic species (Stark 2005). Mineral oil and silicone surface agents have been developed to replace petroleum based Golden Bear.

Methoprene (or s-methoprene) is an insect growth regulator that is currently used in a variety of pest control formulations. It is a synthetic juvenile insect hormone used to disrupt the transformation of mosquito larvae into adults and is an active ingredient in larvicides such as Altosid® and Aquaprene™. Because mosquitoes also become resistant to methoprene with its long-term use (Florida Coordinating Council on Mosquito Control 2009), mosquito control agencies periodically rotate the use of methoprene and other growth regulators with the bacterial larvicides, *Bacillus thuringiensis israelensis* (Bti), *Bacillus sphaericus* (Bs), and spinosad, which are discussed further under biological control. They have evaluated the possible use of other biological organisms to control mosquito larval populations as well.

Insecticides that target adult mosquitoes are also widely used by mosquito control agencies, but as secondary control methods to source reduction and the application of larvicides. The main adulticides currently used in mosquito control are natural pyrethrins, synthetic pyrethroids, and organophosphate insecticides. Natural pyrethrins are derived from chrysanthemum flowers, particularly strains from Africa, and the Middle East and surrounding areas. These compounds kill larvae of mosquitoes by acting on the sodium and potassium pumping mechanisms necessary for transmission of nerve impulses in arthropods. They do not act significantly on mammals owing to the presence of mammalian enzymes that break down their active compounds (USEPA 2006b); they are not stable in sunlight and breakdown in a few hours.

Pyrethrins are generally not utilized by vector control districts as much as the synthetic pyrethroids because their availability has been limited by problems with production in the areas of origin and, in some years, they have not been available in the quantities needed for vector control activities or their cost has been exorbitant. Synthetic pyrethroids (sumithrin, permethrin, etc.), on the other hand, can be manufactured to meet demand. As well as being less costly than pyrethrins, pyrethroids last longer and can persist up to weeks after treatment when they become incorporated in sediments (Weston et al. 2006). Pyrethrins and pyrethroids both depend upon a synergist to offset detoxification by the target insects. Use of a synergist allows lower initial doses and prolongs the persistence of the pesticides. The most commonly used synergist is piperonyl butoxide (PBO).

2.1.5.2 Chemical Inventories

Questions are often asked about the number and variety of chemicals carried in vector control districts inventories. There are two main reasons vector control districts keep stocks of many chemicals. The first is the development of new pesticides that are more vector-specific and less persistent in the environment and the other, more compelling reason is the development of resistance of vectors to chemicals and classes of chemicals, requiring alternation among chemicals to maintain adequate control of vector populations with pesticides.

2.1.5.3 District's thresholds for treatment

Mosquito and vector control districts have always relied upon some type of threshold to initiate physical and chemical control measures. In California, as elsewhere, the initial mosquito control measures were designed to reduce high populations of aggressive biting mosquitoes and very high levels of human malaria. As these programs gained in success, more and more mosquito control districts were developed to reduce the swarms of day-biting mosquito species and the incidence of malaria and other mosquito-borne diseases.

The appearance of SLE added another factor in determining a point at which control measures were justified. The WNV infections in the US increased the need for establishing thresholds for treatment of larval and adult mosquitoes. The California Department of Public Health released the California Mosquito-Borne Virus Surveillance & Response Plan in 2011, and it has been adopted by many districts including SYMVCD. This approach uses a semi-qualitative method incorporating seven surveillance factors for estimating the level of risk for humans, which are:

- Environmental or climatic conditions,
- Adult *Culex* vector abundance,

- Virus infection rate in *Culex* mosquito vectors,
- Sentinel chicken seroconversions (i.e., presence of antibodies against a disease),
- Fatal infections in wild birds (WNV only),
- Infections in humans, and
- Proximity of detected virus activity to urban or suburban populations (WEE only).

Factors are rated on a scale of 1 to 5 and used to calculate a normal operations season, emergency planning need, or an epidemic situation. These are determined for each virus of concern (SLE, WEE, and WNV) and may be coordinated on a regional basis by CDPH. Data management for the analysis has been enhanced and expanded though use of the California Vector-borne Disease Surveillance Gateway program (Barker et al. 2010).

SYMVCD uses a low threshold for the presence of mosquito larvae in rice fields, one mosquito larva per 40 dips, based on studies conducted by UC Davis within the District (Washino and Dritz 1995, unpublished manuscript), as allowed by the surveillance program. All districts use residents' complaints as one determinant of when to apply adulticides; the other determinants used are listed above.

2.1.5.4 Larvicide Applications by the District

Application of chemical larvicides (Table 2-2) is conducted when source reduction techniques have not reduced mosquito populations to tolerable levels and levels or those at which the risk of disease transmission is considered low, based on the surveillance and response plan. The primary chemical larvicides used by SYMVCD are the surface agents, Agnique® and GB-1111, and the insect growth regulator, methoprene. SYMVCD also uses the bacteria, Bti and Bs, (discussed further under Biological Control) in several products for mosquito control within the District to treat rice fields, duck clubs, pastures, and wetlands. GB-1111 production has ceased, and manufacturers are and have been developing substitutes based on silicone and mineral oils.

Surface agents (Agnique®) and the growth regulator, methoprene (Altosid® products), were used predominantly in duck clubs and irrigated pastures in 2009 and 2010. The District has a special use permit for insecticide application on the Sutter National Wildlife Refuge that allows the use of methoprene as well as Bti for control of mosquito larvae. Methoprene and Bti are applied either from the ground or the air; they are applied from air when sources (such as duck clubs or large wetlands) are too large to cover adequately from the ground. The District field tested spinosad bacteria (Natular™) in very small amounts in 2010 and will use it as an alternative control agent to prevent development of resistance to the other bacterial compounds. Dursban® 2% coated granules (chlorpyrifos) were used as a larvicide in tires and dehydrator sump pumps and drains in 2010. This material is no longer available, and the District's very limited supply has been exhausted. Dimilin® 25W (diflubenzuron), an insect growth inhibitor that prevents the molting process, is also used in very limited amounts to control mosquitoes in wastewater treatment ponds only.

Table 2-2. Mosquito larvicides used by SYMVCD in 2010.

Product Name	Active Ingredient	Concentration	Application Rate
AGNIQUE® MMF	alcohol ethoxylated surfactant	100.00%	0.35 – 1 gal/acre
AGNIQUE® MMF-G	alcohol ethoxylated surfactant	32.00%	11-21.5 lb/acre
ALTOSID® PELLETS	methoprene	4.25%	2.5 – 10 lb/acre
ALTOSID® SBG	(s)-methoprene	0.20%	5 – 20 lb/acre
ALTOSID® XR BRIQUETS	methoprene	2.10%	1/100 sq ft, 2 ft water depth
ALTOSID® XR-G	(s)-methoprene	1.50%	5-20 lb/acre
DIMILIN® 25W	diflubenzuron	25.00%	3.25 oz/acre
DURSBAN® 2 CG	chlorpyrifos	2.00%	2.5-5 lb/acre
VECTOBAC® 12AS	*Bacillus thuringiensis israelensis*	11.61%	4-32 oz/acre
VECTOBAC® G	*Bacillus thuringiensis israelensis*	2.80%	10-20 lb/acre
VECTOLEX® CG	*Bacillus sphaericus*	7.50%	5-20 lb/acre
VECTOMAX® CG	*Bacillus sphaericus, Bacillus thuringiensis*	2.7% 4.5%	5-20 lb/acre
GB-1111	petroleum distillate oil	98.70%	3-5 gal/acre
NATULAR™ G-30	spinosad	2.50%	5-20 lb/acre
NATULAR™ XRT	spinosad	6.25%	1 tablet (1.2 oz) per 100 sq ft

2.1.5.5 Adulticide Application by the District

Application of adulticides (Table 2-3) in the integrated vector management model is generally a third-level measure to control mosquitoes when source reduction and use of larvicides have failed to adequately reduce mosquito populations. Source reduction may not be possible if the source habitat falls within a natural area subject to environmental legislation that prevents draining or other habitat alterations, or is under agricultural practices that are incongruent with physical elimination of standing water (e.g., rice production, irrigated pasture). If mosquito breeding occurs over very large areas with limited access or other conditions that prevent adequate coverage with larvicides, adequate control of mosquito populations with larvicides alone may not be feasible and use of adulticides may be necessary. Adulticides are also used to protect population centers when mosquitoes travel from production sources in search of human hosts and as barrier sprays after water is drained from rice fields in the fall months and mosquitoes migrate toward urban areas.

Adulticides are applied using ultra-low volume dispersal, which is defined by the USEPA "as a method of dispensing liquid insecticides at the rate of one half gallon or less per acre (ac)."

Table 2-3. Chemical adulticides used by SYMVCD and application rates.

Product Name	Active Ingredients	Concentration	Application Rate oz/acre
ANVIL® 2+2	phenothrin piperonyl butoxide	2.00% 2.00%	1.3
ANVIL® 10+10	phenothrin piperonyl butoxide	10.00% 10.00%	.21 - .62
AQUAHALT™	pyrethrins piperonyl butoxide	5.00% 25.00%	.28 - .76
BIOMIST® 4+4	permethrin piperonyl butoxide	4.00% 4.00%	.75 – 3.0
DRAGNET®	permethrin	36.80%	Dilution rate of ½ oz per gal water, applied to surface to point of runoff
DUET™	prallethrin sumithrin piperonyl butoxide	1.00% 5.00% 5.00%	.41 – 1.24
FYFANON®	malathion	96.50%	0.71-4.0
PYRENONE® 25-5	pyrethrins piperonyl butoxide	5.00% 25.00%	0.83
PYROCIDE® MOSQ. ADULT.	pyrethrins piperonyl butoxide	5.00%	0.83
TRUMPET®	naled	78.00%	.60 -1.2
ZENIVEX® E20*	etofenprox	20%	.015-.59

Formulations for the control of public health vectors and pests are dispersed at concentrations of 10-90% at flow rates up to 18 fluid ounces per minute. Technical grade application rates typically range from 0.001-0.1 gallons (0.006 - 0.06 pounds) per acre, and maximum rates may be even lower; for example, pyrethrins are applied by the District at a maximum rate of 0.0025 pounds of active ingredient per acre. ULV insecticides are applied as an aerosol typically consisting of particles ranging in diameter from 15 to 45 microns (µm); 80% of the particles must have a diameter within the 15 to 30 micron range. Droplet parameters are further defined for each insecticide labeled for ULV dispersal (US Department of Defense 1999). Mosquito control districts have found that droplets within the 10-25 micron range are the most effective at controlling adult mosquitoes. The ULV aerosols are applied either from the ground using specially designed mist applicators that are mounted on trucks or from the air using small agricultural aircraft. The pickups use paved and dirt roads, including those on field boundaries.

The District currently uses malathion and naled, pyrethrins, various synthetic pyrethroids combined with piperonyl butoxide, and etofenprox (Zenivex®), an insecticide with an action similar to pyrethroids that does not require a synergist, to control adult mosquitoes. The primary adulticide used in 2009 and 2010 was naled (Figure 2-6).

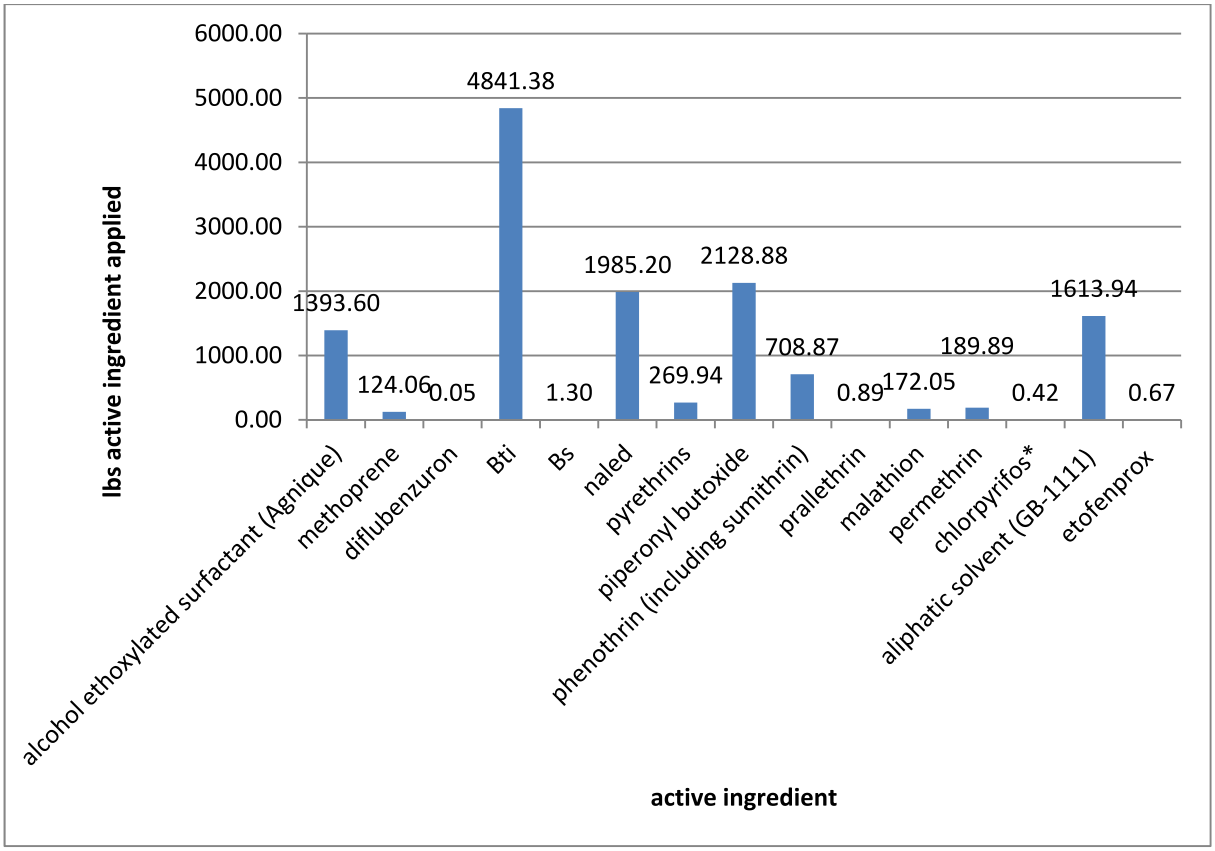

Figure 2-6. Active ingredients in pounds applied by SYMVCD, 2010. *= product no longer used.

Table 2-4. Acres treated by SYMVCD by active ingredient, 2010.

Active Ingredient(s)	Acres treated
alcohol ethoxylated surfactant (Agnique)	305.74
methoprene	1,655.97
diflubenzuron	19.6
Bti	126,372.3
Bs	3.02
naled	55,939
pyrethrins*	109,632.34
piperonyl butoxide	344,323.5
phenothrin, sumithrin, prallethrin*	210,025.82
malathion	1,201
permethrin*	24,665.28
chlorpyrifos[1]	4.2
aliphatic solvent (GB-1111)	87.01
etofenprox	174

* products with these active ingredients may also contain piperonyl butoxide; [1] product no longer used.

The choice of particular active ingredient used is the result of considering its effectiveness on the mosquito species controlled, as some mosquito species have become more tolerant or resistant to certain chemicals, as well as the type of source that is treated. For example, naled is permitted in and around Sutter Wildlife Refuge only when West Nile virus has been detected on the refuge. Timing of the application of the adulticides is also determined by the species. Most of the locally significant mosquito vectors are crepuscular species (active at dawn and dusk), so adulticides are applied after night-fall to maximize contact with active mosquitoes as well as reduce potential exposure to beneficial insects and humans.

Malathion and naled may be applied from the ground or air. Within the District, malathion was applied only from the ground within irrigated pastures in 2010, while naled was applied aerially over duck clubs and rice fields (Figure 2-7, Figure 2-8). Pyrethrins and pyrethroids were applied from small agricultural aircraft and from the ground in duck clubs and rice fields (Figure 2-8). They were also applied from the ground along routes in towns, orchards and pastures (Figure 2-9). Etofenprox was also used in very limited amounts (0.67 lbs of active ingredient) along town routes, as use in agricultural areas has not yet been approved by CDPR.

Adulticides may also be used as “barrier” sprays, which consist of application of a material with residual properties (i.e., it persists longer in environment) to foliage, buildings or resting areas of a mosquito species to intercept adult mosquitoes hunting for blood meals. This technique is used around perimeters of human population centers. The main adulticide used as a barrier spray by the District in 2009 and 2010 was Dragnet® (permethrin), but the chemical used will be determine by the natural history and behavioral characteristics of the mosquito species treated.

2.1.6 Biological Control

The use of biological control agents for control of insect vectors, particularly mosquitoes, has increased dramatically in recent years. This section provides an overview of types of biological agents used by the District or investigated by the District and/or others as alternatives to mosquito insecticides.

2.1.6.1 Bacterial Larvicides

The District’s current program utilizes several bacterial larvicide products, Bti, Bs, and spinosad, and a vertebrate mosquito predator, the mosquitofish (*Gambusia affinis*) for biological control of larval mosquitoes. Bti and Bs are commercially produced bacteria that are used extensively in control of larval mosquitoes. The bacterial spores in the products are ingested by larval mosquitoes and produce proteins in the alkaline gut of the larval mosquito that are toxic to it and kill it before it reaches maturity. Although these materials are biological products, they are evaluated and regulated in the same way chemicals are by the USEPA and CDPR. One reason for the popularity of these products for mosquito control is that while they are effective in killing larval forms of various mosquitoes, they have almost no effect on other organisms, so are considered preferable to use of chemical larvicides. Both *Bacillus* species are cost-effective, easily grown on artificial media, and easy to apply using the conventional arsenal of mosquito and vector control technologies.

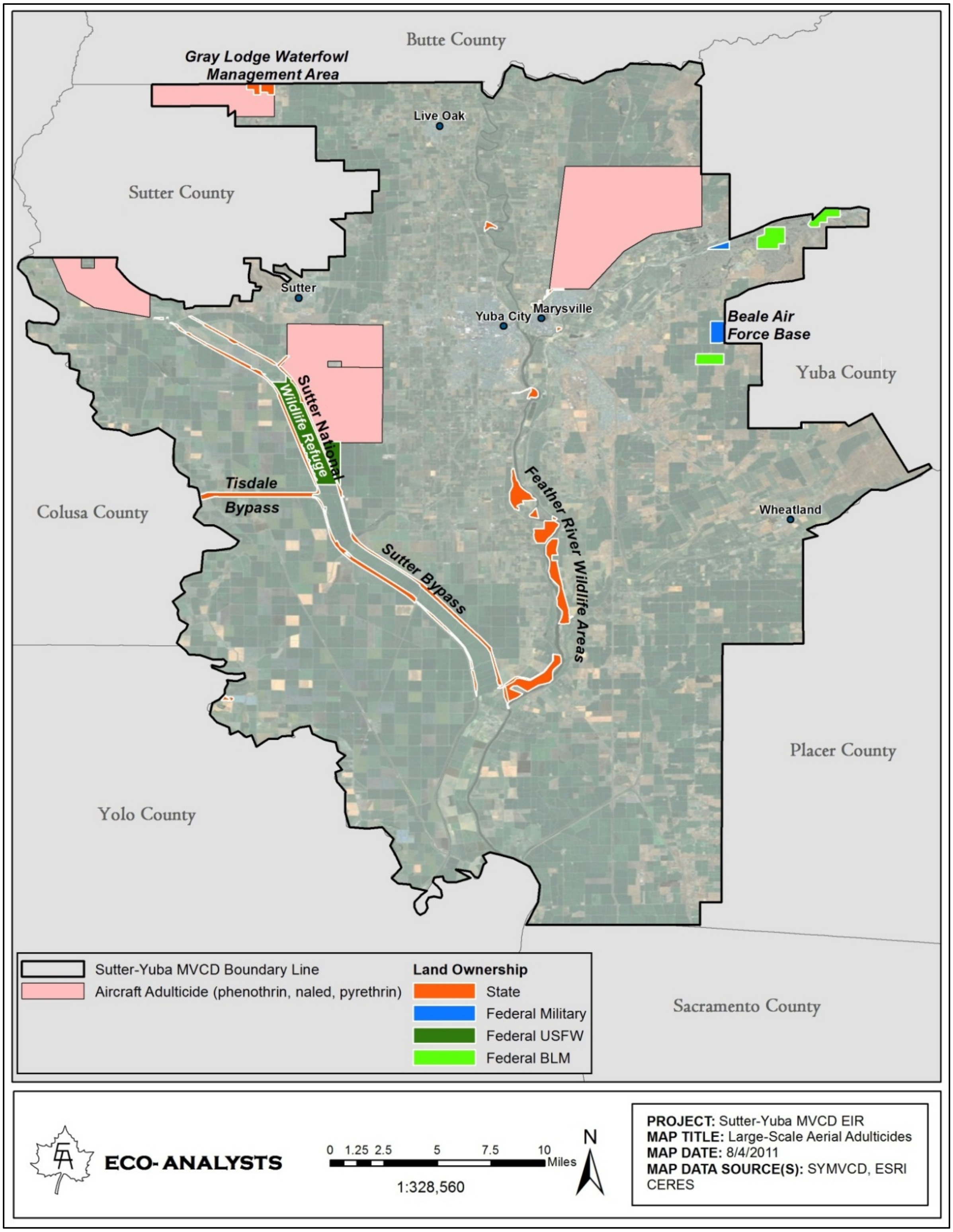

Figure 2-7. Large-scale aerial treatment with adulticides within SYMVCD.

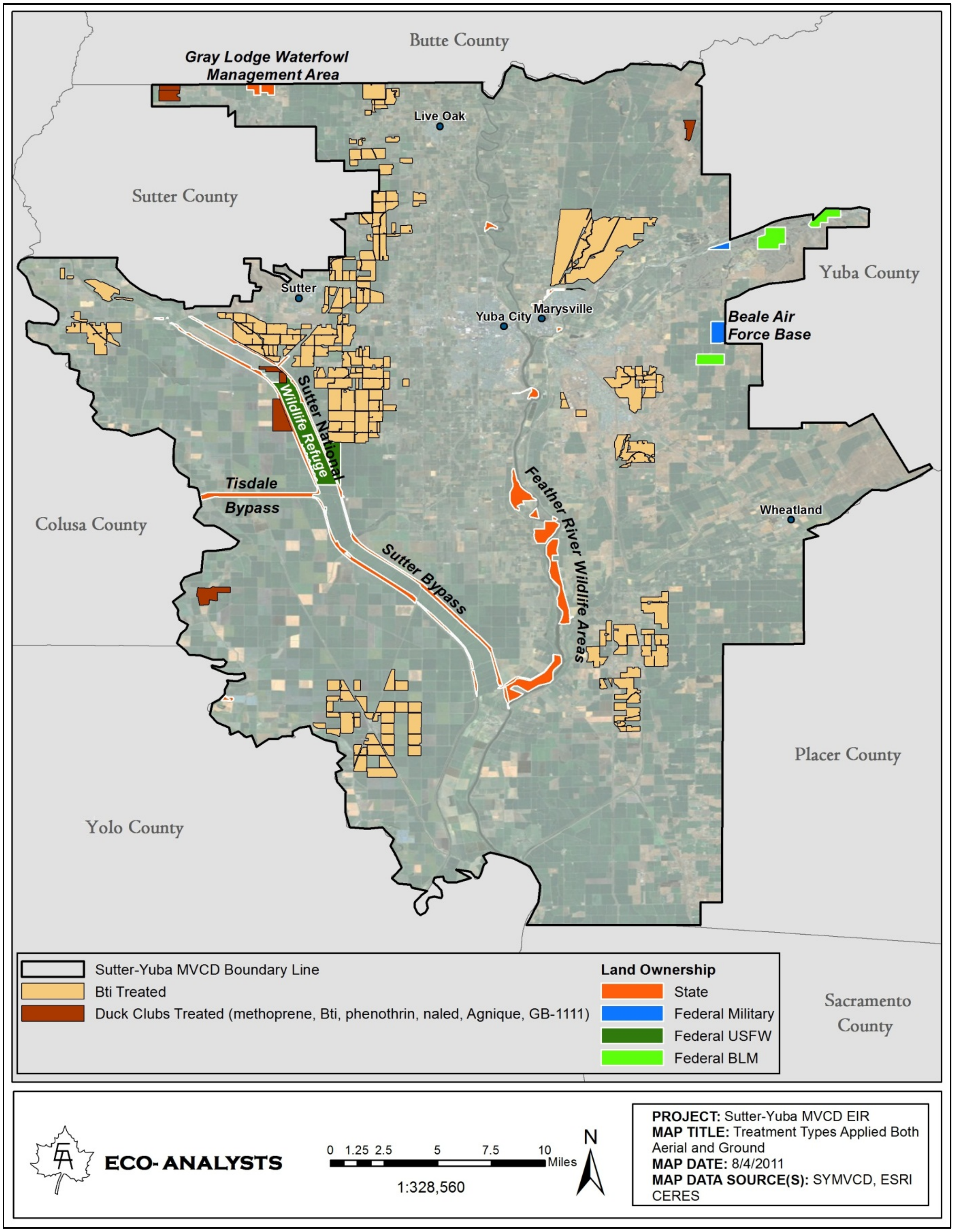

Figure 2-8. Areas treated with larvicides and adulticides by ground and air within SYMVCD.

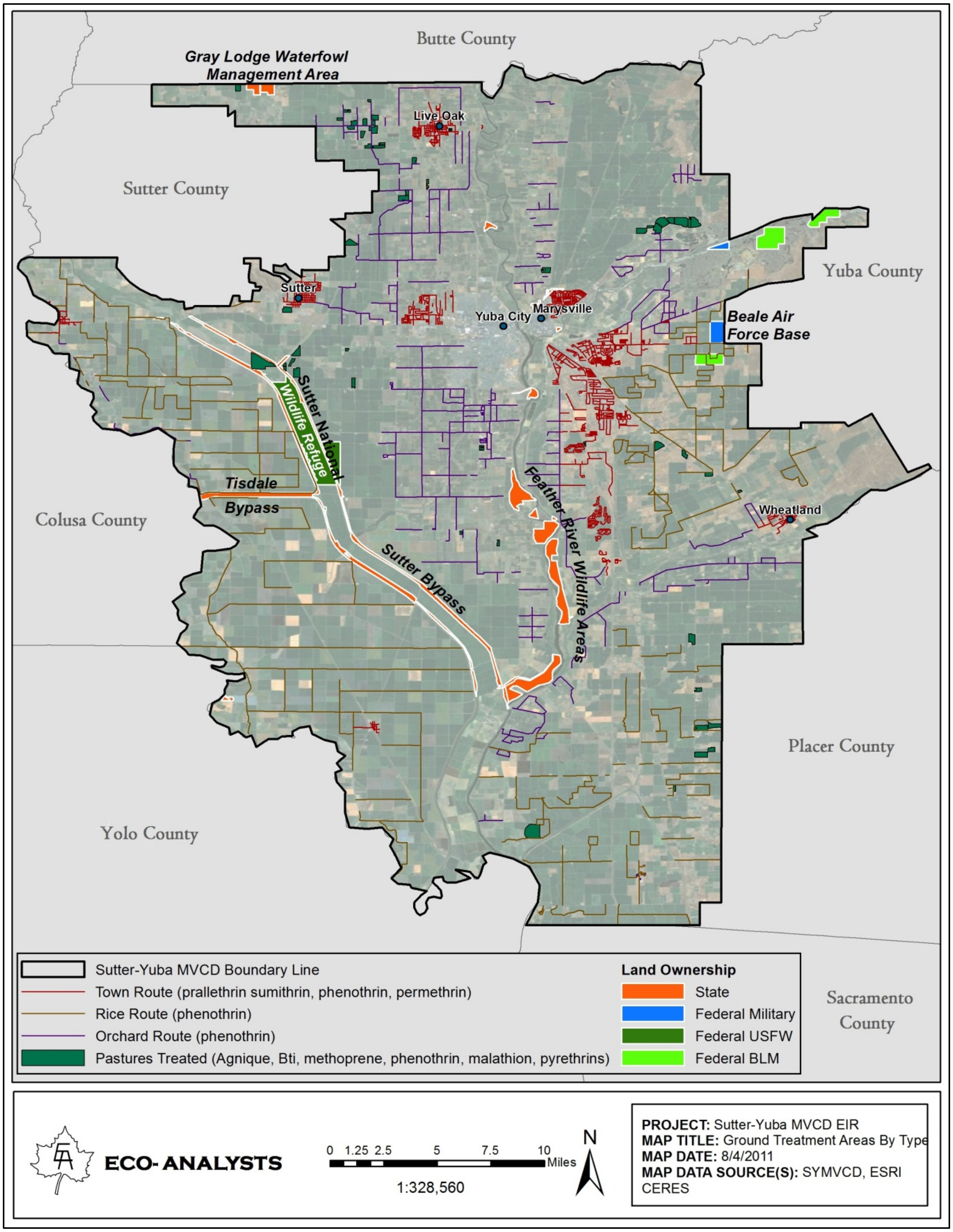

Figure 2-9. Areas treated with larvicides or adulticides by ground within SYMVCD.

Bti is considered by the USEPA to be non-toxic (USEPA 1998); Bs is the preferred strain for waters with high organic waste loads. Spinosad (Natular™) is a relatively new larvicide derived from a naturally-occurring soil bacterium, *Saccharopolyspora spinosa,* which is becoming more widely used in mosquito control in California.

2.1.6.2 Other Microbes and Invertebrates

Many aquatic insect larvae and some adults are predators of immature and adult mosquitoes. Water striders, spiders, and planaria (flatworms) feed on larvae and pupae at the surface (Mogi 2007). Predaceous diving beetles, notonectids (i.e., backswimmers) and water scavenger beetles feed on larvae below the surface. Dragonfly and damselfly nymphs feed on mosquito larvae, and the adult forms are voracious predators on adult mosquitoes (Chatterjee et al. 2007). Dragonflies can produce quite effective control of adult mosquitoes when they emerge at the same time; however, commercial production of dragonflies for mosquito control has not been pursued at this time.

There are a number of microbes and invertebrates that provide control of mosquito larvae in addition to the bacterial products used by the District. Viral infections of mosquitoes are caused by iridoviruses, densonucleosis viruses, nuclear polyhedrosis viruses, cytoplasmic polyhedrosis viruses, and entomopoxviruses (Genus C) (Webby et al. 1998, Buchatsky 1989, Arif 1995). Laboratory production tests are being run on densonucleosis virus to test for the feasibility of mass production (Buchatsky 1989). Mosquito larvae are also known to be infected with parasitic fungi or fungus-like organisms, including *Lagenidium giganteum, Coelomomyces* species, *Culicinomyces clavosporus*, and *Metarhizium anisopliae* (Scholte et al. 2004).

Lagenidium giganteum, a water mold related to diatoms and brown algae (often described as an oomycete fungus), has a wide distribution in several continents and has caused high mortality rates in mosquitoes in both laboratory and field tests (Reid et al. 1996). It has been produced commercially as Laginex™, approved by both the USEPA and Cal/EPA, and appeared to be a promising control agent for mosquitoes. It reproduced during an entire mosquito season and maintained its effectiveness as a control agent for mosquito larvae in North Carolina (Jaronski and Axtell 1983). A larger scale field test in northern California resulted in 40-90% infection rates in *Culex tarsalis* and *Anopheles freeborni* sentinel larvae (Kerwin and Washino 1987). Overall, the results have not been satisfactory for mosquito control because this fungus does not survive from year to year and is susceptible to poor water quality and to many chemicals used by agriculture and vector control districts.

Coelomoyces has been observed to cause significant epizootics in mosquito larvae over a period of years. Field tests have resulted in unpredictable infection rates, and mass production of this fungus has been difficult (Scholte et al. 2004).

Protozoans attacking mosquito larvae include *Nosema algerae, Hazardia milleri, Vavraia culicis, Helicosporidium* species*, Amblyospora californica, Lambomella clarki, and Tetrahymena* species. These species have not been commercially produced or applied in vector control.

Nematodes are known to infect mosquito larvae, including the mermithid nematode, *Romanomermis culicivorax*. This organism is found naturally in slow-moving water and lake-bottom sediments in temperate and tropical freshwater environments. SYMVCD established an objective of rearing this nematode for operational uses in 1980 (Kimball and Kauffman 1984) and realized that objective in 1984. Storage of parasite cultures has proven problematic and labor-intensive, although progress had been made in improving storage methods (Critchfield 1985). This organism is no longer used by the District because cost-effective and easy application methods were never achieved (Federici 1995).

2.1.6.3 Birds and Bats

Bats and several species of birds that prey on adult mosquitoes have also been investigated as biological control organisms. Most of the information on success of using these species has been anecdotal. The first attempts to create municipal bat roosts to control malaria were in the early 1930s when a dentist from San Antonio, Texas, C. A. R. Campbell, had some very large roosts constructed (Allen 1939). The attempt was met with limited success, and the numbers of Mexican free-tailed bats (*Tadarida brasiliensis*) using the roosts were small. Bats within the genus *Myotis* are the most likely feeders on mosquitoes because they choose prey of the same size as mosquitoes and hunt at the same heights above the ground used by mosquitoes. A 2002 study of the foods of *Myotis lucifigus* in Fairbanks, Alaska, indicated that mosquitoes provided 1.8% of the bats' insect diet (Rydell et al. 2002). A study originally published in 2009 in the Journal of Medical Entomology used a more sophisticated approach (Reiskind and Wund 2009). The researchers placed plastic tubs with water and decaying hay (equivalent to gravid traps) inside and outside large wire enclosures that contained *Myotis septentrionalis*. They found that the bats reduced mosquito egg rafts by 32%. This level of success would be considered insufficient by mosquito abatement districts, however, and a disadvantage of using bats widely for mosquito control is their potential to harbor zoonotic diseases, such as rabies and histoplasmosis.

Martins, large members of the swallow family of birds, feed at the same elevations above ground that mosquito swarms occur. While martins are capable of devouring hundreds of mosquitoes while the latter are swarming, they feed on all flying insects of a similar size, including chironomids (midges) and flying ants. Swifts and swallows are the best analogs for martins in the Sacramento Valley. Colonies of these birds are never large enough to consistently reduce populations of mosquitoes in marshes or rice areas. In addition, martins are susceptible to WNV, which can significantly reduce numbers of this bird in an area.

2.1.6.4 Mosquitofish (Gambusia)

Gambusia affinis, also known as the mosquitofish, is a small freshwater fish of the family Poeciliidae (Livebearing Toothcarps) that has been distributed widely since the early 20th century as a biological control agent for mosquito control. It is commonly believed to be the most effective vertebrate predator of mosquito larvae and pupae. *Gambusia* are native to the central, Gulf and south Atlantic states and Mexico where they were historically known to feed on larval and pupal stages of mosquitoes, other invertebrates and small organisms, including algae. Mosquitofish now enjoy a nearly global distribution in tropical and temperate countries. They were introduced to this state in 1922 by the

California State Board of Health officials (Coykendall 1980) and are now widely established throughout the state.

Mosquitofish grow to a maximum size of almost three inches and can live two to three years. They are live-bearing, producing three to four broods a year with a few to several hundred fry per brood (Coykendall 1980). They are tolerant of a wide range of temperatures and water quality conditions, and each individual is capable of eating over 100 mosquito larvae per day under optimal conditions. Although their high rate of reproduction can lead to large populations being quickly established, these same populations can crash dramatically in winter if temperatures plummet, water quality dramatically changes, diseases emerge or food sources become depleted. They also are eliminated when ephemeral pools dry up or ponds are drained. Mosquitofish are subject to predation by herons and other wading birds and provide a food source for Giant Garter Snakes (*Thamnophis gigas*), a species listed as threatened by California and the USFWS, in rice growing areas.

Mosquitofish are a critical part of the District's IVM approach to mosquito control. The District has 20 acres of *Gambusia* rearing ponds in southern Sutter County with a limited ability to produce *Gambusia* at the District headquarters. The District places *Gambusia* in mosquito breeding sources such as urban and suburban water features (swimming pools, ornamental ponds, and containers), roadside ditches, and rice fields. District staff also collect mosquitofish from previously stocked areas, as needed, for redistribution by District technicians. Collection of mosquitofish occurs in previously stocked artificial or isolated water bodies to avoid effects on native fauna. The District has provided mosquitofish to the public but is considering discontinuing this in the future. A revised policy on *Gambusia* was adopted by the Board of Trustees in July 2011. The District distributes an information sheet that discusses best uses and guidelines, including avoiding streams, creeks, and vernal pools when distributing mosquitofish to the public. In 2010, approximately 1,358 lbs of mosquitofish were planted or distributed by SYMVCD into breeding sources or provided to the public for residential use. Approximately 6,994 acres were treated in 2010.

The use of mosquitofish is preferable in areas that can be treated in early spring so that they sustain a population during mosquito season. Mosquitofish are used in addition to control with bacterial and chemical larvicides when sources are so large that use of mosquitofish alone does not adequately control production of mosquitoes.

2.1.6.5 Native Fish

Researchers have examined using alternative species of fish and developed a rating system for determining the appropriateness of fish species selection for mosquito larvae control (Ahmed et al. 1988). In some cases, native fish species can be effective at controlling larval mosquito populations (Coykendall 1980).

SYMVCD has experimented with several other fish species for mosquito control use in the 1970s, including the desert pupfish (*Cyprinodon macularius*). However, to date, no other fish species has been found that is more effective than *Gambusia affinis* at mosquito reduction. Mosquitofish remain the most commonly utilized vertebrate biological control agent because of their high tolerance to polluted and poorly oxygenated water, rapid reproduction rate, widespread availability and effectiveness at controlling mosquito larvae.

2.1.7 Public Education

An important component of integrated vector management is educating the public and local agency personnel about the extent of vector problems, the existence of disease organisms, ways to reduce or eliminate vectors and personal protection against vectors and vector-borne diseases.

SYMVCD maintains a strong public outreach program within its jurisdiction by educating the public on mosquito control issues. Public education is one of the four types of mosquito control methods (i.e., physical, chemical, biological and public education) practiced by the District. The SYMVCD's website provides information on vector and non-vector nuisance species in the District, backyard prevention, repellents, and diseases. The website also provides information on the SYMVCD, including its staff, the Board of Trustees and its goals. Brochures, podcasts, and educational videos are available as well as means to contact staff for additional information or to place a request for control of the nuisance or vector species. SYMVCD is active in schools and at community events providing useful information on mosquito vector control and a response to the public's concerns. In addition, District staff actively advertise through local newspapers, mailers and billboards to ensure awareness and to further enhance the public's knowledge of safety, prevention, and control.

2.1.8 Personnel

The District's Office Manual lists 29 staff positions, 11 of which are permanent employees. The 18 remaining positions belong to seasonal and summer employees.

The District is run by the Manager with the help of the General Foreman. Together, they plan, organize, and direct the operation of the District under the authority vested in them by the seven members of the Board of Trustees. The Administrative Manager, under the direction of the Manager, with help from a Seasonal Aide, organizes and controls administrative records.

The remaining positions are involved in mosquito surveillance and control operations. The Entomologist, with the assistance of a summer Entomologist Aide, provides entomological services for the District, conducting studies to determine population and distribution of mosquitoes in addition to educating staff and the public on mosquito issues. The Field Foreman provides field instruction and inspection of the work of technicians. Three levels of Mosquito Control Technicians serve the District from Technician III, with the most authority and experience, to Technician I, an entry level position. Field technicians perform inspection and control operations in an assigned zone or any specialized function of a mosquito and vector control district. Lastly, 13 Mosquito Control Aides are hired for three months in the summer to perform inspection and control operations in an assigned zone or a specialized function of a mosquito and vector control district.

The District requires that the Manager, General Foreman, Entomologist, Field Foreman, and the Level III Mosquito Control Technicians possess mosquito and vector control certificates administered by the State of California Department of Health, in categories A thru D, in addition to a Qualified Applicator

Certificate issued by the California State Department of Agriculture. Mosquito Control Technician II requires possession of mosquito and vector control certificates in categories A thru D. Mosquito Control Technician I requires possession of mosquito and vector control certificates in categories A and B. All other staff are trained by their supervisors.

2.1.9 *Equipment*

The majority of the equipment used by the District are light-duty pickup trucks used in vector surveillance and control activities. The District owns 34 trucks, from the year 1994 to 2011. The newer models are flex-fuel vehicles which are designed to run on gasoline or a blend of up to 85% ethanol. Vehicle equipment includes pesticide foggers, pumps, tanks, and tool boxes. The foggers are used for ULV application of adulticides and are electric. The tanks and pumps are used to transport mosquitofish for biological control of mosquitoes. For access to rough terrain the District owns four all-terrain vehicles (ATVs). A variety of trailers built for ATVs and trucks are used for pesticide transport and spraying. The District contracts the services of a pilot and use of three airplanes, one Cessna 188 Ag Wagon for application of adulticide, a Cessna 188 Ag Truck for application of liquid larvicides, and an Ayres Turbine Thrush for applying granular Bti and Altosid. For headquarters maintenance, the District owns a riding lawn mower, tractor, forklift, backhoe, and a generator.

2.2 Alternative 2: Elimination of, or Reduction in, Chemical Insecticide Applications by SYMVCD

There are a small number of people who oppose the use of insecticides for mosquito control by public health agencies. Within California, the greatest opposition has been against aerial ULV application of mosquito insecticides over urban areas by aircraft and in residential neighborhoods by ground ULV fogging from vehicles.

In northern California, strong opposition to mosquito abatement practices was originally voiced by some citizens in Sacramento and Yolo Counties when aerial applications of pesticides were used to combat mosquitoes in response to West Nile virus infections in these counties. In Butte County, a small group protested the local mosquito and vector control district's use of ground-based ULV fogging in Chico (Butte County Mosquito and Vector Control District Board Meetings 2008-2009). Trustees of the Marin/Sonoma Mosquito and Vector Control District listened to both strong opposition to ground-based ULV fogging and strong support for the same control activity (May 2010). One group in southern California, Friends of Ballona Wetlands (a marsh located just north of the Los Angeles International Airport), is opposed to pesticide use "where a target organism is merely a 'nuisance' and there is no significant threat to public health or safety" (e-mail letter to State Water Resources Control Board, 18 October 2010).

The following options, which are variations on elimination or reduction of applications of chemical insecticides, were considered as alternatives to the current programs of the District.

2.2.1 *Option 1: Elimination of ULV Adulticide Applications*

This option would entail eliminating ULV adulticide applications, including aerial applications from airplanes or ground application with backpack sprayers. Other methods of control, including public education, source reduction, and biological control would still be utilized.

Opponents of mosquito abatement programs primarily object to application of aerosolized pesticides on the grounds that they are being unnecessarily exposed to toxic compounds and do not receive adequate warning to protect their houses or lawn furniture and gardens from the chemicals. They object to the use of larvicides because they believe that these compounds poison fish and other aquatic animals. Some of the opposition by these people is based on a perception of risk related to practices over which they have no control (Peterson and Higley 1993). Many of the objections heard by the Sacramento-Yolo and Butte County Mosquito & Vector Control Districts were based on the erroneous perception that the pesticides used were older organophosphate compounds, or pyrethrin formulations containing lactones, chemicals that have been largely abandoned by vector control districts in favor of safer, more environmentally friendly alternatives.

Control of adult mosquitoes is a “third level measure” by the SYMVCD when source reduction and application of larvicides have not adequately reduced biting mosquito populations. The District has not formally adopted numeric thresholds for chemical control. The District bases the decision to utilize chemical control on the numbers of mosquito species per larval dip or trap night and the presence of disease organisms. The SYMVCD’s Best Management Practices Manual (SYMVCD 2010; Appendix A) lists specific steps to be taken to control mosquito production to limit the necessity of applying adulticides and to determine when control of adult mosquitoes is necessary.

Many residential areas in both counties are near large areas of rice production and other natural and managed wetlands and experience significant exposure to large numbers of biting mosquitoes and disease. Various local, state and federal agencies that own or manage the large wetlands in the Sutter and Yuba Counties have contracted with SYMVCD to provide vector control. Because marshes and some wetland areas within the District represent sensitive habitats, it is difficult to practice source reduction with the current federal and state restrictions on activities in wetlands. In addition, many of the wetlands are too large for effective control using larvicides alone.

Under this alternative option, protection of residents living near rice fields, natural wetlands, and mitigation wetlands would require an increase in source reduction activities and the use of amphibious equipment to reach large areas of marshes and wetlands from spring through the fall months. Some physical damage to habitats in sensitive areas would occur using this specialized equipment. Additional education efforts on personal protection would also be required for local residents of areas producing large numbers of adult mosquitoes that are potential disease vectors.

SYMVCD uses aerial applications of Altosid® SBG, (methoprene) and Vectobac® G & 12 AS (Bti) for larvicides and Trumpet® (naled, an organophosphate), Aquahalt™ (a pyrethrin/PBO mix), and Anvil® 10+10 (phenothrin/PBO) mix) for adulticides in irrigated agricultural areas and on duck clubs in both counties. The District also utilizes Fyfanon® (malathion) for treatment of irrigated pastures. SYMVCD uses truck-mounted fogging equipment, where feasible, within urban areas when it is not possible to eliminate the larval stages in rural areas.

The current (2011) NPDES regulations for public health pesticides do not allow use of chemicals in the same class of pesticide found in locally impaired waters. Within SYMVCD boundaries a number of waterways (the Feather River, Butte Slough, Jack Slough and Wadsworth Canal) are classified as impaired by organophosphates (including malathion, chlorpyrifos and diazinon), which limits the use of Trumpet® (naled), another organophosphate, as an adulticide near these waterways. In addition, the National Marine Fisheries Service (2008) has recommended buffers of 500 feet for ground ULV application and 1,000 feet for aerial ULV application for insecticides containing malathion, chlorpyrifos, and diazinon to protect listed salmonids. A separate biological opinion released for naled (NMFS 2010) concluded its use was not likely to adversely affect the listed salmonids that occur within the District, the Central Valley spring-run Chinook Salmon, Winter-run Chinook and Central Valley Steelhead.

2.2.1.1 Advantages

Review of the literature on risk from public health pesticides produced no information on any significant advantages in discontinuing ULV applications of adulticides and larvicides in terrestrial environments as use of insecticides for public health comprises a small proportion (less than one percent) of pesticide applications in the state (Howard et al. 2010). Studies and risk assessments on effects of ULV aerosols on non-endangered wildlife and humans and have not indicated significant adverse effects when the particular adulticides in use by SYMVCD are applied at label rates and in a manner consistent with label guidelines (Davis et al. 2007, Davis and Peterson 2008, Macedo et al. 2010).

Literature indicates there may be advantages associated with decreased use of organophosphates in aquatic habitats utilized by salmonid species (NMFS 2008). However, because agricultural operations apply the preponderance of organophosphates within the District, there would be a minimal advantage in limiting use of organophosphates by public health agencies alone. Accordingly, there are no significant advantages in discontinuing ULV insecticide applications for public health.

2.2.1.2 Disadvantages

The elimination of ULV applications in rice growing and other irrigated agriculture would not provide significant environmental benefits. Adequate control of mosquitoes in these habitats and adjacent areas without ULV applications of adulticides would be considerably more difficult (if not impossible), time and cost prohibitive, and require increased public education. Humans and susceptible wildlife would have an increased risk of arbovirus infections, as well as possible health effects from large numbers of mosquito bites in sensitized humans and domestic animals.

Elimination of ULV adulticide sprays would remove an important control measures for protection of the public. Although SYMVCD spends 90% of its field efforts finding and eliminating mosquito larvae, large acreages of irrigated and flooded lands in Sutter and Yuba Counties still produce very large numbers of adult mosquitoes. When rice fields are drained in the fall, adult *C. tarsalis* and *A. freeborni* migrate to urban areas, which lie in close proximity to agricultural fields in Sutter and Yuba Counties. This is also the time of the year when WNV infections are peaking.

The residents of cities and communities in Sutter and Yuba Counties would be at increased risk of arbovirus infections if ULV applications were eliminated. Wild birds would also be at increased risk of West Nile virus, including many migratory species, which could spread the virus to other areas.

2.2.2 Option 2: Elimination of Aerial Applications of Larvicides

This option would involve elimination of aerially applied larvicides to rice fields, irrigated pastures, and duck clubs. Ground application spray rigs and hand or backpack sprayers could be used to apply control to the perimeters of flooded fields.

2.2.2.1 Advantages

There are no significant advantages to eliminating aerially applied larvicides. The formulations are deposited on the fields from low flying aircraft with little or no drift. While there may be impacts to freshwater invertebrates active during aerial applications, existing literature suggests insect populations rebound in sprayed areas within hours (Zhong et al. 2005, Miles et al. 2002). Because aerial application is a control measure utilized under limited conditions, no significant advantage to discontinuation is apparent.

2.2.2.2 Disadvantages

Mosquitoes in rice fields do not concentrate near the edges of the fields (Washino and Dritz, unpublished MS); therefore, application of larvicides near the accessible edges would not significantly reduce the production of adult mosquitoes. Treatment of rice and managed wetlands requires coverage of entire fields producing mosquitoes, and many of these fields are too large to cover adequately from the ground. Because the immature stages of mosquitoes are in a relatively confined environment, it is more effective to treat larvae before they emerge as adults to disperse aerially over much larger areas. Decreased use of larvicides would likely result in an increased need to use adulticides, which are generally more toxic than larvicides to both humans and wildlife.

Limiting larvicide application to constructed environments and discontinuing application in natural habitats and ditches leading to surface water streams would eliminate potential effects upon non-target species; however, most studies in the United States and Europe have indicated minor or only temporary (e.g., three days for GB-1111; Miles et al. 2002) effects upon non-target aquatic invertebrates from the use of the bacterial and surface film mosquito larvicides. Lawler et al. (2000) found no detectable effect upon non-target invertebrates in a salt marsh treated with methoprene. The effects of Bti upon aquatic insects are more selective with only aquatic dipterans being affected, and the decreases in dipteran populations also tend to be short-term (Lundström et al. 2010a; Lundström et al. 2010b; Persson Vinnersten et al. 2010). Bs also may affect other aquatic insect larval stages but again effects are insignificant or short-term (Merritt et al. 2005). Surfactants such as Agnique and GB-1111 demonstrate short-term effects upon aquatic invertebrates of a few days to a week (Zhong et al. 2005, Miles et al. 2002). Water surface films affect only the larval forms of insects that must reach the surface and breathe air. There has been some concern that hydrocarbon surface film larvicides may adversely affect wetland nesting birds such as rails. Mitigations that specify avoidance of surface films in rail habitats effectively minimize impacts to this species while still allowing application of other types of larvicides, such as methoprene or bacterial products.

2.2.3 *Option 3: Elimination of All Insecticide Applications by SYMVCD*

As in other predominantly agricultural counties, in which agricultural operations apply hundreds of thousands to millions of pounds of pesticides each year, elimination of the application of pesticides by the SYMVCD would not significantly reduce the amounts of pesticides introduced into the environment in Sutter or Yuba Counties but would severely restrict the District's ability to carry out its mission of protecting the public from vectors and vector-borne diseases. Many of the insecticides used by SYMVCD are the same compounds or chemically similar to those used in agriculture, pest control and landscape maintenance, and by veterinarians and large animal owners. In 2010, Howard et al. published a review of public health pesticides in California and estimated that public health pesticides constituted 0.9% of all pesticides applied. The consequences of eliminating pesticide applications by the District are speculative, but it is likely that the same or similar chemicals in agriculture and pest control products would continue to be applied so that there would be no appreciable change in overall pesticide use in the District. Individual landowners would likely increase their use of chemicals to kill mosquitoes, without the training and adherence to label application rates followed by District employees.

2.2.3.1 Advantages

There are no clear advantages to eliminating all pesticide use by SYMVCD as the overall rate of insecticide application as well as the types of insecticides applied would not change appreciably within the District.

2.2.3.2 Disadvantages

The District would be less able to adequately protect the citizens of Sutter and Yuba Counties from many potentially life-threatening illnesses using only public education, disease and vector surveillance, and physical methods of source reduction. The large number of public service requests annually received by the District would be unaddressed or fall to the individual members of the public to resolve for themselves. The District is contracted to provide service to state and federal agencies; these agencies would need to make other arrangements to control mosquito sources on public land. The use of mosquito insecticides would likely occur at the same rate in Sutter and Yuba Counties, but their application would be more difficult to regulate and control. Scattered individual vector reduction efforts by the public and private pest control operators would be much less effective or ineffectual at controlling spread of vectors and disease on a countywide basis.

Control of mosquitoes in aquatic habitats is more effective than attempts to control them as dispersed adults. Allowing mosquitoes to develop to the adult stage increases the potential for nuisance conditions as well as disease transmission. Increases in source reduction activities to eliminate standing surface water and the development of immature life stages of mosquitoes would be required to reduce mosquito populations under this option. However, source reduction in managed wetlands may have detrimental impacts on wild species and ecosystems and is not always possible under current wetland regulations.

Elimination of all insecticide applications would necessarily result in increased dependence on the remaining control methods, including physical source reduction, public education, surveillance, and (especially) biological control. Increased use of biological control methods, including naturally occurring ecological processes, would depend heavily upon predation by bats, birds and dragonflies for control of adult mosquitoes, and increased reliance on mosquitofish, *Lagenidium*, *Coelomomyces*, *Bacillus* species, spinosad, and invertebrate parasites such as planaria for larval control.

All of the predators of adult mosquitoes are opportunistic feeders and feed on a wide variety of insects. Establishment of colonies of vertebrates large enough to provide countywide control would be difficult and expensive. Bats have been studied the most thoroughly, and the most recent investigation as a control agent (Reiskind and Wund 2009), showed a 32% reduction in mosquito egg rafts, an efficacy rate which would be considered a failure for a pesticide. Dragonflies can be effective when a local hatch of this predator occurs at the same time there is a large mosquito emergence, but populations are seldom large enough to control adults over a large area for the duration of the mosquito season.

Mosquitofish have proven to be an effective form of larval mosquito control in standing water situations but are less effective in the presence of dense emergent vegetation, very large water bodies, or small ephemeral puddles and pools, and release of mosquitofish into natural habitats is avoided to reduce impacts to native species.

The invertebrate parasites generally require standing water for several weeks to achieve populations large enough for larval control. Mass production has been possible in the case of *Lagenidium*, but not for others. Overwintering of *Lagenidium* has not been good in most localities (Scholte et al. 2004). SYMVCD conducted experiments with *Lagenidium* and determined in field trials that it did not produce a consistently high level of control and that rearing *Lagenidium* in the lab and distributing it was too costly and labor intensive.

2.2.4 Option 4: Increased Use of Abatement Proceedings

This alternative would involve increased reliance on private property owners to control mosquitoes utilizing physical and chemical control methods or changes in land management techniques. Increasing use of abatement orders and proceedings would be necessary to motivate owners and managers of significant mosquito breeding sources to perform control. Increased application of insecticides by private landowners would be an expected consequence of application of this strategy.

Division 3, Chapter 1, Article 5 of the California Health and Safety Code (Cal HSC § 2060-2067) provides mosquito and vector control districts with the legal power to require property owners to abate a public nuisance and to compensate an agency for the control. The statute is primarily written for mosquito control and focuses on water management. The SYMVCD's Best Management Practices Manual provides guidelines to encourage property owners to control conditions that promote vector production on their land. When landowners are uncooperative, abatement proceedings by the District's Board of Trustees can provide a legal mechanism to correct the problem at the landowner's expense.

2.2.4.1 Advantages

Abatement proceedings could be used to control mosquitoes produced in neglected swimming pools if one or more lending institutions foreclosed and controlled a large number of properties. Summary abatement proceedings can be applied by cities in emergency situations in which a threat to public health or safety is involved. In Sutter and Yuba Counties, this would require all cities and the Counties to enact summary abatement proceedings in their governing ordinances. These actions would not protect the local residents in nuisance situations.

2.2.4.2 Disadvantages

Abatement enforcement is seldom used except for repeated or major vector production problems. It is an expensive, time-consuming process that allows vector production to continue during the gathering of evidence and hearings required to issue abatement orders. Issuance of abatement orders competes for the limited resources of the District.

3 ENVIRONMENTAL SETTING

3.1 PUBLIC HEALTH AND DISEASE

Vector-borne diseases have been a significant factor in societal development throughout the millennia. "Plagues" of various sorts have caused enormous losses of life and health problems since the earliest records of mankind. Modern public health practices and vector control agencies have reduced the impacts of many diseases, although few have been completely eradicated. Intense, historically short-term disease control efforts have essentially eliminated small pox and reduced the incidence of poliomyelitis through immunization. Unfortunately, there are few effective vaccines for vector-borne diseases in humans (with the exception of yellow fever), and these illnesses continue to exact a serious toll in terms of human life and health.

The following vector-borne diseases are the primary diseases of concern to the SYMVCD.

3.1.1 MALARIA

Malaria, a serious infectious disease caused by protists in the *Plasmodium* genus and transmitted by mosquitoes, was one of the major vector-borne diseases affecting early Californians and was apparently brought into the state by fur trappers (Patterson 2009). The *Anopheles* species of mosquito was especially abundant in the Central Valley region and caused serious illness and deaths in the local Native American populations as well as the immigrant populations in the state. Early agricultural development in the Sacramento Valley was interrupted by high malaria rates. In the northern Sacramento Valley in the area of Shasta, Tehama, and Butte Counties, the malaria rate was 48.6 cases per 100,000 people, or 10 times the rate in the remainder of the United States (Gray 1912). Major reclamation and drainage projects to produce more arable land in the early 20th century reduced the incidence of malaria in many areas of the Central Valley.

Military personnel infected with malaria returning to the US at the end of World War II reintroduced this disease throughout California and the US. A number of mosquito abatement districts were established shortly after the war to counter this threat to public health. Improved housing, socioeconomic conditions and case management efforts assisted in this control effort. The conflicts in Korea and the war in Vietnam also resulted in small outbreaks of malaria spread by returning service personnel. Currently, malaria cases are primarily imported into the US from areas in Asia and sub-Saharan Africa, where malaria is still present at high rates (CDC 2010a). There is currently a United States presidential initiative in 15 sub-Saharan African countries to reduce mortality related to malaria there by 50% (USAID 2008). Earlier programs aimed at eradication of malaria or elimination of *Anopheles* mosquitoes proved unachievable, but a 50% reduction appears to be a feasible goal.

A few localized outbreaks of malaria within California have occurred as a result of these introduced infections, but they have all been quickly controlled. In 2008, the CDC reported 128 cases in California (CDC 2010b). In 1957, Sutter County had four cases of malaria. An outbreak occurred again in 1974 resulting in 12 cases of *Plasmodium vivax* malaria from within the SYMVCD. The origin was the Punjab region of India, although three of the cases resulted from local transmission (Singal et al. 1977). Numerous cases of imported malaria were reported from within the SYMVCD during the 1970s and 1980s (Table 3-1), with numbers of cases trailing off in the 1990s (Table 3-2). In recent years, small numbers of cases of imported malaria have been diagnosed in both Sutter (one in 2008; four in 2009) and Yuba (one in 2008) Counties (Table 3-2).

3.1.2 Mosquito-Transmitted Viral Encephalitis

Neuroinvasive viruses, viruses that affect the central nervous system, seem to be increasing in modern times, with new forms being introduced presumably by air travelers from exotic localities and by migratory birds. Communicable disease officials believe that one or more viruses will arrive from Africa or Asia in the near future. The following diseases are the primary neuroinvasive viruses transmitted by mosquitoes in California, which vector control districts seek to reduce or eliminate through their control efforts.

Table 3-1. SYMVCD malaria cases, 1974-1991. Source: SYMVCD.

Year	Cases
1974	9
1975	19
1976	12
1977	24
1978	44
1979	77
1980	58
1981	39
1982	19
1983	6
1984	15
1985	10
1986	20
1987	13
1988	3
1989	4
1990	8
1991	17
Total Cases:	**397**

Table 3-2. Sutter County malaria cases: 1992-2010. Source: SYMVCD, CDPH.

YEAR	CASES	POPULATION ESTIMATE*	RATE (per 100,000 pop.)
1992	0	69,684	0.0
1993	0	71,477	0.0
1994	5	72,932	6.9
1995	8	74,166	10.8
1996	9	74,980	12.0
1997	8	76,420	10.5
1998	2	76,891	2.6
1999	0	78,035	0.0
2000	2	79,632	2.5
2001	0	81,034	0.0
2002	0	83,124	0.0
2003	1	85,633	1.2
2004	0	87,881	0.0
2005	0	90,519	0.0
2006	0	93,409	0.0
2007	0	95,584	0.0
2008	1	97,800	1.0
2009	4	100,044	4.0
2010	0	102,326	0.0

*Population estimates are from the California Department of Finance website.

Saint Louis encephalitis was the first (1933) recognized major neuroinvasive arbovirus in the United States. In 1975, there was a major outbreak of 2,000 cases in the Ohio-Mississippi River Basin (CDC no date). Sporadic human cases have been diagnosed in California, although the virus and antibodies against it are more frequently recovered from wildlife during research studies. Since 1945, 597 human cases have been reported in California. The most recent outbreaks (26 cases) occurred in the Los Angeles area in 1984, with 29 cases in the San Joaquin Valley in 1989. SLE was considered the most important mosquito-borne virus in North America until the arrival of WNV in 1999 (California Vector-borne Disease Surveillance System, www.calsurv.org). No mosquito pools tested positive for SLE in 2009 in Sutter and Yuba County (CDPH 2010a)

Western equine encephalitis has been a significant cause of death and disease in humans and horses in the United States. In 1938, more than 300,000 horses and mules were infected in the US In 1952, an outbreak, centered in Kern County, resulted in 813 cases in humans and an incidence rate of 1,120/100,000 horses. Severe disease and mortality was especially high in very young children of farm workers who lived in houses without air-conditioning or screened windows. Organized mosquito abatement has reduced the threat posed by this disease, but any potential financial reduction of abatement programs can result in resurgence of this virus. No mosquito pools tested positive for WEE in 2009 in Sutter and Yuba County (CDPH 2010a).

West Nile virus was first diagnosed in the United States in New York City in 1999 and rapidly spread westward throughout the United States. New York City had 62 confirmed cases of WNV, and seven deaths were reported. The epidemic was noticed in July and August, and an emergency spraying program was undertaken in September using chemicals to control adult mosquitoes. During subsequent years, WNV spread to nearby northeastern states, reaching all of the lower 48 states by 2003 (Macedo et al. 2010). Outbreaks in all 58 counties in California occurred in 2004, when 779 cases in humans were confirmed, and in 2005, when 880 cases were confirmed with 19 fatalities (Carney et al. 2008). In the early stage of the outbreak in California, donated blood samples from asymptomatic donors were tested for WNV; the rate of WNV in these samples reached a high of 10% of all confirmed cases in 2007 and 2008 (CDPH 2007, 2008). The State of California initially provided funds for equipment and pesticides to supplement those of local mosquito and vector control districts. Numbers of confirmed cases in California have declined and supplemental state funds have ceased. WNV remains at unacceptably high levels and appears to be endemic in the state.

In the US, during the period 2004 – 2009, there were approximately 25,000 cases of WNV and 1,000 deaths. WNV has been considered to have caused the largest arboviral encephalitis epidemic outbreak in US history (Davis et al. 2007). While the rate of incidence and the percentage of severe effects are relatively low (less than one tenth of one percent), the disease has been found to be persistent in kidneys in at least 5 out of 100 patients studied and was fatal in some cases (i.e., led to kidney failure in 6 out of 100 cases; Murray et al. 2010). Other studies have found that pre-disposition to the virus may occur from receiving previous mosquito bites (Schneider et al. 2007). A study by Barber et al. (2010) reported that the total immediate cost of 163 cases of WNV (including diagnosis and treatment of infections, some physical therapy and subsequent control measure by the Sacramento-Yolo Mosquito and Vector Control District) was 2.98 million dollars. No estimate of cost was given by this study for the long-term care of those with severe neuroinvasive infections.

In 2004, when WNV was found in all counties of California, Sutter and Yuba Counties had no diagnosed human cases. Eleven horses were diagnosed with WNV in each county; 28 wild birds tested positive in Sutter County and 13 tested positive in Yuba County (SYMVCD). Sutter County produced eight mosquito pools with WNV, and 12 chickens in the sentinel flocks demonstrated blood sera positive for WNV (SYMVCD). In 2005, Sutter County reported nine positive cases in humans, one confirmed case in a horse, nine infected wild birds, 43 pools with positive mosquitoes and six positive chickens. Yuba County had six diagnosed human cases, 10 infected horses, 12 infected birds, four positive mosquito pools and 10 positive sentinel chickens (SYMVCD). In 2006, Sutter County had 12 diagnosed human cases, one positive horse, two positive wild birds, 55 infected mosquito pools and 36 chickens from sentinel flocks that tested positive for WNV (SYMVCD). In 2007, no human cases were diagnosed in either county. In 2008, 2009, and 2010, one human case per year was confirmed in Yuba County (CDPH 2008, 2009, 2010b). No human cases were reported from Sutter County during these years, though WNV was documented in wild birds (3 cases), sentinel chicken flocks (49 chickens in six flocks), and tested mosquitoes (63 pools; Figure 3-1).

3.1.3 Tick-Borne Diseases

Lyme Disease was first recognized in 1975 and named after the town in Connecticut where it was diagnosed. The causal agent is a spirochete that is carried by the western back-legged tick, *Ixodes pacificus*, in California. This tick often begins by parasitizing lizards. Later stages move to rodents, and the adults are found on deer. Humans are accidental hosts when working or hiking in areas that support deer. Lyme disease gradually becomes a systemic disease, if not treated with broad spectrum antibiotics. It can become a chronic disease that causes arthritis and nerve damage. From 2000-2009 no cases of Lyme disease were reported in Yuba County. Sutter County reported one case of Lyme disease in 2000 and another case in 2001; no cases have been reported since then.

3.2 Physical Resources

3.2.1 Topography

The counties of Sutter and Yuba overlie portions of the Great Valley Geomorphic Province, with Yuba County extending eastward into the Sierra Nevada Geomorphic Province. The majority of the SYMVCD also lies within the Great Valley Province, with the smaller eastern portion of the District lying within the Sierra Nevada Foothills of the Sierra Nevada Province.

The Great Valley Geomorphic Province, an alluvial plain approximately 50 miles wide and 400 miles long was caused by downwarping of the earth's crust and is situated in the center of California. Its northern portion, the Sacramento Valley, is drained by the Sacramento River, while the southern portion, the San Joaquin Valley, is drained by the San Joaquin River. Both rivers merge into the Sacramento-San Joaquin

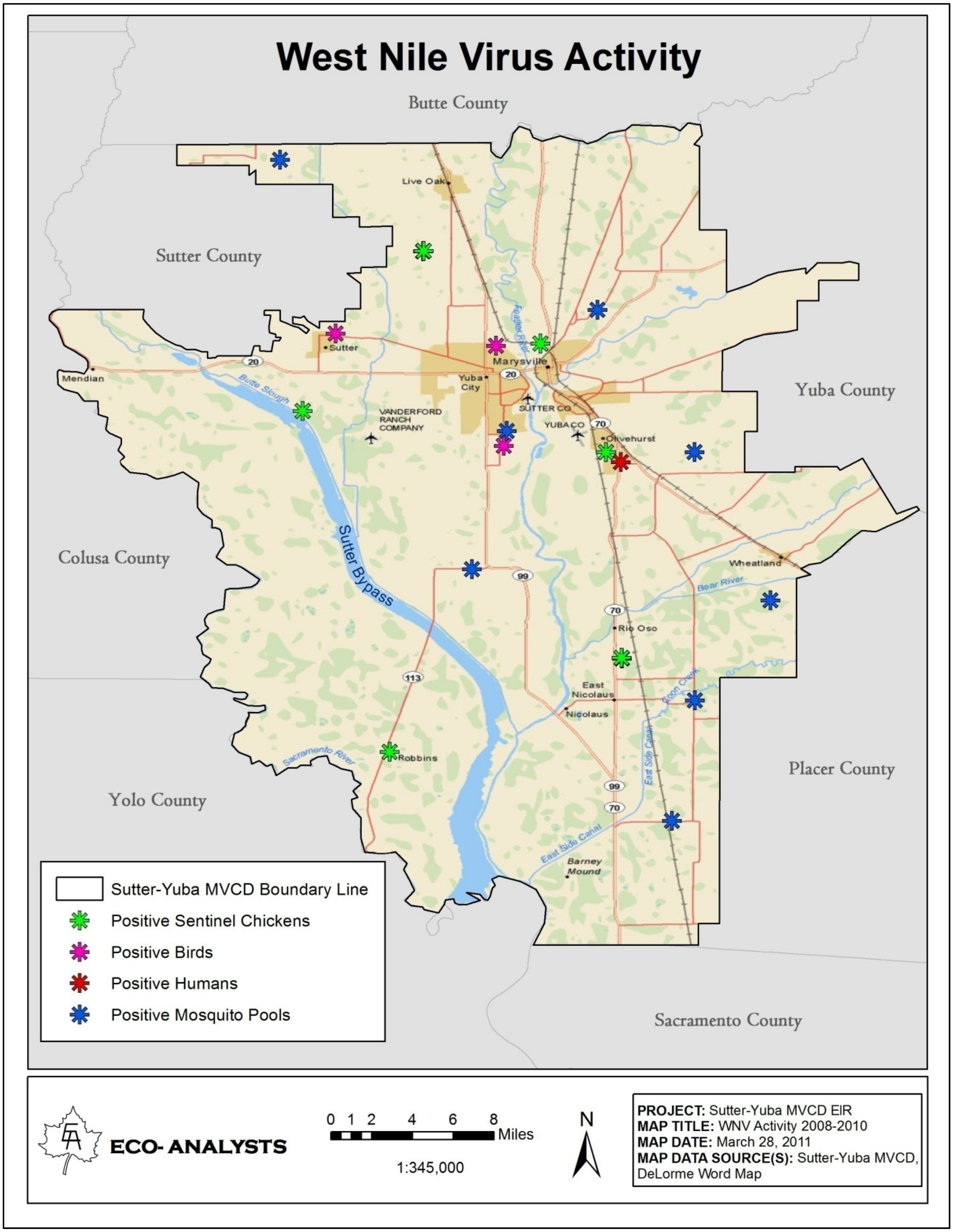

Figure 3-1. West Nile virus activity in the SYMVCD, 2008-2010. Source: SYMVCD.

Delta, flowing westward into Suisan Bay to San Francisco Bay and into the Pacific Ocean. Gentle flatlands typify the topography.

The Sierra Nevada Geomorphic Province is a west-tilted fault block of 400 miles in length with accordant crests. The high rugged mountains (the Sierra Nevada) of the eastern scarp gradate to gentle western slopes that extend below the Great Valley Geomorphic Province. The province is composed mostly of Mesozoic batholithic granites, Mesozoic and Paleozoic metamorphic rocks, and some pre-Cambrian metamorphics. The bedrock of the northern boundary is covered by the younger volcanic Cascade Range. Elevations range from 30 to 400 feet above sea level within the District and are typified by flatlands and gentle foothills.

3.2.2 *Geology*

The geology of California is defined by several dynamic processes of plate collisions and subduction, intense volcanic activity and magma flows, uplift, folding, faulting, the carving of deep canyons by glaciation and runoff, and constant erosion over time that has resulted in a great depositional valley bounded on the north by the Klamath and Cascade Mountains, on the west by the Coastal Mountains and on the east by the Sierra Nevada Mountains. Accumulated thicknesses of deposits from these geomorphic provinces range from a few feet in the Sierra Nevada Foothills in the east to 2,000 feet at the edge of the valley on the western margins.

The Sacramento Valley is a large northwest-trending structural trough of continuously deposited sediments spanning 160 million years (Jurassic to present). A narrow interface of Plio-Pleistocene non-marine sedimentary rocks (silt, sand, clay) lies between the Valley and the Foothills.

All of Sutter County and the valley floor of Yuba County are comprised of a series of alluvial fans, fans, and channel deposits. Recent alluvial and sedimentary deposits of Sutter and Yuba County are underlain by later Quaternary formations to a depth of 100-600 feet. All formations overlie the marine Great Valley sequence of Mesozoic to older rocks (California Department of Water Resources [CDWR] 2003, Sutter County Groundwater Management Plan 2008).

The Sutter Buttes, an anomalous Pliocene volcanic remnant consisting of volcanic, igneous and Cretaceous sedimentary rocks, rises out of the valley floor in Sutter County to an elevation of 2,117 feet. Erosion over time has deposited a band of alluvium around the Sutter Buttes that extends into the District's northwestern boundary.

3.2.2.1 Geologic Hazards

Sutter and Yuba Counties are not listed as Alquist-Priolo Earthquake Fault zones, have relatively low seismic activity, and no highly active faults. No Quaternary fault displacement is noted on fault maps, but active faults regionally could produce ground-shaking, liquefaction, lateral movement, and other seismic hazards (Sutter County 2011, Yuba County 2011a).

The Sutter Buttes, underlain by a series of small Quaternary faults, last erupted over 1.35 to 1.6 million years ago and are not seen as a geologic or seismic hazard by the State. The inactive Willows Fault underlies Sutter County west of the Sutter Buttes, then centrally between the Sacramento and Feather Rivers, under Highway 70/99 and southward. An inactive foothill fault system runs south-southeastward across Yuba County near Loma Rica, Browns Valley and Smartville southward and includes the Prairie Creek Fault Zone, Spenceville Fault, and Swain Ravine Fault (Yuba County 2011a).

Sutter County is not known to have any naturally occurring hazardous minerals. Northeastern Yuba County has a small area of potentially asbestos-bearing ultramafic rock outside of the District boundaries to the east, but no mining of asbestos occurs (Yuba County 2011a). By nature of the uranium-bearing rocks in the Sierra Nevada, subsequent erosion and deposition, radon may be present in certain areas. Other heavy metals and sulfur deposits are also associated with this area.

3.2.3 Soils

The Natural Resource Conservation Service soil surveys for Sutter County and Yuba County have been merged to produce a map of the SYMVCD area of interest (Figure 3-2).

Sutter County soils within the boundary of the SYMVCD are grouped into the Soils of Floodplains and Terraces. Approximately 83% of the County's acreage is used for agricultural production. The NRCS has mapped over 40 soil series in Sutter County (NRCS 1977a). The dominant soil series, comprising over 60% of Sutter County soils combined, are listed below (Sutter County 2008).

Capay: Very deep, moderately well drained soils formed on moderately fine and fine textured alluvium derived from sandstone and shales found on alluvial fans, flats, interfan basins and basin rims below elevations of 1,200 feet with slopes no greater than 9%. The Capay series is found in western and southern parts of the County. Dense stands of annual grasses and forbs are native to the series; irrigated crops and pasture, dry crops and pasture are suited to the soil series.

Clear Lake: Very deep poorly drained soils formed in fine textured alluvium derived from sandstone and shales, found in basins and level drainage swales with 0 to 2% slopes at elevations from 25 to 2,000 feet. Native vegetation consists of grasses and forbs; row crops, irrigated pasture, dry grains, dry pasture and rangeland are suited to the soil series.

Tisdale-Conejo: Very deep, well drained soils that formed in alluvium from igneous or sedimentary rocks found on alluvial fans and stream terraces at elevations of 20 to 2,000 feet, with slopes from 0 to 9%. Native vegetation includes annual grasses, forbs and oak; agricultural uses include irrigated row crops, orchard, hay and pasture, and grain.

Oswald-Gridley-Subaco: Moderately deep, poorly drained soils that formed from mixed alluvial sources over siltstone, located in basins and on basin rims of slopes of less than 2% at elevations from 30 to 2000 feet. Subject to seasonal flooding due to its fairly poor drainage and slow permeability, the soil is used for irrigated rice, small grains and row crops; a perched water table at 18-36 inches is common from December to April.

Olashes: Very deep, well drained soils that formed in alluvium weathered from mixed sources found in the Sutter Buttes and the southeastern Sacramento Valley on alluvial fans and fan terraces with slopes from 0 to 5 %; elevation ranges from 45 to 740 feet. Soils drain relatively well with very low runoff potential and moderately slow permeability. Soils may be subject to seasonal flooding. This soil series is used mainly for irrigated orchards, small grain and forage crops.

Yuba County soils are grouped into three physiographic units by NRCS (1977b): Soils of Floodplains and Terraces, including mine tailings (42%), Soils on Foothills and Mountains (29%), and Soils on Mountains (29%); 60% of Yuba County land is used for cropland and grazing. Yuba County Soils present within the District predominantly include soils of floodplains and terraces. The most representative series include:

Columbia-Holillipah-Shanghai: Very deep, somewhat poorly drained or somewhat excessively drained alluvial soils on floodplains with 0 to 8% slopes at 10 to 150 foot elevations. These soils are subject to flooding, have a high water table and require levee protection; used for irrigated crops and orchards.

Dumps and Mine Tailings: Very deep material dredged from river channels and floodplains during gold mining; used primarily for construction material. Holocene Dredger Tailings occur along the Bear, Feather, and Yuba Rivers. Coarse gravels and cobbles are up to 125 feet thick and are highly permeable. They have no agricultural use.

Conejo-Kilaga: Deep to very deep, well-drained alluvial soils on alluvial fans and stream terraces; may have some flood hazard; used for orchard crops. 0 to 9% slopes found at 30-2000 foot elevations.

San Joaquin-Cometa: Moderately well-drained, alluvial soils of low fan terraces derived from granitic sources; moderately deep to a hardpan with a dense clay subsoil; slopes of 0-9% at elevations of 20-500 feet; used for irrigated crops, such as rice and corn, due to limitations of slow permeability, restricting root growth.

Redding-Corning-Pardee: Moderately deep, very deep or shallow well-drained alluvial soils with dense clay subsoil (or underlain by bedrock), located on high fan terraces and hills on 0-30% slopes at elevations of 40-2,000 feet; used primarily for urban development or grazing because soils have slow permeability and/or very low available water capacity restricting rooting depth.

Finally, soils of Yuba County within the SYMVCD categorized as Soils on Foothills and Mountains include the following series:

Sobrante-Rock outcrop-Auburn: Moderately deep or shallow and well-drained soils derived from weathered basic metavolcanic rocks of the foothills; limited by restricted soil depth, slope and hazard of water erosion. This unit is primarily used for grazing, woodlands, and homesites.

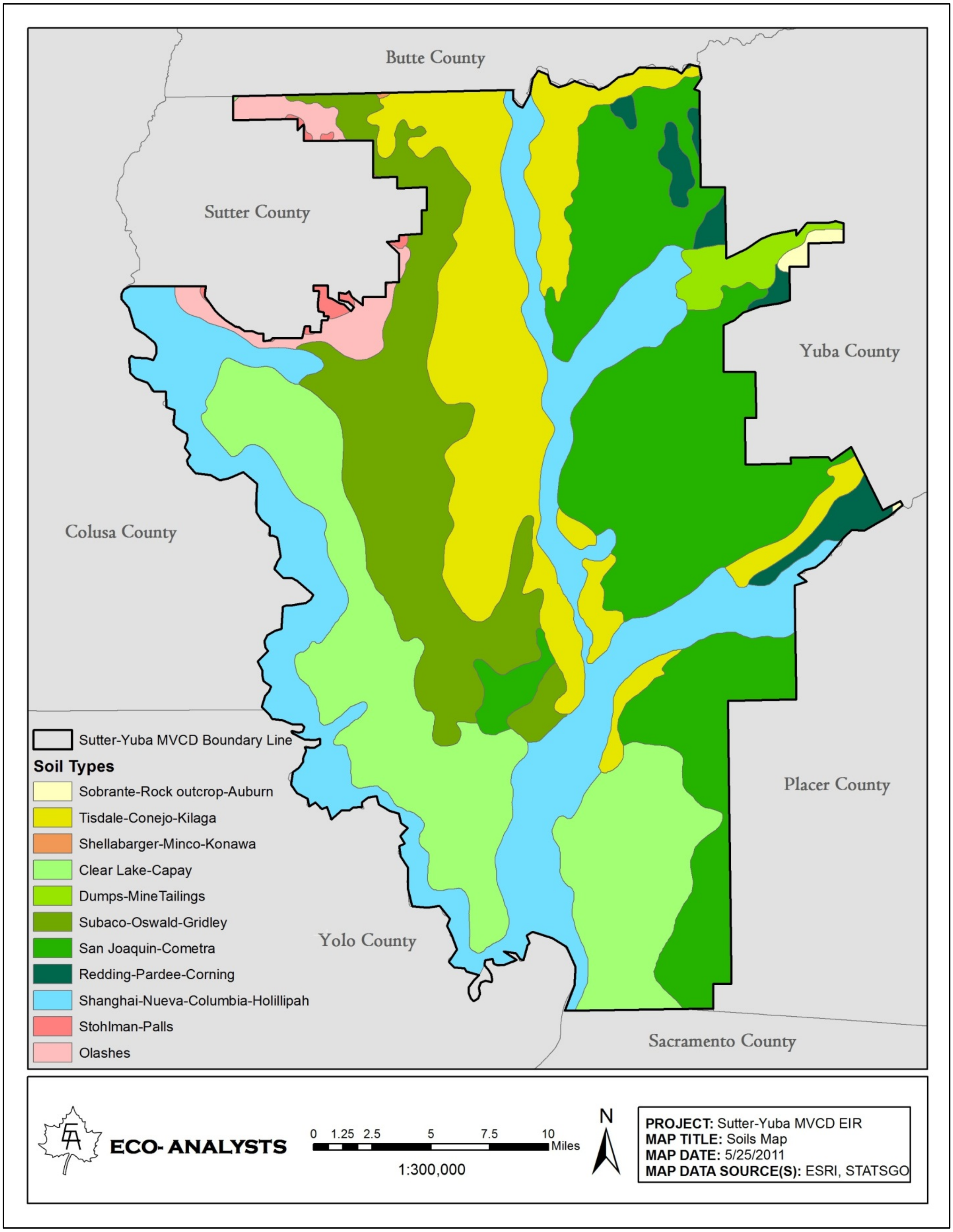

Figure 3-2. Soil types within SYMVCD.

3.2.3.1 Soil Hazards

Erosion, a naturally occurring system often accelerated by human activities, is a function of climate, soil cover, slope conditions, and soil properties. Water is the dominant agent for breakdown processes and transport. The Natural Resources Conservation Service maps potential erodibility into three named categories: slight (0-9% slopes), moderate (9-30% slopes), and high (30-75%). Most of the soils within the SYMVCD are identified as having a slight erodibility potential.

Expansive soils are prone to change in volume due to the presence of water. Thirty-four percent of soil types in Sutter County have a high shrink-swell potential, and 23% have a low potential. In Yuba County, soils with moderate to highest shrink-swell potential are more common on the western side of the county parallel to the Feather River. Low shrink-swell soils occur throughout most of the County and along the Feather River.

Subsidence, the sinking of a large area of ground surface displaced vertically downward, usually results from withdrawal of oil, gas, or groundwater. The SYMVCD policy area has a low subsidence potential (Sutter County 2008).

3.2.4 Hydrology

3.2.4.1 Surface Waters

Hydrology within the boundaries of the SYMVCD is dominated by the Sacramento and Feather Rivers. The Sacramento River, at 327 miles long, drains over 27,000 square miles, averaging 22 million acre-feet per year with an average annual controlled flow of 19,000 cubic feet per second (cfs); it is the state's largest river. Dams, diversions, and reservoir construction have greatly altered the hydrology of the river. Prior to construction of Shasta Dam flood flow was at 121,000 cfs at Red Bluff and after, flood flows reduced to 79,000 cfs. Over two million acres within the watershed are farmed (Sacramento River Valley Coalition 2004).

Most of the drainage for the upper Sacramento River Watershed (Figure 3-3) occurs above Shasta Dam and derives from the eastern Sierra; the drier west side of the watershed is fed by a series of streams originating in the Interior Coast Range. The watershed contains four major landform types: floodplain, basin rim/basin floor, terraces and foothills and mountains.

The California Interagency Watershed Mapping Committee (IWMC), formerly the CalWater Committee, is responsible for interagency watershed mapping and dataset creation, including the compilation of the California section of the Watershed Boundary Dataset being produced by the USGS and NRCS. The Sacramento River Watershed is hydrologically linked to 244 drainages of several major tributaries and is divided into regional subwatersheds, retaining the naming system developed by the IWMC.

Subwatersheds in the SYMVCD boundary area are: Butte-Sutter-Yuba (Big Chico Creek, Butte Creek, Sutter Bypass, Lower Yuba River and Upper Bear River) and the Upper Feather-Upper Yuba (North Fork Feather River, Middle Fork Feather River, Lower Yuba River, Upper Bear River).

Sutter County generally lies between the Sacramento River and the Feather River; Butte Creek forms a portion of its northwestern border. The Sutter Bypass, a wide flood control channel below Butte Sink, carries excess Sacramento River flood water from the east bank at Tisdale Weir through Sutter County to the confluence of the Sacramento and Feather Rivers; it is used for agriculture and also serves as a wildlife refuge.

Yuba County is bordered on the north by Honcut Creek and on the west by the Feather River, with Bear River at its southern boundary. The Yuba River flows through the center of the County, merging with the Feather River at Marysville. The Yuba River provides a sixth of the flow for the Feather River, draining 1,339 square miles from the western slopes of the Sierra Nevada Mountains. Hydraulic mining from 1852-1906 deposited over 70 feet of sediment near Marysville and over 40 feet of silt and gravel upstream; flood control projects along the Feather and Yuba Rivers were constructed to prevent flooding and to allow sediments to transport downstream. Yet, since 1940, 90% of the hydraulic mining debris remains as stable quasi-permanent deposits in the floodplains (Adler 1980).

The Feather River, a main tributary to the Sacramento River within the District, merges with the Sacramento River below the SYMVCD near Verona. This watershed drains about 6,000 square miles, most of which is above Oroville Dam in Butte County. The Feather River forms the boundary between Sutter and Yuba Counties. It is joined by the Yuba River at Marysville in Yuba County and the Bear River, north of the community of Nicolaus.

3.2.4.2 Groundwater Resources

The District's boundaries incorporate lands that overlie the large groundwater basins of the northern Sacramento Valley (Figure 3-4). These basins are charged by surface waters from dozens of rivers that drain from the Sierra Nevada, Cascades, Klamath, and Coast Range mountains toward the interior of the state and deep percolation from rainwater and irrigation. A relative high point in the topography between Colusa and Knight's Landing serves to limit flow and back up both surface and ground waters, charging area groundwater aquifers and providing the basis for the region's flood agriculture, as well as providing hunting and fishing grounds for local enthusiasts.

California's groundwater basins are described and catalogued by the California Department of Water Resources. District boundaries lie within the Sacramento River Hydrologic Region and overlie the Sacramento Valley Groundwater Basin (basin number 5-21), including portions of five groundwater subbasins. These include the East Butte (5-21.59), North Yuba (5-21.60), South Yuba (5-21.61), Sutter (5-21.62), and North American (5-21.64) subbasins.

The East Butte Subbasin (5-21.59) underlies the northwestern portion of the District. This subbasin is bounded on the west and northwest by Butte Creek, on the east by the Cascade Ranges, on the southeast by the Feather River, and on the south by the Sutter Buttes. It is comprised of deposits of Tertiary to Quaternary age, including Holocene stream channel and basin deposits, Pleistocene deposits of the Modesto and Riverbank Formations, and Sutter Buttes alluvium. The Tertiary deposits include the Tuscan and Laguna Formations. This basin is largely overlain by agricultural uses. Where water levels in

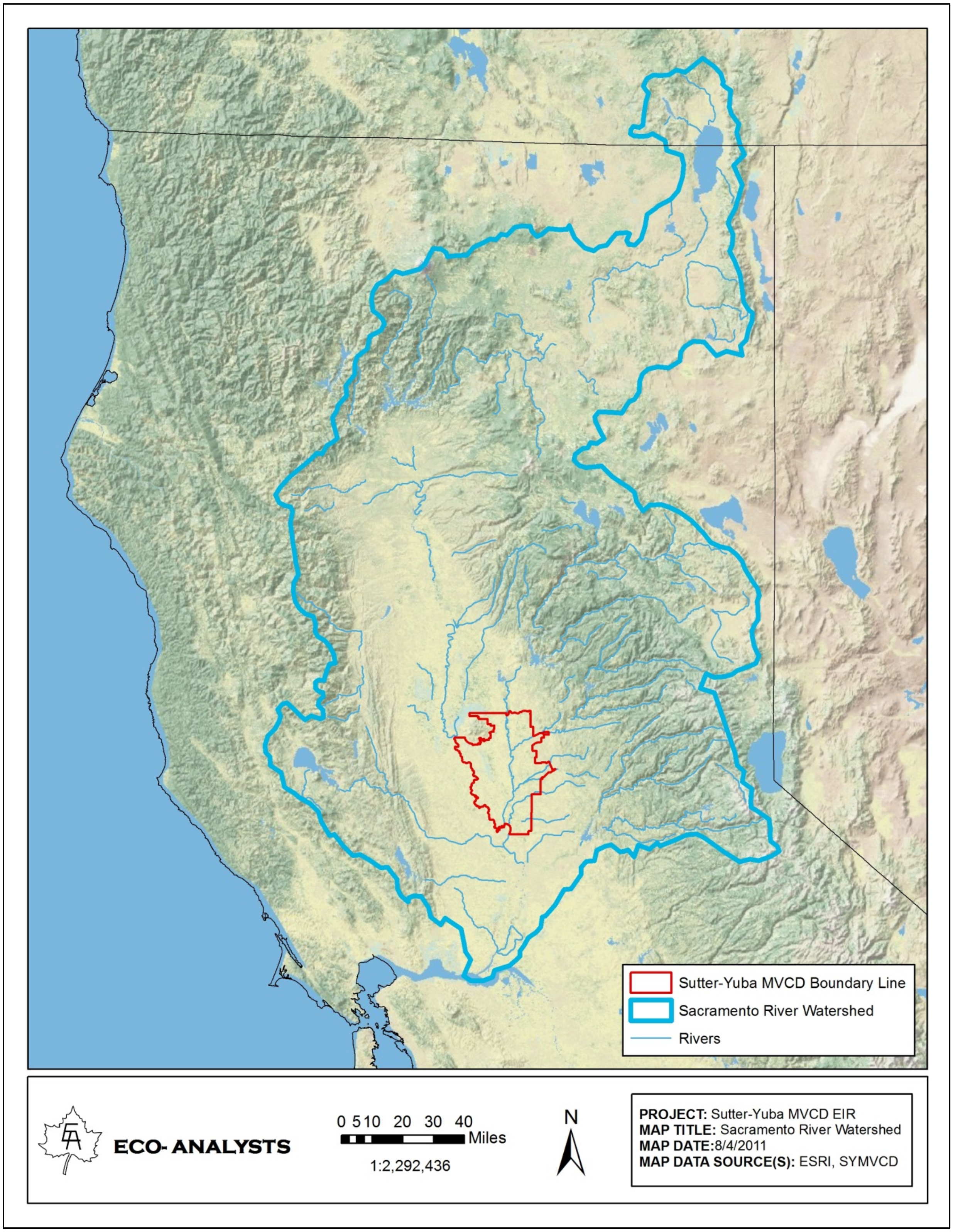

Figure 3-3. Sacramento River watershed.

the northeast corner of the basin decreased significantly during the 1960s and 70s, they have since recovered.

The North Yuba Subbasin (5-21.60) is bounded on the north by Honcut Creek, the Feather River on the west, the Yuba River on the south, and the Sierra Nevada Foothills on the east. Based on analysis of hydrographs, the Yuba and Feather Rivers create a groundwater divide that act as flow barriers in the subsurface. The Quaternary to Late Tertiary deposits range from a few hundred feet to 1,000 feet at the subbasin western margin. Dredger tailings exist along the Feather and Yuba Rivers composed of very permeable coarse gravels and cobbles up to 125 feet thick.

Groundwater levels for both the North and South Yuba Subbasins show seasonal drawdown for irrigation where more groundwater than surface water is in use (SWRCB 2010).

The South Yuba Subbasin (5-21.61) is bounded on the north by the Yuba River, on the west by the Feather River, on the south by the Bear River, and on the east by the Sierra Nevada Foothills. Elevations range from 150 feet in the northwest to 30 feet at the confluence of the Feather and Bear Rivers. The thickness of continental deposits in the subbasin ranges from a few hundred feet to 1,400 feet at the western margin. Dredger tailings also occur in the subbasin along the Yuba and Bear Rivers.

The Sutter Subbasin (5-21.62) lies entirely within the Sacramento River watershed. It is bounded on the north by the confluence of Butte Creek and the Sacramento River and the Sutter Buttes, on the west by the Sacramento River, on the south by the confluence of the Sacramento River with the Sutter Bypass, and on the east by the Feather River. This aquifer system is comprised of continental deposits of Quaternary (Recent) to Late Tertiary (Miocene) age. The thickness of the deposits increases from a few hundred feet in the eastern Sierra Nevada Foothills to over 2,000 feet along the western margin of the subbasin. The water table in this subbasin is generally 10 feet below the ground and is considered stable (CDWR 2003, Sutter County 2008).

The southeastern portion of Sutter County is within the North American Subbasin (5-21.64), which is bounded on the north by the Bear River, the Feather River on the west, and the Sacramento River on the south. The greater portion of the subbasin is under Sacramento County.

Most of the groundwater is produced in the northern portion of the subbasin. Accumulated deposits range from a few hundred to 2,000 feet thick. Water levels have been relatively steady with the exception of a portion of southwestern Sutter County showing a moderate decrease (Sutter County 2008).

Fresh groundwater in the Sacramento Valley is found only in the upper formations, as the valley is primarily a saline water aquifer system (Fulton et al. no date). Groundwater provides most of the potable water for Sutter County; Yuba City uses both groundwater and surface water from the Feather River. Potable water for Yuba County is derived from Yuba County Water Agency diversions and groundwater wells for rural users.

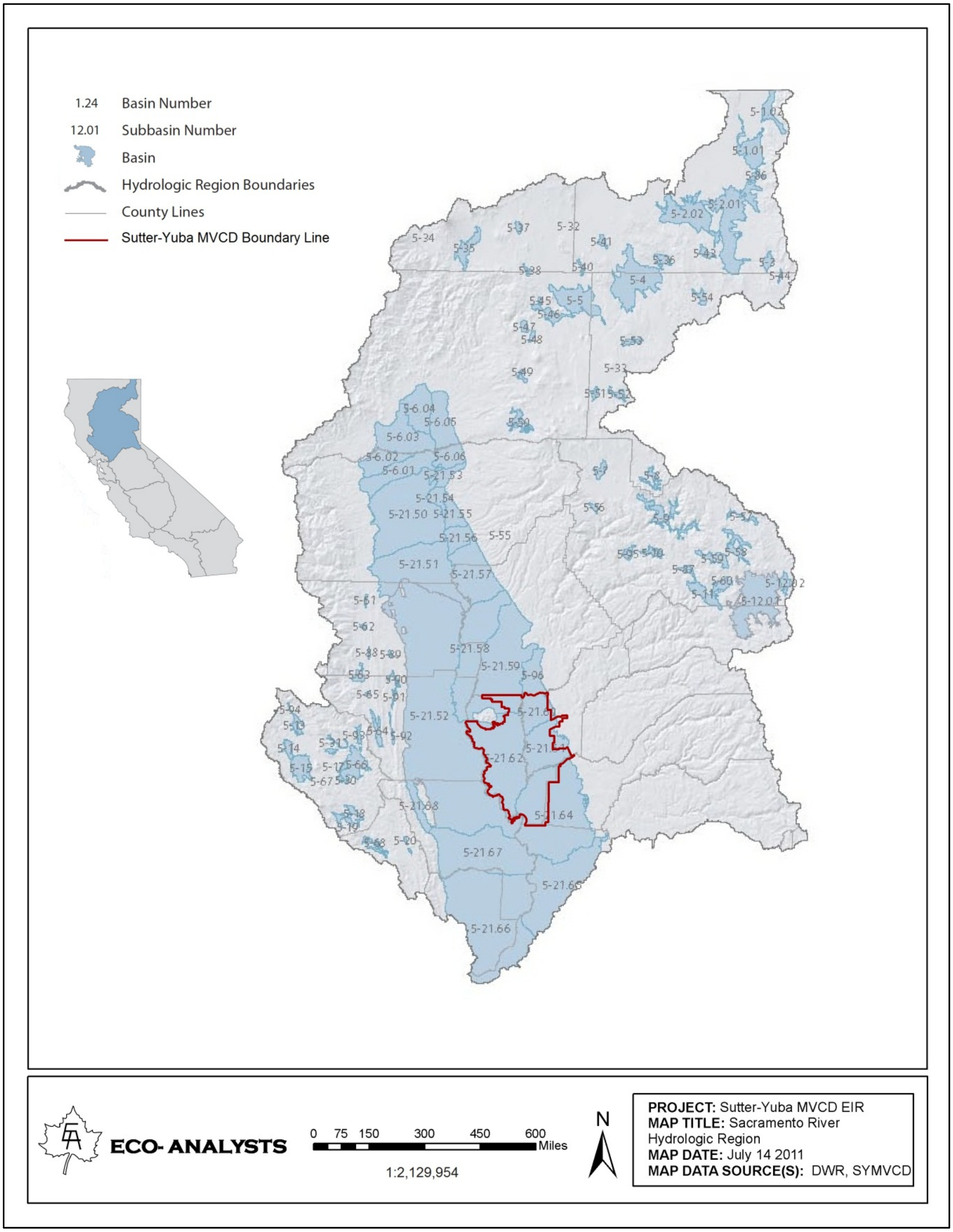

Figure 3-4. Sacramento River hydrologic region groundwater subbasins.

Groundwater recharge throughout the SYMVCD is facilitated by the highly permeable stream channel and floodplain deposits along the Sacramento, Feather, and Yuba Rivers, Honcut Creek, and other tributaries, deep rainwater percolation, and percolation from irrigation. Water table levels vary throughout the year due to season and irrigation usage, but over the long term water table levels are basically stable (CDWR 2003, Sutter County 2008). Available data on groundwater, however, is generally incomplete and reliant on well logs of varying reliability and limited studies.

3.2.4.3 Hydrological Hazards

Historically, flooding has been the most serious hazard for both counties due to the low elevations of the Valley floor and proximity to three major rivers, the Sacramento, Feather, and Yuba. Aging levees in both counties contribute to potential for catastrophic flooding in areas near levee breaches, such as occurred in the communities of Linda and Olivehurst (Yuba County) in 1986.

3.2.5 Water Quality

Both surface water and groundwater provide sources of irrigation for agriculture and industry, supply drinking water for communities, support fish and wildlife, maintain habitat, and provide countless recreational opportunities. These and other uses, however, can also cause detrimental impacts to water quality. Existing water quality issues within District boundaries were compiled using data from the State Water Resources Control Board's list of impaired water bodies (SWRCB 2006), university studies (UC Davis 2003), and other state and federal agency sources including the NMFS and CDWR.

3.2.5.1 Surface Water Quality

Impacts to waterways within the District have been identified as being related predominantly to resource extraction and agriculture. Impacts described include pollution from mercury, pesticides, pH, and unknown toxicities (Table 3-3).

3.2.5.2 Mercury Pollution

Use of mercury in waterways dates back to the California gold rush and early mining practices. Mercury was used to bond gold particles during the extraction of the precious metal. Subsequent volatilization of the mercury reintroduced it into the environment, where it began to move down waterways toward larger water bodies and accumulate in shallow soils and riverine gravels. Mercury pollution is associated with mercury mining sites along the Interior Coast Range and gold mining areas throughout the Sierra Nevada Mountains. Although these mining activities that lead to mercury contamination of waterways are largely a thing of the past, the legacy of these practices persists.

3.2.5.3 Pesticide Pollution

Introduction of pesticides into waterways has affected the water quality of many stream segments in the area. The chemicals monitored by SWRCB have been associated largely with agriculture (SWRCB 2006), although pesticide runoff from residential areas and other non-agricultural sources also occurs.

Diazinon, an organophosphate insecticide, is the most common pollutant identified in the CWA 303(d) list for water bodies within the District. Diazinon is a known neurotoxin, developmental toxin, cholinesterase inhibitor, a suspected endocrine disruptor, and a potential ground water contaminant with a moderate acute toxicity to humans. Diazinon has been eliminated from all residential, non-agricultural sales since 2004. However, use of existing stockpiles of diazinon is still permitted. The USEPA has determined that, if applied according to label instructions, diazinon use does not present a significant risk (USEPA 2011) to human health. Diazinon pollution is known within Butte Slough, Jack Slough, and Wadsworth Canal. These waterways are typically slow moving and adjacent to intensive agricultural land uses, with both attributes contributing to the accumulation of diazinon in these waterways.

Table 3-3. Clean Water Act 303(d)list of water quality limited segments within SYMVCD boundaries. Source: SWRCB 2006.*

Segment Name (Watershed HUC8)	Pollutants/Stressors	Potential Sources
Butte Slough (52030000)	diazinon	agriculture, crop-related
Feather River, lower (51922000)	chlorpyrifos, Group A Pesticides, mercury, unknown toxicity	resource extraction, agriculture, unknown sources
Jack Slough (51540000)	diazinon	agriculture
Sacramento River, Red Bluff to Knights Landing (50420070)	mercury, unknown toxicity	resource extraction, unknown
Sacramento Slough (51922000)	mercury	unknown sources
Wadsworth Canal (52030000)	diazinon	agriculture

*A 2008-2010 update to the 3030 (d) list exists but has not yet been officially adopted by SWRCB.

Group A pesticides, or organochlorine pesticides (including toxaphene, chlordane, dieldrin, aldrin, endrin, heptachlor, heptachlor epoxide, hexachlorocyclohexane [including lindane], and endosulfan) are known as “legendary pesticides” because they were banned several decades ago due to their long-term persistence in the environment and associated bioaccumulation in wildlife. These chemicals are known carcinogens and present a special risk to those who consume fish from affected waterways. The lower Feather River is a listed water body with Group A pesticide accumulations.

Chlorpyrifos (the active ingredient in Dursban®, Lorsban®, Piridane, etc.) is a broad-spectrum organophosphate insecticide that has been widely used in mosquito control, row crops and orchard agriculture, and residential applications since 1965. It is a known neurotoxin, cholinesterase inhibitor, reproductive and developmental toxin, and suspected endocrine disruptor. The USEPA classifies it as a Class II chemical with a moderate acute toxicity to humans, and it is very highly toxic to fish, including salmon (USEPA 2011). In 2001, Dow withdrew registration of this pesticide from products intended for residential use, although it is still heavily used in agriculture. In 2008, the National Marine Fisheries Service determined that this compound jeopardizes the continued existence of 27 species of endangered or threatened salmon and other fish and, through a published biological opinion (NMFS

2008), has recommended a 1,000-foot aerial spray buffer for salmon habitat to protect listed salmonids. The lower Feather River is classified as having chlorpyrifos contamination.

Finally, unknown toxicities are listed for the Feather River and the Sacramento River. The SWRCB describes unknown toxicity as water that displays some negative effect on organisms, but has not yet been subject to a toxic identification evaluation (personal communication, Jeffrey Shu, SWRCB; May 5, 2011).

3.2.5.4 Groundwater Quality

Knowledge of the extent and types of groundwater pollution is more limited than that of surface water pollution. The USEPA defines acceptable levels of groundwater constituents, including organic, inorganic, and microbial matter, through its drinking water program. CDPH monitors groundwater attributes through its Drinking Water Source Assessment and Protection Program. Public water systems are also required to publish information about water quality annually in Consumer Confidence Reports. CDWR published evaluations of groundwater basins in California Groundwater Bulletin 118, which was last updated in 2003.

In general, the most prevalent forms of groundwater contamination include salt and nitrate contamination, followed by pesticide and industrial contamination, and pathogens associated with septic systems and animal waste (UC Davis 2003). Groundwater quality within the region is generally excellent, although local groundwater problems do exist. Natural water quality impairments occur along the margins of the Sutter Buttes, where Cretaceous marine sediments combine with fresh water, resulting in high total dissolved solids and degraded water quality. Uranium-bearing rocks, radon-bearing rocks, and sulfide-mineral deposits containing heavy metals occur along the Sierra Nevada Foothills. These deposits can also lead to naturally occurring water quality impairments.

Human-induced impairments are generally associated with septic systems in shallow aquifers or fractured hard rock. Ninety-five percent of wells sampled by CDWR between 1994 and 2000 tested below primary maximum contaminant levels (MCL) established for safe drinking water, while 5% of the wells sampled contained at least one constituent above primary MCL standards (UC Davis 2003). Of these, only 4% (4 wells) contained pesticide levels above the MCL. In all four cases the actual contaminant detected was di(2-ethylhexyl)phthalate, a plasticizer common in polyvinyl chloride (PVC) products and a compound not typically applied as a pesticide. No other reports of groundwater pesticide contaminations were revealed.

3.2.6 Air Quality

3.2.6.1 Regional Climate

The majority of land within Sutter and Yuba Counties lies on the floor of the Sacramento Valley. The climate of this region of California is generally Mediterranean with summers characterized by high temperature and low humidity. Summer temperatures average 90° F during the day cooling to an average of 50° F at night. Prevailing winds are moderate and predominantly from the south. In winter, day time temperatures average in the low 50s while night-time temperatures often drop into the upper

30s. Prevailing winds are from the south, though north winds are frequent. Rain is frequent from October to May, with an average accumulation of 17 to 22 inches per year (Sutter County 2011, Yuba County 2011b).

3.2.6.2 Regional Air Quality

The SYMVCD falls within the Sacramento Valley Air Basin (SVAB), which includes the counties of Butte, Colusa, Glenn, Sacramento, Shasta, Sutter, Tehama, Yolo, Yuba and portions of Placer and Solano Counties. The SVAB is bounded by the Cascade Range on the north, the Coast Range on the west, the Sierra Nevada Mountains on the east and the San Joaquin Valley Air Basin to the south. Air quality in Yuba and Sutter Counties is fairly good relative to some of the more densely populated areas of California. However, these counties regularly experience air inversions that contribute to poor air quality because the majority of land lies at lower elevations on the floor of the Central Valley and is bounded by mountains that prevent dispersion of pollution. Inversions during the summer months trap pollution near the ground and contribute to photochemical smog. Inversion layers during winter can also occur when air near the ground cools while warmer air remains aloft. Local "hot spots" of air pollution occur when pollutants are poorly dispersed from emission sources (FRAQMD 2010).

The predominant source of air pollution within the northern portion of the SVAB, i.e., the counties of Butte, Colusa, Glenn, Tehama, Shasta and the northern portions of Yuba and Sutter, or the Feather River Air Quality Management District (FRAQMD), is mobile transportation sources, which includes motor vehicles. Within the FRAQMD area, mobile sources contribute 60-70% of the air pollution. The remaining 30-40% comes from stationary sources including farming operations, which contribute substantially to the production of particulate matter that affects air quality (Sutter County 2008). In addition, the area is subject to ozone pollution that is in part transported from the broader Sacramento area into the northern Sacramento Valley.

Ambient air quality standards have been set by both federal and state governments to protect public health. Air pollutants emitted into the air by mobile and stationary sources are regulated by both federal and state law and are referred to as "criteria air pollutants." The USEPA and CARB have established ambient air quality standards for common criteria air pollutants; the standards represent safe levels that avoid specific adverse health effects associated with each pollutant (see below). California standards represent levels that may not be exceeded whereas federal standards (other than those for ozone, particulate matter and those based on annual averages or annual arithmetic mean) are not to be exceeded more than once a year.

3.2.6.3 Criteria pollutants

Ozone is a gas that is not emitted itself but is created by a chemical reaction between oxides of nitrogen (NOx) and volatile organic compounds (VOC) in the presence of sunlight. Motor vehicle exhaust, industrial emissions, gasoline vapors, chemical solvents and natural sources emit NOx and VOC, which contribute to the formation of ozone at ground level. While ozone in the stratosphere protects humans and ecosystems from the harmful effect of the sun's rays, at ground level it forms smog and may exist in concentrations in the air that are harmful. Urban areas tend to have high levels of ground-level ozone, but some rural areas have increased ozone levels because wind carries ozone and the pollutants that form it hundreds of miles from their original sources. Breathing ozone can trigger a variety of health problems including respiratory problems such as asthma and throat irritation. Repeated exposure may permanently scar lung tissue. It also damages vegetation and ecosystems.

PM_{10} and $PM_{2.5}$ "Particulate matter" is a complex mixture of extremely small particles and liquid droplets. Particle pollution is composed of many components, including acids (such as nitrates and sulfates), organic chemicals, metals, and soil or dust particles. The size of particles in particulate matter pollution is directly linked to their potential for causing health problems. Particles 10 micrometers in diameter or smaller can pass through the throat and nose and enter the lungs, where they can cause serious health effects. USEPA groups particle pollution into two categories: "Inhalable coarse particles" (PM_{10}), which are larger than 2.5 micrometers and smaller than 10 micrometers in diameter, and "fine particulate matter" less than 2.5 micrometers in diameter ($PM_{2.5}$) found in smoke and haze. These particles are emitted from sources such as forest fires, industries and automobiles and can cause damage to the lungs and heart, reduce visibility and damage the environment by contributing to acid rain, depleting soil nutrients, and damaging crops and sensitive ecosystems.

Carbon monoxide (CO) is a colorless, odorless gas that is formed when carbon in fuel is not burned completely. A major source of CO is motor vehicle exhaust; other outdoor sources include industrial processes (e.g., metals processing and chemical manufacturing), residential wood burning, and natural sources such as forest fires. Indoor sources of CO include woodstoves, gas stoves, cigarette smoke, and unvented gas and kerosene space heaters. CO reduces oxygen delivery to the body's organs and can cause death at high levels. At lower levels, it negatively affects the cardiovascular system and the central nervous system. CO contributes to the formation of smog and ground-level ozone.

Nitrogen dioxide (NO_2) is one of a group of highly reactive gases known as nitrogen oxides. While USEPA's National Ambient Air Quality Standard covers this entire group of NOx, NO_2 is the indicator for the larger group of nitrogen oxides. NO_2 is formed by emissions from cars, trucks and buses, power plants, and off-road equipment. NO_2 is linked with a number of adverse effects on the respiratory system and contributes to the formation of ground-level ozone and fine particle pollution.

Sulfur dioxide (SO_2) is a highly reactive gas within a group known as "oxides of sulfur." SO_2 emissions result predominantly from fossil fuel combustion at power plants and other industrial facilities. Smaller sources of SO_2 include industrial processes (extracting metal from ore) and burning of high sulfur containing fuels by locomotives, large ships, and non-road equipment. SO_2 is linked with a number of adverse effects on the respiratory system. Even very short term exposure can lead to an array of adverse respiratory effects including increased asthma symptoms.

Lead, a metal found naturally in the environment, also is found in manufactured products. The primary sources of lead emissions have historically been motor vehicles and industrial processes, such as lead smelting, waste incineration, utilities and manufacture of lead-acid batteries. Among lead's adverse effects on health are impairment of the nervous system, kidney function, and the immune, reproductive, developmental and cardiovascular systems. Lead is persistent in the environment and accumulates in soils and sediments, causing a wide range of adverse environmental effects.

Visibility Reducing Particles is a California criteria pollutant category and consists of suspended particulate matter, a complex mixture of tiny particles including dry solid fragments, solid cores with liquid coatings, and small droplets of liquid. These particles containing many different materials such as metals, soot, soil, dust, and salt contribute to the formation of haze and impaired visibility.

Sulfates (SO_4^{2-}), the fully oxidized ionic form of sulfur, are another measured criteria air pollutant within the State of California. Emissions of sulfur compounds occur primarily from the combustion of petroleum-derived sulfur-containing fuels (e.g., gasoline and diesel fuels), which are rapidly converted to sulfate compounds in the atmosphere. Exposure to sulfates decreases pulmonary function, aggravates asthmatic symptoms, and increases risk of cardio-pulmonary disease. Sulfates can also degrade visibility, harm ecosystems, and damage materials and property largely due to their acidity.

Hydrogen Sulfide (H_2S) is a colorless, flammable, extremely hazardous gas that occurs naturally in crude petroleum, natural gas, and hot springs and is produced by bacterial breakdown of organic materials and human and animal wastes (e.g., sewage). Industrial activities of humans, relating to petroleum/natural gas drilling and refining, wastewater treatment, and paper milling, release hydrogen sulfide, which is both an irritant and chemical asphyxiant. The California Board of Public Health adopted and refined an air quality standard for H_2S in the late 1960s.

Vinyl Chloride is a colorless gas produced by the manufacture of PVC products. Major sources are building and construction, the automotive industry, electrical wire insulation and cables, piping, industrial and household equipment, and medical supplies. Vinyl chloride is a known cancer-causing agent that was added by the California Air Resource Board to the list of California criteria pollutants in 1978 and the list of toxic air contaminants in 1990.

3.2.6.4 Local Air Quality

Ambient air quality within the FRAQMD is monitored at two monitoring station locations: Yuba City on Almond Street and on the Sutter Buttes at the top of the South Butte. The Yuba City – Almond Street Station records data on the following pollutants: ozone, carbon monoxide, NO_2, $PM_{2.5}$ and PM_{10}. The Sutter Buttes station is used to track transport ozone, and data from this station are not used to estimate ambient air quality on the valley floor. From 2007 through 2009, the state standard for ozone was exceeded once in 2007, and the national 8-hour standard was exceeded three times in 2007 and once in 2008 and 2009 (Table 3-4). The national standard for $PM_{2.5}$ was measured above the national standard several times each year and the PM_{10} was measured above the state standard in 2007 and 2008 (Table 3-4).

3.2.7 Greenhouse Gases

Greenhouse gases (GHG) are gases that trap the heat in the atmosphere and include water vapor, carbon dioxide, methane, ozone, and nitrous oxides, all of which may be produced by natural biological and physical processes, as well as by human activity. Humans have also added various synthetic fluorocarbon compounds and other aerosols to the atmosphere and have increased the rate of release of carbon dioxide, nitrous oxides and methane. The impact of human activities on the atmosphere began accelerating with the advent of the Industrial Age and continues to increase with development as countries' economies shift from being based predominantly on agricultural to manufacturing. Global climate change—a change in the average weather of the earth that can be measured in wind, storm patterns, precipitation and temperature— is thought to be partly the result of these long-term chemical releases to the atmosphere by humans.

A major contribution to greenhouse gases in California is the transportation sector. While modern engines produce significantly lower amounts of greenhouse gases than combustion engines of the past, this decrease has been offset by the large increase in numbers of automobiles on the roads. The transportation sector in 1990 was estimated to emit roughly 38% of California's greenhouse gases, or a total of 182.4 million metric tons of carbon dioxide equivalent (CARB 2007). As it is statewide, the transportation sector is the largest producer of greenhouse gases within Yuba and Sutter Counties. Other sources of greenhouse gases include the production of electricity using fossil fuels, wood burning to heat homes, and agricultural burning and other practices.

Table 3-4. Ambient air quality data, Yuba and Sutter Counties, 2007-2009. Source CARB 2011.

Criteria Pollutant		Year	
Ozone	**2007**	**2008**	**2009**
Maximum concentration (1-hr/8-hr avg, ppm)	0.095/0.081	0.092/0.080	0.089/0.076
Number of days State standard exceeded (1-hr)	1	0	0
Number of days national 1-hr/8-hr standard exceeded	0/3	0/1	0/1
Fine Particulate Matter $PM_{2.5}$			
Maximum concentration (µg/m^3)	45.0	127.2	41.8
Number of days national standard exceeded (measured)	6	9	2
Respirable Particulate Matter (PM_{10})			
Maximum concentration (µg/m^3)	51.0	66.9	50.7
Number of days state standard exceeded (measured*)	1	4	0
Number of days national standard exceeded (measured)	0	0	0
Carbon Monoxide	**2004**	**2005**	**2006**
Maximum concentration (µg/m^3)	5.80/2.54	4.40/3.39	3.10/2.29
Number of days state standard exceeded	0	0	0
Number of days national standard exceeded	0	0	0

*Measure days are those days with an actual measurement above the standard and area collected every six days. Calculated days are the estimated number of standard had the data been collected every day. Number of days above standard is not necessarily number of violations of the standard that year.

3.3 Biological Resources

3.3.1 Habitats

Yuba and Sutter Counties have developed a land cover classification that includes 22 categories of land cover. For the purpose of this discussion, we combined all similar cover types within the urban, upland crops, riparian and woodland land cover categories to make 14 broad land cover types (Figure 3-5).

These include annual grassland, upland crop, woodland, irrigated pasture, orchard and vineyard, rice, riparian, lacustrine, riverine, fresh emergent wetland, vernal pool, rural residential, urban, and barren and disturbed lands. These land cover types may be further subdivided into representative habitat types (Table 3-5).

Land within the SYMVCD is home to a diverse group of habitats; however, the majority of land in the District is dedicated to agriculture. Approximately 360,000 acres of agriculture account for 76% of the total acreage of the District. Agriculture within the jurisdiction of the SYMVCD consists of row crops, vineyards, orchards, cropland, dryland grain crops, irrigated grain crops, irrigated hayfield, pastures and rice. Rice fields account for 47% of the agricultural acreage. Rice is grown in leveed fields that are flooded much of the growing period and dried out to mature for harvesting.

Loss of 95% of historic wetlands in the Central Valley has resulted in rice fields acting as a surrogate habitat for at least 230 species of wildlife, many of which are species of special concern or threatened or endangered (California Rice Commission 2009).

The second most abundant agriculture type is orchards and vineyards, which together comprise 28% of the agriculture acreage. Orchards in California are typically single species, uniformly spaced, tree-dominated habitats. Orchards within the SYMVCD commonly produce almonds, walnuts, peaches, apples, and oranges. Correspondingly, vineyards are composed of a single vine species planted in rows on supports made from wood and wire. Vineyards in SYMVCD commonly produce grapes, kiwis, and boysenberries. Some species of birds and mammals are well suited to the orchard and vineyard habitats. Several have become “agricultural pests,” which has resulted in intensive efforts to reduce crop losses, while other wildlife species act as biological control agents by feeding on weed seeds or insect pests. In return orchards provide wildlife with cover, water, food, and shade.

Upland crops make up 21% of the agriculture acreage. Upland crops consist of dryland grain crops, irrigated grain crops, irrigated hayfield, and irrigated row and field crops. Vegetation in this habitat includes a variety of sizes, shapes and growing patterns. Most crops are annuals, though some, such as asparagus and strawberries, are perennial. Conversion of native habitats to croplands has greatly reduced wildlife habitat; however, availability of irrigation water during dryer months benefits many wildlife species, especially in arid landscapes. Many species of rodents and birds have adapted to croplands and as a result are controlled to ensure crop safety.

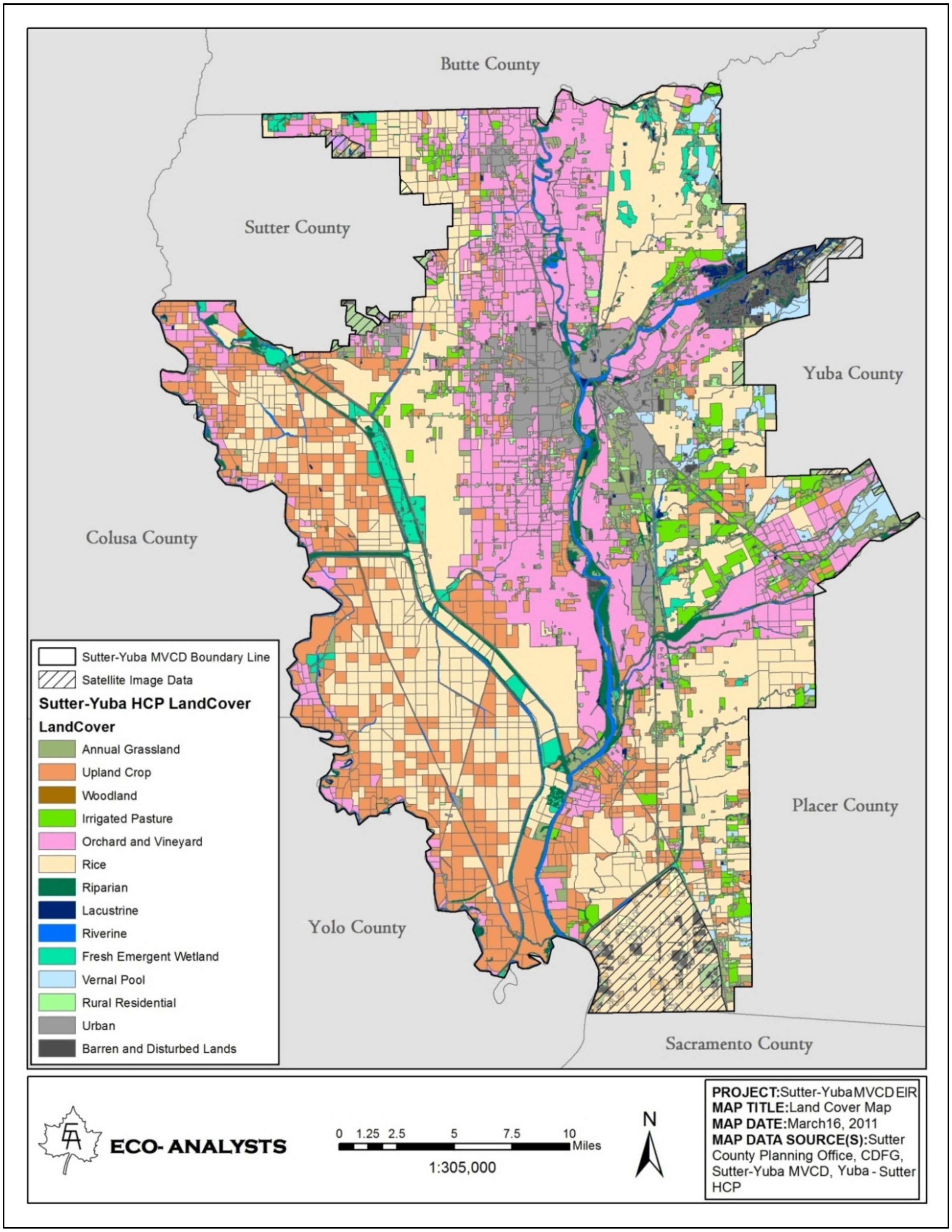

Figure 3-5. Land cover types within the SYMVCD.

Table 3-5. Natural plant communities of SYMVCD.

Land Cover Type	Habitats	Characteristics	Location
Agriculture land	Pasture, Cropland, Dryland Grain Crops, Irrigated Grain Crops, Irrigated Hayfield, Irrigated Row and Field Crop, Rice, Orchard-Vineyard, Deciduous Orchard	Vegetation includes a variety of sizes, shapes, and growing patterns. Most croplands support annuals, planted in spring and harvested during summer or fall. Croplands in Sutter and Yuba Counties consist of rice fields, row and field crops, orchards (primary walnut and peach), alfalfa, vineyards, and irrigated pastures.	Most abundant land cover type. Exists throughout the District.
Annual Grassland	Annual Grassland	Consists of mostly nonnative herbaceous vegetation (grasses, herbs and subshrubs that grow in deep, well developed soils) that shows a dramatic difference in appearance between seasons and years. Commonly observed species include ripgut brome (*Bromus diandrus*), soft chess (*Bromus mollis*), wild oat (*Avena fatua*), Italian rye (*Lolium multiflorum*).	Occurs in undeveloped portions of the District and along rivers and streams.
Riparian	Valley Foothill Riparian	Dominated by herbaceous, scrub or forest communities near rivers and streams. Most trees are winter deciduous. Common species that occur are Valley oak (*Quercus lobata*), Fremont cottonwood (*Populus fremontii*), Northern California Black Walnut (*Juglans hindsii*), White alder (*Alnus rhombifolia*), and willow (*Salix spp*.)	Occurs along river, creeks, and canals that occur throughout the District.
Woodland	Blue Oak Woodland,Valley Oak Woodland, Blue Oak-Foothill Pine, Eucalyptus	Oak woodlands are multi-layered, non-riparian forests with canopies, varying from savanna-like to forest-like stands and composed mostly of winter-deciduous, broad-leaved species. Ground cover consists of annual grasses and forbs. Common species are blue oaks (*Quercus douglasi*), Valley oaks, and Interior Live oaks (*Quercus wislizenii*)	Southwestern base of the Sutter Buttes, and along the Sacramento, Feather, Yuba, and Bear rivers adjacent to riparian vegetation.
Rivers, Creeks, Canals	Riverine, Lacustrine	A river is a natural freshwater watercourse. A creek or stream is a small river that can be permanent or intermittent. Both rivers and creeks are feed by snow melt and rain. Lacustrine habitats are inland depressions or dammed riverine channels containing standing water (Cowardin 1979). They may vary from small ponds less than one hectare to large areas covering several square kilometers. Canals are man-made watercourses that are used to deliver water for human consumption.	Major watercourses include Sacramento, Yuba, Feather, Snake, Bear Rivers, Butte Slough, East side Canal, Coon Creek, Honcut Creek. There are many small lakes that occur throughout the District; some examples are Abbott Lake, Ellis Lake, and Wood Lake.

Land Cover Type	Habitats	Characteristics	Location
Freshwater Marsh	Fresh Emergent Wetland	Freshwater marshes are composed of saturated or periodically flooded soils that are not forested or tidal. The habitat consists of water-loving aquatic plants. Common species include cattails (*Typha latifolia*), tule (S*cirpus californicus*), sedges, rushes, and water primrose (*Ludwigia peploides*).	Butte Sink South west of the Sutter Buttes, Sutter Bypass, small areas along the Sacramento, Feather, and Bear Rivers, and unnaturally along rice farming canals.
Vernal Pool and Seasonal Wetlands	Vernal Pool Complex	Vernal pools are seasonal depression wetlands. They are covered by shallow water for variable periods from winter to spring, but may be completely dry for most of the summer and fall. These wetlands range in size from small puddles to shallow lakes and are usually found in a gently sloping plain of grassland. Common species include water-starwort (*Callitriche marginata*), annual hairgrass (*Deschampsia danthonioides*), horned downingia (*Downingia ornatissima*), and Coyote thistle (*Eryngium vaseyi*). Vernal pools also serve as habitat for endangered fairy shrimp.	Most of them occur along the east boundary of the District.
Other	Barren Urban	Barren habitat is a habitat without vegetation including rocky outcroppings, and mudflats. Urban settings covered in pavement and buildings are also classified as barren. Marysville, Yuba City, and Linda are the largest urban areas in the District	Most urban areas occur in the center of the District. The barren areas are clumped along the northeast boundary of the District.

Irrigated pastures make up 4.5% of the agriculture acreage. Pasture is a mixture of perennial grasses and legumes. Height of vegetation varies, according to season and livestock abundance. The mix of grasses and legumes varies due to seed mixture, fertilization, soil type, irrigation, weed control, and the type of livestock on the pasture. Ground-nesting birds nest in pastures under suitable conditions. Flood-irrigated pastures provide foraging and roosting habitat for many wetland-associated birds. Mammals are also known to utilize these pastures but only if surrounded by suitable shelter habitat.

The second most abundant land cover in the SYMVCD is annual grassland, which comprises 6.7% of the total acreage of the District. Annual grasslands are open grasslands composed primarily of annual plant species that germinate after fall rains. Introduced annual grasses are the dominant plant species in this habitat. A dramatic difference in composition both between seasons and between years is a characteristic of this habitat. Annual grassland typically occurs on flat plains to gently rolling foothills. Many wildlife species use annual grasslands for foraging, but some require additional habitat features such as cliffs, caves, ponds, or trees for breeding, and cover.

The urban land cover type comprises 4.8% of the total acreage of the District. Urban habitats are characterized by human development and consequently an absence of species richness; however urban areas do have components of wild habitats. The structure of urban vegetation varies, with five types of vegetative structures commonly seen: tree grove, street strip, shade tree/lawn, lawn, and shrub cover. A distinguishing feature of the urban wildlife habitat is an abundance of exotic plant species, which can provide a good source of food in the form of fruits and berries. Cities and highly populated areas have low wildlife species richness but high species density. In more vegetated urban areas, species richness increases while species density decreases.

Riparian areas, or the boundary between land and a river or stream, comprise 2.8% of the total acreage of the District. Riparian communities along the river margins and banks are made up of hydrophytic plants. Riparian habitat can exhibit complex structural diversity with a dominant species in the canopy layer, sub-canopy trees, an understory shrub layer and an herbaceous layer, but can also exist as any of these features independently or in any combination. Valley-foothill riparian habitats provide food, water, migration and dispersal corridors, nesting, and thermal cover for an abundance of wildlife.

Fresh emergent wetlands (palustrine) comprise 2.7% of the total acreage of the District. They are characterized by erect, rooted water-loving vegetation. Saturated soils support several moist soil plant species. Fresh emergent wetland habitats may occur in association with terrestrial habitats or aquatic habitats including riverine and lacustrine. These wetlands are among the most productive wildlife habitats in California. They provide food, cover, and water for more than 160 species of birds, and several mammals, reptiles, and amphibians. Many species rely on fresh emergent wetlands for their entire life cycle. Wetlands in California have decreased dramatically from drainage and conversion to other uses, primarily agriculture. Rice fields have become surrogate habitat for many wetland species.

Vernal pool landscapes cover 1.8% of the total acreage of the District. Northern California vernal pools are shallow short-lived water bodies (up to several hectares in size) found in depressions in grasslands and open woodlands throughout the Central Valley of California. Northern California vernal pools are characterized by non-permeable soils that retain water throughout some portion of the spring but dry down entirely during early summer months. These pools provide habitat to a variety of endangered plants and animals, in addition to providing important foraging habitat for migratory waterbirds.

Lacustrine and riverine combined land covers comprise 1.8% of the total acreage of the District. The riverine land cover type is described as intermittent or continually running water. Riverine habitat originates at some elevated source, such as a spring or lake, and flows downward at a rate relative to slope or gradient and the volume of surface runoff or discharge. Rivers are home to many important fish species, several of which occur within the jurisdiction of SYMVCD and are listed by USFWS, NMFS, or CDFG as threatened or endangered. Open water zones of large rivers provide resting and cover for many species of waterfowl, hunting habitat for predatory water birds, and host aquatic mammals. Lacustrine habitat is described as inland depressions or dammed channels containing standing water. Depth and size can vary tremendously. Lacustrine habitats are used by a variety of mammals, birds, reptiles, and amphibians for food, water, cover, and reproduction.

Barren land is defined by the absence of vegetation and comprises 1.6% of the total acreage within the District. Barren habitats include rocky outcroppings, vertical river banks, and canyon walls, among other non-vegetated surfaces. Much of the barren land in SYMVCD is made up of dredged tailings in the north eastern corner of the District. When there is little or no vegetation, structure of the non-vegetated substrate becomes a critical component of the habitat; thus, many animal species utilize rock cliffs, and caves or small crevices for nesting habitat.

Rural residential land cover comprises 1.6% of the total acreage of the District. Rural residential property is a piece of land zoned for residential use that is located in a less densely populated area than cities. This land type can include agricultural or farming areas. Rural residential areas often host a variety of wildlife species because they are often open undeveloped habitats.

Woodlands are scarce within the District, comprising only 0.3% of the total acreage of the District. Woodlands within the District include blue oak woodland, Valley oak woodland, blue oak-foothill pine, and eucalyptus. Blue oak woodland is highly variable climax woodland dominated by blue oak, but commonly including several species of pines and shrubs. A stand can vary from open savannas with grassy understories to fairly dense woodlands with shrubby understories (Holland 1986). Valley oak woodlands have similar characteristics to blue oak woodlands but are usually more open forming a grassy-understory savanna rather than closed woodland. Valley oak is often the only tree present. Blue oak-foothill pine habitats are diverse in structure both vertically and horizontally, with a mix of hardwoods, conifers, and shrubs. The shrub component is typically composed of several species that tend to be clumped, with interspersed patches of annual grassland. All oak woodland habitats provide excellent foraging, breeding, and cover to a many wildlife species. Eucalyptus groves have been extensively planted throughout the state. Overstory composition is typically limited to one, or sometimes a few, species of the genus; few native species are present within eucalyptus planted areas.

Eucalyptus trees are important as roosts, perches, and nest sites for a number of bird species, particularly raptors. Eucalyptus trees with stringy bark, or tendencies for rapid deposition of litter, create microhabitats for a number of small vertebrate species.

Portions of the SYMVCD are within the boundaries of a HCP/NCCP that is currently under development. The main goals of Yuba-Sutter NCCP/HCP are to continue economic growth, protect the vitality of the agricultural community, maintain recreation areas, protect threatened and endangered species, and preserve plant and wildlife communities. The HCP process is authorized under Section 10 (1)(b) of the Endangered Species Act that allows authorization of "take" of federally listed species that is "incidental" to otherwise lawful activity. The aim of HCPs is to allow economic development to occur while continuing to adequately protect the viability of populations of listed species. The NCCP process is a California program that meets requirements of the federal HCP program through the Natural Community Conservation Planning Act of 1991 (Cal FGC § 2800-2835). This Act allows the California Department of Fish and Game to enter into agreements that allow incidental take of species, provided that the species' future survival is not jeopardized, and it attempts to protect species in advance of listing. An NCCP can be prepared by a local, state or federal agency independently or in cooperation with other persons or jurisdictions. The completion date of the Yuba-Sutter NCCP/HCP has not yet been set.

3.3.1.1 Mosquito breeding habitats

Standing Water

Standing water mosquitoes prefer still water found in ponds, rice fields, lakes, and unmaintained swimming pools. Rice fields account for 47% of the agricultural acreage and 35% of the total acreage of the District, making them the most important mosquito breeding habitat in SYMVCD. Rice fields are flood-irrigated, providing ideal breeding habitat for a number of mosquito species including SYMVCD's most abundant mosquito species, *Culex tarsalis* and *Anopheles freeborni*. Both species feed on humans and carry multiple viruses, including malaria, West Nile virus and other forms of viral encephalitis.

Flood Water

Flood water mosquitoes commonly lay their eggs on moist soil or the base of grasses. When the eggs become submerged, they hatch. Irrigated pastures contain important flood water mosquito breeding habitat. Hoof prints filled with water and small rain-filled puddles provide ideal breeding sites for a number of mosquito species. There are approximately 16,000 acres of irrigated pastures in SYMVCD, which provides breeding habitat for *Aedes nigromaculis*, *Aedes vexans*, and *Aedes melanimon,* all aggressive hunters that feed on humans and carry West Nile virus, encephalitis, and canine heartworm. These same species also occur in fresh emergent wetlands and flooded annual grasslands.

Containers

Container mosquitoes prefer enclosed areas of water such as tree holes, buckets, tires, birdbaths, and rain gutters. The SYMVCD contains 23,000 acres of urban land, which entails the existence of gutters, storm drains, sewer lines, swimming pools, and a variety of domestic containers that host mosquito larvae. Two examples of container mosquitoes are *Aedes sierrensis,* which breeds in treeholes and containers with leafy materials, and *Culex pipiens,* which breeds in septic tanks, waste treatment ponds, and improperly maintained swimming pools. Both species are vicious biters and carry West Nile virus, encephalitis, and dog heartworm.

3.3.2 Rare and Endangered Species

Records maintained by the USFWS, the California Department of Fish and Game's California Natural Diversity Database (CNDDB), and the California Native Plant Society (CNPS) on the presence and location of sensitive species within SYMVCD (Appendix B) include 33 wildlife species listed as threatened or endangered by USFWS or CDFG or as a species of special concern by CDFG. This list includes 15 birds, three mammals, two reptiles, four amphibians, five fish (four federally threatened) and three invertebrates (two federally endangered and one federally threatened) (Table 3-6). USFWS has designated critical habitat within the District for four of the federally listed species: the Vernal Pool Tadpole Shrimp, Central Valley Spring-run Chinook, Sacramento River Winter-run Chinook, and Central Valley Steelhead (Figure 3-6). Within SYMVCD, there are also 22 listed plant species; three are federally listed as threatened or endangered (Table 3-7). None of the plants has designated critical habitat within SYMVCD.

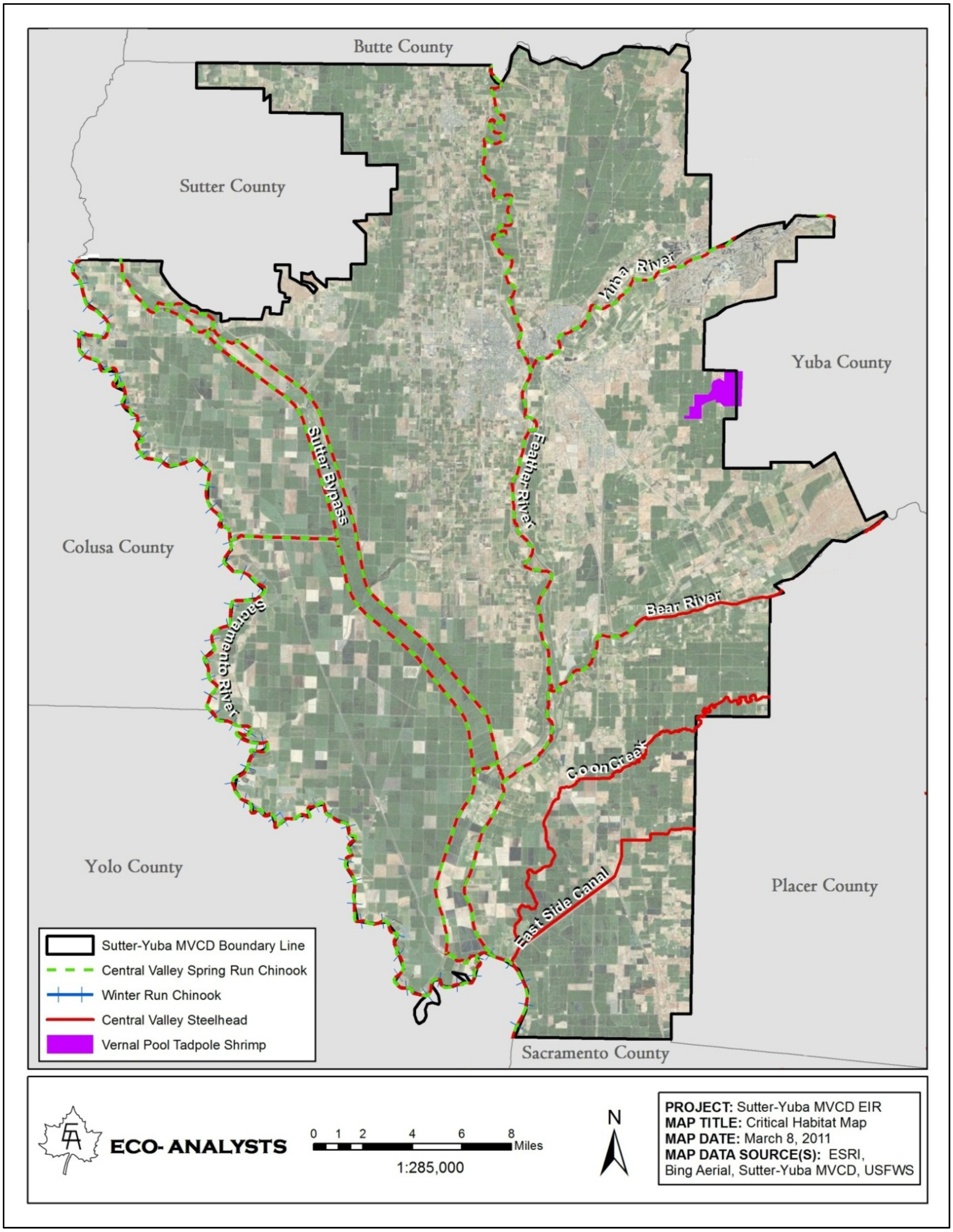

Figure 3-6. Federally designated critical habitat for endangered and threatened species within SYMVCD.

Table 3-6. Wildlife listed as state or federally threatened or endangered or as a CDFG species of special concern in Sutter or Yuba Counties. Source: CNDDB 2011, NMFS 2009, USFWS 1994.

Common Name (*Scientific Name*)	Federal Status	State Status	Habitat Requirements	Habitat within District?	Known Occurrences in District?*/Closest Occurrence*
Conservancy Fairy Shrimp (*Branchinecta conservatio*)	Endangered		Vernal Pools	Yes	No/SE 1.6 miles
Vernal Pool Tadpole Shrimp (*Lepidurus packardi*)	Endangered		Vernal Pools	Yes	Yes
Vernal Pool Fairy Shrimp (*Branchinecta lynchi*)	Threatened		Vernal Pools	Yes	Yes
Chinook Salmon - Central Valley Spring-run ESU (*Oncorhynchus tshawytscha*)	Threatened	Threatened	Estuarine, Marine, Riverine	Yes	Yes[1]
Chinook Salmon – Sacramento River Winter-run ESU (*Oncorhynchus tshawytscha*)	Endangered	Endangered	Estuarine, Marine, Riverine	Yes	Yes[1]
Delta Smelt *(Hypomesus transpacificus)*	Threatened	Threatened	Estuarine , Riverine	Yes	No/S 28.2 miles
California Tiger Salamander (*Ambystoma californiense*)	Threatened	Threatened, Species of Concern	Grasslands, Oak Woodlands, Coniferous forest	Yes	Yes[2]
Giant Garter Snake (*Thamnophis gigas*)	Threatened	Threatened	Freshwater Emergent Wetlands Irrigated Row and Field Crops, Riverine, Shoreline, Valley-Foothill Riparian	Yes	Yes
Central Valley Steelhead (*Oncorhynchus mykiss*)	Threatened		Estuarine, Marine, Riverine	Yes	Yes[1]
Green Sturgeon *(Acipenser medirostris)*	Threatened	Species of Concern	Estuarine, Marine, Riverine	Yes	No/NW 159 miles
California Red-legged Frog *(Rana draytonii)*	Threatened	Species of Concern	Freshwater Emergent Wetlands, Lacustrine, Riverine, Shoreline, Valley-Foothill Riparian, Wet Meadows	Yes	No[2]/ E 17.7 miles

Common Name (*Scientific Name*)	**Federal Status**	**State Status**	**Habitat Requirements**	**Habitat within District?**	**Known Occurrences in District?*/Closest Occurrence***
Valley Elderberry Longhorn Beetle (*Desmocerus californicus dimorphus*)	Threatened		Blue Oak Woodlands, Blue Oak-Foothill Pine, Valley-Foothill Riparian	Yes	Yes
Mountain Plover (*Charadrius montanus*)	Proposed Threatened	Species of Concern	Alkali Desert Scrub, Annual Grasslands, Croplands	Yes	No/W 1.2 miles
Western Yellow-billed Cuckoo (*Coccyzus americanus occidentalis*)	Candidate	Endangered	Desert Riparian, Valley-Foothill Riparian	Yes	Yes
Pacific Fisher (*Martes pennanti (pacifica) DPS*)	Candidate	Species of Concern	Mixed Hardwood and Conifer Forests	No	No/E 16.2 miles
Bald Eagle (*Haliaeetus leucocephalus*)		Endangered	Riverine, Lacustrine, Marine	Yes	Yes[3]
Greater Sandhill Crane (*Grus canadensis tabida*)		Threatened	Annual Grasslands, Croplands, Freshwater Emergent Wetlands, Lacustrine, Perennial Grasslands, Wet Meadows	Yes	Yes
California Black Rail (*Laterallus jamaicensis coturniculus*)		Threatened	Freshwater Emergent Wetland, Saline Emergent Wetland	Yes	Yes
Swainson's Hawk (*Buteo swainsoni*)		Threatened	Annual Grasslands, Blue Oak Woodlands, Croplands, Pastures, Perennial Grasslands, Valley Oak Woodlands, Valley-Foothill, Riparian	Yes	Yes

Common Name (*Scientific Name*)	Federal Status	State Status	Habitat Requirements	Habitat within District?	Known Occurrences in District?*/Closest Occurrence*
Foothill Yellow-legged Frog *(Rana boylii)*		Species of Concern	Riverine, Shoreline	Yes	No[2]/ E 16 miles
Western Spadefoot (*Spea hammondii*)		Species of Concern	Annual Grasslands, Blue Oak-Foothill Pine, Coastal Scrub, Freshwater Emergent Wetlands, Mixed Chaparral Riverine, Vernal Pools	Yes	No/ E 4.4 miles
Sacramento Splittail (*Pogonichthys macrolepidotus*)		Species of Concern	Estuarine, Riverine	Yes	Yes
Western Pond Turtle (*Emys marmorata*)		Species of Concern	Riverine, Lacustrine, Fresh Emergent Wetlands, Vernal Pools, Agricultural Ditches, Estuaries	Yes	Yes
Tricolored Blackbird (*Agelaius tricolor*)		Species of Concern	Annual Grasslands, Croplands, Freshwater Emergent Wetlands, Pastures, Perennial Grasslands	Yes	Yes
Grasshopper Sparrow (*Ammodramus savannarum)*		Species of Concern	Annual Grasslands, Pastures, Perennial Grasslands	Yes	No/NE 3.8 miles
Long-eared Owl (*Asio otus*)		Species of Concern	Grasslands, Montane Chaparral, Riparian, Agriculture, Freshwater Emergent Wetlands	Yes	No/NE 5.7 miles
Burrowing Owl (*Athene cunicularia*)		Species of Concern	Annual Grassland, Coastal Scrub, Coastal Terrace Prairies, Desert Scrub, Perennial Grasslands, Sagebrush	Yes	Yes
Northern Harrier (*Circus cyaneus*)		Species of Concern	Grasslands, Freshwater Emergent Marshes, Agricultural, Riparian	Yes	No/N 0.8 miles
Yellow Warbler (*Dendroica petechia brewsteri*)		Species of Concern	Montane Riparian, Valley-Foothill Riparian	Yes	No/NE 5.5

Common Name (*Scientific Name*)	Federal Status	State Status	Habitat Requirements	Habitat within District?	Known Occurrences in District?*/Closest Occurrence*
Marysville California Kangaroo Rat (*Dipodomys californicus eximius*)		Species of Concern	Annual Grasslands, Mixed Chaparral	Yes	No/N 0.6 miles
Purple Martin (*Progne subis*)		Species of Concern	Grasslands, Riverine, Riparian	Yes	No/SE 8.1
Bank Swallow (*Riparia riparia*)		Threatened	Valley-Foothill Riparian	Yes	Yes
Pallid Bat (*Antrozous pallidus*)		Species of Concern	Barren, Grasslands	Yes	No/W 2.4 miles
Western Red Bat (*Lasiurus blossevillii*)		Species of Concern	Blue Oak-Foothill Pine, Jeffrey Pine, Montane Hardwood-Conifer, Montane Riparian, Orchards and Vineyards	Yes	Yes

ESU = evolutionarily significant unit.* according to CNDDB unless otherwise noted; [1] based on NMFS 2009; [2] presumed extirpated from historical habitat, [3] based on USFWS 1994.

Table 3-7. Sensitive plant species of Sutter and Yuba Counties. Source: CNDDB 2011.

Common Name (*Scientific Name*)	Federal Status	State Status	Habitat Requirements	Habitat within District?	Known Occurrences within District?
Ferris' Milk-vetch (*Astragalus tener var. ferrisiae*)	-	CNPS 1B.1	Meadows and Seeps (Vernally Mesic), Valley and Foothill Grasslands (Subalkaline Flats)	Yes	No
(*Buxbaumbia viridis*)			Soil in Coniferous Forests, Sometimes Rotten Logs or Wood	No	No
Brandegee's Clarkia (*Clarkia biloba ssp. brandegeeae*)	-	CNPS 1B.2	Chaparral, Cismontane Woodland, Lower Montane Coniferous Forests	No	No
Dwarf Downingia (*Downingia pusilla*)	-	CNPS 2.2	Valley and Foothill Grasslands (Mesic), Vernal Pools	Yes	Yes, NW boundary
Ahart's Buckwheat (*Eriogonum umbellatum var. ahartii*)	-	CNPS 1B.2	Serpentinite, Slopes, Openings in Chaparral and Cismontane Woodlands	No	Likely, NW boundary
Pine Hill Flannelbush (*Fremontodendron decumbens*)	Endangered	CR, CNPS 1B.2	Gabbroic or Serpentinite, Rocky Areas in Chaparral or Cismontane Woodlands	No	No
Butte County Fritillary (*Fritillaria eastwoodiae*)	-	CNPS 3.2	Openings in Chaparral, Cismontane woodlands, and Lower Montane Coniferous Forest, Sometimes Serpentinitic	No	No
Woolly Rose-mallow (*Hibiscus lasiocarpus var. occidentalis*)	-	CNPS 1B.2	Freshwater Marshes and Swamps	Yes	Yes
Ahart's Dwarf Rush (*Jucus leiospermus var. ahartii*)	-	CNPS 1B.2	Valley and Foothill Grasslands (Mesic)	Yes	Yes

Common Name (*Scientific Name*)	Federal Status	State Status	Habitat Requirements	Habitat within District?	Known Occurrences within District?
Colusa Layia (*Layia septentrionalis*)	-	CNPS 1B.2	Chaparral, Cismontane Woodlands, Valley and Foothill Grassland	Yes	No, although possible
Legenere (*Legenere limosa*)	-	CNPS 1B.1	Vernal Pools	Yes	Yes
Veiny Monardella (*Monardela douglasii var. venosa*)	-	CNPS 1B.1	Cismontane Woodlands, Valley and Foothill Grassland with Heavy Clay	Yes	Likely extirpated
Baker's Navarretia (*Navarretia leucocephala ssp. bakeri*)	-	CNPS 1B.1	Mesic areas in Cismontane Woodlands, Lower Montane Coniferous Forests, Meadows and Seeps, Valley and Foothill Grasslands, Vernal Pools	Yes	Yes
Layne's Ragwort (*Packera layneae*)	Threatened	CR, CNPS 1B.2	Gabbroic or Serpentinite, Rocky Areas in Chaparral or Cismontane Woodlands	No	No
Cedar Crest Popcorn-flower (*Plagiobothrys glyptocarpus var. modestus*)	-	CNPS 3	Cismontane Woodlands, Valley and Foothill Grassland (Mesic)	Yes	Only one historical site known
Hartweg's Golden Sunburst (*Pseudobahia bahiafolia*)	Endangered	CE, CNPS 1B.1	Clay (Often Acidic) in Cismontane Woodlands and Valley and Foothill Grassland	Yes	Yes
Sticky Pyrrocoma (*Pyrrocoma lucida*)	-	CNPS 1B.2	Alkaline Clay in Great Basin Scrub, Lower Montane Coniferous Forests, Meadows and Seeps	No	No
Brownish Beaked-rush (*Rhynchospora capitellata*)	-	CNPS 2.2	Mesic Upper and Lower Montane Coniferous Forests, Meadows and Seeps, Marshes and Swamps	Yes	No

Common Name (*Scientific Name*)	Federal Status	State Status	Habitat Requirements	Habitat within District?	Known Occurrences within District?
San Francisco Campion (*Silene verecunda ssp. verecunda*)	-	CNPS 1B.2	Sandy Areas in Coastal Bluff Scrub, Chaparral, Coastal Prairie, Coastal Scrub, and Valley And Foothill Grassland	Yes	No
Wright's Trichocoronis (*Trichocoronis wrightii var. wrightii*)	-	CNPS 2.1	Alkaline Meadows and Seeps, Marshes and Swamps, Riparian Forests, and Vernal Pools	Yes	Yes
Siskiyou Mountains Huckleberry (*Vaccinium coccineum*)	-	CNPS 3.3	Upper and Lower Montane Coniferous Forest, often Serpentinitic	Unknown	Unknown
El Dorado County Mule Ears (*Wyethia reticulata*)	-	CNPS 1B.2	Clay or Gabbroic Areas in Chaparral, Cismontane Woodlands, and Lower Montane Coniferous Forests	No	No

CNPS = California Native Plant Society; List 1A: Presumed extinct in California; List 1B: Plants rare, threatened, or endangered in California and elsewhere; List 2: plants rare, threatened, or endangered in California, but more common elsewhere; List 3: Plants about which more information is needed; List 4: Plants of limited distribution – Watch List.

4 POTENTIALLY SIGNIFICANT ENVIRONMENTAL EFFECTS

4.1 HUMAN HEALTH

The following section assesses the potential impact of the District's programs on human health through a review of literature on the topic and assessment of District policies and practices with pertinent regulations.

4.1.1 REGULATORY SETTING

Both USEPA and the CDPR, a department within the Cal/EPA, evaluate the potential health effects of vector control agents on human health as well as regulate their use in California. The use of pesticides within California by vector control districts is also overseen by the California Department of Health with compliance inspections by the County Agricultural Commissioners.

4.1.1.1 The California Environmental Quality Act - Significance Thresholds

The effect of pesticide use on human health is primarily addressed by the CEQA checklist under hazards and hazardous materials. A project would be considered to have a significant adverse impact if it would:

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 (public health pesticides are exempt);

d) Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, 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, the project would 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, the project would 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; or

h) Expose people or structures to a significant risk of loss, injury or death involving wildland fires, including where wild lands are adjacent to urbanized areas or where residences are intermixed with wild lands.

4.1.2 *Methodology*

To evaluate the SYMVCD's program with respect to these significance criteria, Eco-Analysts summarized information on acute toxicity and carcinogenicity to humans of the chemicals used by SYMVCD from USEPA databases, Material Safety Data Sheets (MSDS) and other available databases on toxicity of chemicals (e.g., EXTOXNET) and reviewed the scientific and medical literature for evidence of health effects from use of these chemicals as applied by the District. Eco-Analysts also searched the literature of activist organizations critical of pesticide use to better define the concerns of these groups and to search for credible instances of poisoning or adverse effects from the use of public health pesticides applied according to label requirements.

4.1.3 *Impact Analysis*

District operations do not expose people or structures to loss, injury or death due to wildland fires or impair or interfere with emergency response plans. The District has jurisdiction to conduct vector control operations throughout portions of Sutter and Yuba Counties, which contain airports, airstrips and hazardous waste sites; however, operations do not increase exposure of people to hazards associated with these locations. District operations have potential to create a significant hazard to the public through use and routine transport of hazardous materials and/or create a significant hazard to the public or environment through accident conditions involving release of hazardous materials into the environment. However, the District stores and transports the chemicals it uses in moderate quantities to application sites and applies them with strict adherence to safety guidelines and BMPs designed to protect workers from adverse health effects from these pesticides. The District has a chemical spill response plan (Appendix C) and each field supervisor's vehicle is equipped with a spill kit to reduce the risk of injury to humans and the environment in the case of accidental spills.

A literature review and assessment of pesticide illness reports were used to assess the health impacts of use of the mosquito control chemicals by the District for public health.

4.1.3.1 Literature Review

The analysis of pesticide effects upon human health is both complex and constantly evolving. Testing on laboratory animals is used to understand potentially harmful effects of pesticides and to set regulatory levels of concern (LOC) for humans. In addition, two other types of studies useful in this analysis are clinical trials based on measurements of small populations of patients with known exposure to pesticides and epidemiological studies based on larger, statistical populations with varying exposure. Both of these approaches are complicated by the facts that: 1) exposure is difficult to measure in individuals or populations and may vary widely, even in a specific geographic area and time period; 2) effects vary widely by the sensitivity of the exposed population (by age, body weight, allergic reaction, etc.); and 3) results of studies are often complex and difficult to interpret.

The acute toxicities of the majority of the chemicals used by SYMVCD are classified by the USEPA as Category III and IV, slightly toxic and relatively non-toxic to humans, based on testing on laboratory animals (Table 4-1, Table 4-2, Table 4-3). Most of the chemicals are also non-carcinogenic and non-irritating to skin and eyes. The concentrations of chemicals to which the public is exposed by ULV spraying of mosquito insecticides for public health are well below established acute toxicity levels.

The health impacts of vector control pesticides have been the focus of California Department of Public Health (CDPH 2008) studies as well as of independent risk assessment studies (Macedo et al. 2010, Peterson et al. 2006, Schleier III et al. 2007). These studies have concluded that vector control agencies' use of pesticides to control mosquitoes does not present a significant risk to human health. Macedo et al. 2010 showed both a substantial decrease in mosquito populations due to aerial application of adulticides and human health risk level below levels of concern established by USEPA. This study found that use of adulticides was effective in breaking the infection cycle of West Nile virus and that concentrations used generated minimal human health risk. Similarly, Peterson et al. (2006) and Schleier III et al. (2007) found the risk of human health effects from ULV spraying to be below the regulatory LOC based on USEPA standards.

CDPH summarized the human health effects of adulticides and concluded the following about adulticides applied by ULV spraying (CDPH 2005):

- Adulticides are essentially unstable and will break down in the environment. PBO has a half-life of four days in soil and up to two days in water (National Pesticide Telecommunication Network, NPTN 2000);
- They contain very low dosage rates of insecticides. Typically less than one ounce per acre is applied either to the ground or air. At an application rate of 0.66 ounces of product per acre (0.0025 pounds per acre; typical rate for pyrethrin products) this concentration equates to 0.000015 ounce per square foot, if one assumes all of the product reaches the ground;
- Mosquito insecticides are poorly absorbed through the skin (pyrethrins and PBO);
- No evidence of exposure has been found following ULV spraying. In a CDC study, researchers found no increase in urine metabolite concentrations of the metabolites of naled, permethrin, or d-phenothrin after ULV spraying compared to a baseline (CDC 2005).

4.1.3.2 Pesticide Illness Reports

Reports of confirmed illness related to public health mosquito spraying are rare. In the CDC and CDPR databases, there are many records of pesticide "poisoning;" however, these records are mainly related to agricultural operations or to pest control use inside residential units. In 2008, the most recent published data from CDPR (2008a, 2008b, 2008c), there were 649 reported cases of definite/probable exposure to pesticides.

Table 4-1. Acute toxicity of mosquito adulticides used by SYMVCD, 2010. Source: USEPA Registration Eligibility Decisions, MSDS.*

Product Name	Active Ingredients	USEPA Toxicity Class	Oral LD_{50}	Inhalation LD_{50}	Dermal LD_{50}	Eye Effects	Skin Effects	Human Carcinogen
ANVIL® 2+2	d-phenothrin, piperonyl butoxide	IV	> 5,000 mg/kg (rat)	3.76 mg/l (rat)	> 2,000 mg/kg (rabbit)	irritating	mildly irritating	no
ANVIL® 10+10	d-phenothrin piperonyl butoxide	IV	> 5,000 mg/kg(rat)	3.76 mg/l rat)	> 2,000 mg/kg (rabbit)	irritating	mildly irritating	no
AQUAHALT™	pyrethrins piperonyl butoxide	III	500-5,000 mg/kg (rat)	2.03 ml/l (rat)	> 2,000 mg/kg (rabbit)	irritating	irritating	no
BIOMIST® 4+4	permethrin piperonyl butoxide	III	>5,000 mg/kg	> 2,000 mg/kg	> 2,000 mg/kg	irritating	irritating	likely
DRAGNET®	permethrin	III	2,280-3,580 mg/kg (rat)	> 23.5 mg/l/4 hr (rat)	> 2,000 mg/kg (rabbit)	slightly irritating	mildly irritating	suspected
DUET™	phenothrin prallethrin piperonyl butoxide	III	> 5,000 mg/kg (rat)	2.04 mg/l (rat)	> 2,000 mg/kg (rabbit)	irritation	slightly irritating	no
FYFANON®	malathion	III	~ 5,500 mg/kg (rat)	> 5.2 mg/l/4 hours	> 2,000 mg/kg (rat)	irritation	slightly irritating	no
PYRENONE® 25-5	pyrethrins piperonyl butoxide	III	> 5,000 mg/kg	> 4.93 mg/l (4hr)	> 5,000 mg/kg	slightly irritating	slightly irritating	no
PYROCIDE® MOSQ. ADULT ULV	pyrethrins piperonyl butoxide	III	> 3,000 mg/kg (rat)	> 5,000 mg/kg (rat)	> 2,000 mg/kg (rabbit)	primary irritation	slightly irritation	unlikely
TRUMPET®	naled	I	235 mg/kg (rat)	1.51/>2.07 mg/l 4hr (rat)	> 5,050 mg/kg (rabbit)	extremely irritating	corrosive	possible
ZENIVEX®	etofenprox	IV	> 5,000 mg/kg (rat)	2 mg/l	> 5,000 mg/kg (rat)	moderately irritating	repeated exposure may cause irritation	suspected

*USEPA 2006a,2006b, 2006c, 2006d, 2007a, 2008a; Clarke 2008 (MSDS Duet); Pesticide Action Network (PAN) Pesticide Database-etofenprox.

Table 4-2. Acute toxicity of mosquito larvicides used by SYMVCD, 2010. Source: USEPA and others*.

Product Name	Active Ingredient	USEPA Toxicity Class	Oral LD_{50}	Inhalation LD_{50}	Dermal LD_{50}	Eye Effects	Skin Effects	Human Carcinogen
AGNIQUE® MMF	alcohol ethoxylated surfactant	III	> 2,000 mg/kg	> 5 mg/l	> 2,000 mg/kg	slightly irritating	non-irritating	unknown
AGNIQUE® MMF G	alcohol ethoxylated surfactant	III	> 5,000 mg/kg	no data	no data	slightly irritating	non-irritating	unknown
ALTOSID® PELLETS	s-methoprene	IV	> 34,000 mg/kg (rat)	> 5.19 mg/l (rat)	> 2,000 mg/kg (rabbit)	non-irritating	non-irritating	no data
ALTOSID® SBG	s-methoprene	IV	> 34,000 mg/kg (rat)	> 5.19 mg/l (rat)	>2,100 mg/kg (rabbit)	mildly irritating	non-irritating	non-carcinogenic
ALTOSID® XR BRIQUETS	s-methoprene	IV	> 34,000 mg/kg (rat)	not inhalable	> 2,000 mg/kg (rabbit)	mildly irritating	non-irritating	no
ALTOSID® XR-G	s-methoprene	IV	> 34,000mg/kg (rat)	> 5.19 mg/l (rat)	> 2,000 mg/kg (rabbit)	practically non-irritating	non-irritating	non-carcinogenic
DIMILIN® 25W	diflubenzuron	III	>40 g/kg (rat)	> 3.5mg/l (rat)	>20 g/kg (rabbit)	probable irritant	probable irritant	no data
DURSBAN® 2 COATED GRANULES[1]	chlorpyrifos	II	82 mg/kg (rat)	78 mg/kg (rat)	2,000 mg/kg (rabbit)	irritating	irritating	non-carcinogenic
GOLDEN BEAR-1111[1]	petroleum distillate oil	III	no data	no data	no data	no data	no data	no data
NATULAR™ G30 AND XRT	spinosad	IV	> 5,000 mg/kg (rat)	irritating	> 5,000 mg/kg (rat)	temporarily irritating	non-irritating	no
VECTOBAC® 12AS	*Bacillus thuringiensis israelensis*	IV	> 5000 mg/kg (rat)	> 5.34 mg/l	> 5,000 mg/kg (rabbit)	mildly irritating	mildly irritating	no
VECTOBAC® G	*Bacillus thuringiensis israelensis*	IV	> 5,000 mg/kg (rat)	no lethality	> 5,000 mg/kg (rabbit)	non-irritating	non-irritating	no
VECTOBAC® WDG	*Bacillus thuringiensis israelensis*	IV	> 5,000 mg/kg (rat)	no lethality	> 5,000 mg/kg (rabbit)	non-irritating	mildly irritating	no
VECTOLEX® CG	*Bacillus sphaericus*	IV	> 5,000 mg/kg (rat)	no data	> 2,000 mg/kg (rabbit)	mildly irritating	mildly irritating	no data
VECTOMAX® CG	*Bacillus sphaericus, Bacillus thuringiensis israelensis*	IV	> 5,000 mg/kg (rat)	no data	> 5,000 mg/kg (rabbit)	mildly irritating	mildly irritating	no data

Kollman 2002; Csondes 2004; PAN Pesticide Database – *B. sphaericus*; Stark 2005; Toxnet 2003; USEPA 1997; 1998a, 1998b, 2001, 2002, 2007b. [1]product no longer manufactured.

Table 4-3. USEPA Toxicity Categories of Pesticides. Source: USEPA 2007c.*

Toxicity Category	Signal Word Required on the Label	Categories of Acute Toxicity LD50 Oral (mg/kg)	LD50 Dermal (mg/kg)	LC50 Inhalation (mg/l)	Probable Oral Lethal Dose for 150 lb Man	Antidote Statement Other Cautions[a]
I Highly Toxic	DANGER ☠ POISON	0 thru 50	0 thru 200	0 thru 0.2	A few drops to a teaspoonful	Skull and Crossbones "Call Physician Immediately" Antidote Statement
II Moderately Toxic	WARNING	from 50 thru 500	from 200 thru 2,000	from 0.2 thru 2	> 1 teaspoonful to one ounce	
III Slightly Toxic	CAUTION	from 500 thru 5,000	from 2000 thru 20,000	from 2.0 thru 20	> 1 ounce to one pint or one pound	
IV Relatively Non-toxic	CAUTION	> 5,000	> 20,000	> 20	Over one pint or one pound	

[a]All pesticide labels are required to include statement, "Keep out of reach of Children

* http://www.epa.gov/oppfead1/labeling/lrm/chap-07.pdf.

In addition, 246 cases were listed as possible, i.e., health effects corresponded to exposure but the evidence did not support exposure. Of the definite/probable cases, 402 were in occupational exposures, that is applicators or workers. Of non-occupational exposures, 172 were recorded from single and multiple family units and likely related to household use of chemicals.

From 1999-2002, seven states reported a small number of cases (34) of pesticide illness related to pyrethroids used in West Nile virus control (CDC 2003). In New York City, spraying with pyrethroids was not associated with increases in rates of emergency room visits for asthma in 1999-2000 (Karpati et al. 2004). Based on these reports, CDPH has indicated that there is a small risk that people who have been "sensitized" to pyrethrins (i.e., are allergic to lactone a contaminant in flower extracts) may have an allergic reaction, such as contact dermatitis or exacerbation of asthma, if they are re-exposed. The pyrethrin formulations currently used for public health do not contain lactones.

There have been a number of reports of self-diagnosed weakness, dizziness, headaches, heat intolerance, difficulty concentrating, depressed mood and memory loss claimed to be related to pesticide exposure by those experiencing these symptoms. This array of symptoms is currently classified as "idiopathic environmental intolerance" or IEI. Several investigations have failed to find an immune, immunoglobulin (IgE) response in patients (Florida Coordinating Council 2009). IgE plays an important role in allergies and asthma, as well as in many parasitic worm infections. In the absence of antibodies, the cause of these complaints may be psychosomatic (Florida Coordinating Council 2009). Despite lack of medical confirmation of a link between use of pesticides for public health and this array of symptoms, some members of the public continue to oppose their use.

4.1.3.3 District Best Management Practices and Policies

SYMVCD along with other such districts is charged with protecting the public health. Therefore, the SYMVCD must set the probability of effects of illness transmitted to the human population by vectors against the risk of additional adverse health effects of the chemical controls used. When the risk of additional illness equals or exceeds the benefits of utilizing controls to mosquito or other pest population, the SYMVCD would cease utilization of such controls and substitute other methods.

Best management practices reduce the risk that vector control pesticides negatively affect human health and should continue to be followed by the SYMVCD and the public. California Department of Public Health recommends that all individuals, particularly pregnant women, should take simple precautions to avoid exposure to pesticides, including those used in mosquito control. Workers, especially mixers, loaders and applicators of pesticide formulations are at greater risk of exposure to pesticides than the general public. These workers should receive regular training in handling pesticides and follow all instructions on pesticide labels and MSDS. They should also be monitored for any potential health effects including self-monitoring and periodic monitoring by a physician. Application precision yielded by GPS technology and drift prediction technology should continue to be used by vector control districts and should be upgraded as new, more precise technology becomes available.

In summary, the use of pesticides by the District as in the current vector control program is not found to constitute a significant hazard to the public based on the low acute toxicity of most chemicals and their limited persistence in the environment, the existence of an accidental spill plan and kits, the oversight by USEPA, CDPR and CDPH and the availability of numerous BMPs to avoid human health risks associated with these products.

4.1.4 Mitigations

No mitigations are required based on adequacy of current BMPs and CDPH and DPR oversight, and the lack of scientific and medical evidence for significant effects on human health when the chemicals used by the District are applied in the low concentrations consistent with label regulations.

4.2 WATER QUALITY

Mosquitoes are reliant upon open water during much of their lifecycle. Reduction in mosquito populations necessarily involves a range of activities by the District in and around water. These activities involve components of both physical control and chemical control. Water quality within many streams and water bodies within the District's boundaries is considered impaired by a variety of pollutants (see Section 3.2.5). Any release of chemicals identified as already elevated in these listed waterways may contribute to cumulative impacts on these already compromised water bodies.

4.2.1 REGULATORY SETTING

The State Water Resources Board and regional water quality control boards are responsible for regulating impacts to water quality in the State of California. The District operates within the boundaries of the Central Valley Regional Water Quality Control Board (CVRWQCB, Region 5), which extends approximately from Live Oak south to Modesto and from the crest of the Coast Range to the crest of the Sierra Nevada Mountains. Major cities within this region include Sacramento, Stockton, Modesto, Marysville, Yuba City, Woodland, Davis, and Vacaville.

The State Water Resources Control Board, with assistance from regional water quality control boards, periodically lists streams and other water bodies with known contamination that has resulted in limited water quality. Once a waterway is listed, the agencies identify Total Maximum Daily Load (TMDL) levels and a set a target date for compliance. The regional water boards work with local jurisdictions and landowners to address contamination problems, develop strategies for achieving TMDL compliance, and issue NPDES and other permits for local projects.

4.2.1.1 Water Quality Permits

The District has complied with the Vector Control Statewide General Permits for use of larvicides (NPDES permit no. CAG 990004). This permit expired on May 20, 2009, but remains in effect until a new General Permit is adopted. SWRCB has developed a Statewide NPDES General Permit for residual pesticide discharges, including adulticides, to Waters of the United States from vector control applications (Order No. 2011-002-DWQ; General Permit No CAG 990004). The permit has been circulated for public comment. The District has submitted an application for the General Permit, including a Notice of Intent and Pesticide Application Plan.

Monitoring Requirements

Water quality monitoring requirements will be carried out per the conditions of NPDES permits, which require the District to submit monthly reports to the regional water quality control boards on the discharge of aquatic pesticides to surface waters. The permit provides that monitoring exemptions may be appropriate for vector control projects involving microbial larvicides, thin film larvicides, and methoprene. Accordingly, the District's monitoring plan does not include water sampling or water quality analysis or testing.

New monitoring requirements are being developed for the Statewide NPDES General Permit for vector control districts, which is anticipated to be finalized by October 31, 2011. These new requirements will be specified in the General Permit and include watershed-wide monitoring to be performed for the consortium of mosquito and vector control districts by a third-party consulting firm. Components of the new monitoring program include background monitoring, event monitoring, and post-event monitoring in a watershed-wide setting. SYMVCD will implement these requirements when they become finalized as a member of the Mosquito and Vector Control Association of California Monitoring Coalition.

Reporting Requirements

The District currently files copies of its pesticide applications each month with each County Agricultural Commissioner. Monthly and annual reporting to the Central Valley Water Quality Control Board is also performed regularly. The District has prepared and submitted a Pesticide Application Plan for the new permit, which includes expanded requirements in general and annual reporting, including sampling results and recommendations for improving the monitoring program based upon results of monitoring. Reporting protocol shall be determined by the procedure specified in 40 CFR Part 136. Additional reporting and monitoring requirements may be added by the SWRCB's Deputy Director of the Division of Water Quality.

4.2.1.2 The California Environmental Quality Act - Significance Thresholds

CEQA requires that lead agencies analyze the impact of projects on hydrology and water quality. A significant adverse effect on hydrology or water quality is found under CEQA if the project would:

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 deficient aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted);

c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site;

d) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site;

e) Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff;

f) Otherwise substantially degrade water quality;

g) Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map;

h) Place within a 100-year flood hazard area structures which would impede or redirect flood flows;

i) Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam;

j) Inundation by seiche, tsunami, or mudflow;

4.2.2 *Methodology*

To evaluate the SYMVCD's program with respect to these significance criteria, Eco-Analysts reviewed data from the State Water Resources Control Board's list of impaired water bodies (SWRCB 2006), university studies (UC Davis 2003), and other state and federal agency sources including NMFS and CDWR to identify water bodies with impaired water quality within the District and to determine if the District's programs contribute significantly to any impairments.

4.2.3 *Impact Analysis*

Operations of the District do not rely on substantial water use or development of new structures. They will not substantially deplete groundwater supplies or interfere substantially with groundwater recharge. Because operations do not require construction within channels, they will not substantially alter the existing drainage pattern of sites in a manner that would result in substantial runoff, erosion, siltation, or flooding or place structures that would impede or redirect flood flows within a 100-year flood hazard area. Operations will not expose people or structures to a significant risk of loss, injury, or death involving flooding as a result of the failure of a levee or dam, or expose people or structures to inundation by seiches, tsunami, or mudflow.

The District applies several different insecticides to both terrestrial and aquatic environments, and regional water quality control boards believe this practice has the potential to violate water quality standards. The District, however, contributes only about 1% of the total regulated pesticides for Sutter and Yuba Counties (Kriedich et al. 2005, Howard et al. 2010) and is not considered a substantial source for potential water quality impacts. Ongoing District operations are unlikely to substantially degrade water quality.

An active ingredient used by the District, naled, belongs to a class of chemicals known as organophosphates, which also includes diazinon. One additional organophosphate insecticide currently used in vector control by the District, malathion, is a chemical currently listed as contributing to the impaired water quality of the listed regional streams and water bodies monitored by the SWRCB and the regional water quality control boards. Several water bodies within the District area, including Butte Slough, Jack Slough, and Wadsworth Canal, are currently listed as impaired by organophosphates (see Table 3-3). Organophosphate contamination has arisen primarily from heavy agricultural use of these chemicals, especially in tree and nut crops such as walnuts. Use of naled, malathion, chlorpyrifos, or other organophosphate insecticides adjacent to streams or in a manner that could introduce these chemicals into streams has the potential to contribute cumulatively to existing water quality impairments.

Malathion, the active ingredient in Fyfanon®, is an organophosphate insecticide with a half-life ranging from one to 17 days in water, and degrades quickly when exposed to sunlight. Malathion degrades into a number of products in water, some of which are even more toxic than malathion. Malaoxon, a metabolite derivative of malathion, is considered between 22 and 33 times more toxic than malathion, but is less stable and is quickly degraded to non-toxic metabolites. Malathion and other organophosphates work by binding the enzyme acetylcholinesterase (AChE), ultimately resulting in overstimulation of the nervous system. AChE is found in mammals, amphibians, fish, reptiles, birds, and insects. Uptake and metabolism of organophosphates are similar for insects and mammals, although mammals tend to detoxify and excrete organophosphates more quickly than insects. Persistent toxicity of malathion in waterways suggests regular to constant introduction of this compound from a number of sources, primarily agricultural. The District currently uses malathion only on the ground, which is unlikely to exacerbate existing organophosphate pollution. Changes to label requirements for malathion are currently undergoing court and agency review, which may result in further restrictions on malathion use. Regardless of the outcome of review, the relatively small amount of insecticides used for public health by the District, combined with the rapid degradation of malathion and lack of District use of this chemical in waterways, makes it unlikely that significant adverse impacts to water quality could occur.

Naled, the active ingredient in Trumpet®, is an organophosphate insecticide with a half-life of less than one day in soil, less than two days in water, and rapid degradation when exposed to sunlight (Table 4-5). Naled, also known as dibrom, binds the AChE enzyme like other organophosphates and can cause similar problems related to the overstimulation of an organism's nervous system by buildup of acetylcholine. Naled, however, has a much shorter half-life then malathion and is not persistent in water. The District currently uses naled in proximity of streams and creeks, which could exacerbate existing organophosphate pollution in some waterways; however, the rapid degradation of naled and low concentrations used in ULV applications make it unlikely that significant adverse impacts on water quality could occur.

Chlorpyrifos, the active ingredient in Dursban® and several other pesticides, is a crystalline organophosphate insecticide that was historically widely used by agriculture and public health. It can be very persistent in the environment, with a half-life in soil of over a year and persistence in water of 80-100 days, and a photodegradation rate of several weeks. Once the most widely used household pesticide in the US, residential sales of Dursban® have been curtailed since 2001 due to the threat of regulatory action by the USEPA. The District has discontinued use of products containing chlorpyrifos and applied less than a pound of active ingredient in 2010; therefore, the impact on water quality is considered not to be significant.

The insecticides currently used by the District in aquatic areas are applied in a manner consistent with current safety label requirements (see Chapter 2.15, Chemical Control). Most begin breaking down shortly after reaching the water surface, most rapidly in situations where the water is exposed to sunlight (Table 4-4, Table 4-5). Adequate control of larval mosquitoes may require longer term persistence of control agents in water bodies.

For example, Altosid®, a solid form of s-methoprene is mixed with plaster as a slow release mechanism. Charcoal is added to the plaster to retard degradation due to ultra-violet light. Briquets and pellets with Altosid® may last from 30 to 150 days in water (Wellmark International 2009). Altosid® does bond to many soils but has a low solubility and is considered unlikely to leach into groundwater (Csondes 2004). Photolysis occurs in shallow waters and is the probable cause of dissipation. If it becomes incorporated into sediments, it may persist for longer periods.

The surface active agents GB-1111, a petroleum oil distillate, and Agnique®, an alcohol ethoxylated surfactant, tend to be used in highly polluted waters, including those with floating organic matter. They do not mix with water but gradually breakdown and evaporate. They may persist from a few days to three weeks (Cognis Corporation 2006, Napa County Mosquito Abatement District 2004, Stark 2005). The use of GB-1111 is being phased out and this surfactant is no longer manufactured.

PBO, the synergist used with pyrethroids, has a low to moderate leaching potential when deposited on wet soils. It has a half-life on soil of 4.3 days and 0.55 to 1.64 days in water (NPTN 2000). The aerosol form has an estimated half-life of 3.4 hours (NPTN 2000). When PBO attaches to soil particles and then is eroded into waterways, it may be incorporated into the sediments and synergize entrapped pyrethroids from agriculture and landscape uses (Weston et al. 2006).

In summary, the District in currently in compliance with existing label and larvicide permit requirements and will apply for the General Permit currently under development and anticipated for finalization in October 2011. Monitoring specified by the new General Permit will additionally facilitate the evaluation of water quality impacts from vector control practices. Label safety guidelines help minimize the introduction of many of the other pesticides used in the District's control programs into aquatic systems. However, use of organophosphate insecticides in or directly adjacent to stream segments and other water bodies with existing organophosphate toxicity has the potential to contribute to an existing water quality limitation.

4.2.4 MITIGATIONS

Impact WQ-1: Use of organophosphate chemicals, including naled and malathion, has the potential to contribute to existing water quality impairments.

Mitigation Measure WQ-1: Organophosphate Limitations
Organophosphate insecticides shall not be applied to or immediately adjacent to (within 50 feet) the waters listed in the SWRCB's most current 303(d) List of Water Quality Impaired Segments. The District shall remain up to date on the most current 303(d) list as part of normal District operations. Annual district or regional training sessions shall explicitly state this requirement. All applications of organophosphate pesticides shall be reviewed prior to application to ensure they are not applied in, or immediately adjacent to water bodies with existing organophosphate water quality limitations.

Table 4-4. Environmental degradation rates of mosquito larvicides used by SYMVCD in 2010.

		Rate of Environmental Degradation			
Product Name	**Active Ingredient**	**in Soil**	**in Water**	**in Sunlight**	**Source**
AGNIQUE® MMF	alcohol ethoxylated surfactant	ND	5-22 day (film)	ND	Cognis Corporation2004
AGNIQUE® MMFG	alcohol ethoxylated surfactant	ND	5-22 day (film)	ND	Cognis Corporation2004
ALTOSID® PELLETS	s-methoprene	10 days	30-150 days	rapid	Csondes 2004
ALTOSID ® SBG	s-methoprene	10 days	30 hours	rapid	Csondes 2004
ALTOSID ® XR BRIQUETS	s-methoprene	10 days	30-150 days	rapid	Csondes 2004
ALTOSID ® XR-G	s-methoprene	10 days	30 hours	rapid	Csondes 2004
DIMILIN® 25W	diflubenzuron	2-4 days	30-80 days	3.7-11.3 days	USEPA 1997,Extoxnet Diflubenzuron
DURSBAN® 2 COATED GRANULES[1]	chlorpyrifos	7-120 days	3.5 -20 days	3-4 weeks	NPIC Chlorpyrifos Extoxnet Chlorpyrifos
GOLDEN BEAR-1111	petroleum distillate oil	ND	2-3 days	ND	USEPA 2007b
NATULAR™ G30	spinosad	14-17 days	> 30 days	1-9.5 days	Kollman 2002
NATULAR™ XRT	spinosad	14-17 days	> 30 days	1-9.5 days	Kollman 2002
VECTOBAC® 12AS	*Bacillus thuringiensis israelensis*	ND	2 days	1-4 days	USEPA 1998a Extoxnet Bti
VECTOBAC® G	*Bacillus thuringiensis israelensis*	ND	2 days	1-4 days	USEPA 1998a Extoxnet Bti
VECTOBAC® WDG	*Bacillus thuringiensis israelensis*	ND	2 days	1-4 days	USEPA 1998a Extoxnet Bti
VECTOLEX® CG	*Bacillus sphaericus*	0.5-2 weeks	ND	ND	USEPA 1999
VECTOMAX® CG	*Bacillus sphaericus, Bacillus thuringiensis israelensis*	0.5-2 weeks	ND	ND	USEPA 1999 USEPA 1998a,b

*ND= no data; [1] Product no longer manufactured and District no longer uses.

Table 4-5. Environmental degradation rates of mosquito adulticides used by SYMVCD in 2010.

		Rate of Environmental Degradation			
Product Name	**Active Ingredient**	**in Soil**	**in Water**	**in Sunlight**	**Source**
ANVIL® 2+2	d-phenothrin	18.6-25.9 days	36.1 days	6.5 days	USEPA 2008a
ANVIL® 10+10	d-phenothrin	18.6-25.8 days	36.1 days	6.5 days	USEPA 2008a
AQUAHALT™	pyrethrins, piperonyl butoxide	4.3 days	0.55-1.64 days	ND*	USEPA 2006d NPIC pyrethrin Gunasekara 2004
BIOMIST® 4+4	permethrin, piperonyl butoxide	11.6-113 days	19-27 hours	ND	NPIC permethrin
DUET™	d-phenothrin, prallethrin, piperonyl butoxide	18.6-25.8	36.1 days	6.5 days	USEPA 2008a
DRAGNET®	permethrin	11.6-113 days	19-27 hours	ND	NPIC permethrin
PYRENONE® 25-5	pyrethrins piperonyl butoxide	4.3 days	0.55-1.64 days	13 hours	USEPA 2006d NPIC pyrethrin Gunasekara 2004
PYROCIDE® MOSQ. ADULT ULV	pyrethrins, piperonyl butoxide	4.3 days	0.55-1.64 days	13 hours	USEPA 2006d NPIC pyrethrin Gunasekara 2004
FYFANON®	malathion	1-17 days	1.6-17.4 weeks	rapid	NPIC malathion Newhart 2006
TRUMPET®	naled	<1 day	1-2 days	60 hours	Extoxnet naled CDPR 1999 USEPA no date (naled fate transport)
ZENIVEX®	etofenprox	6–26.5 days	49.1 to 100 days	4.7-7.9 days	Vasquez 2011 Food and Agriculture Organization of the United Nations (FAO) 1993 - etofenprox

*ND= no data

No other significant impacts to water quality are identified as the District complies with the permit requirements set forth by the State Water Resources Control Board through the National Pollution Discharge Elimination System permits and complies with all label requirements reviewed and approved by the Department of Pesticide Regulation. No additional mitigations are warranted.

4.3 AIR QUALITY

4.3.1 REGULATORY SETTING

Air quality within the Sacramento Valley Air Basin is regulated through efforts of federal, state, regional and local government agencies, which work both jointly and independently to improve air quality through legislation, regulations, policies and programs, and education.

4.3.1.1 US Clean Air Act

The Clean Air Act of 1970 (42 USC § 7401 et seq.; amended 1990) requires the USEPA to develop and enforce regulations to protect the general public from exposure to hazardous airborne contaminants.

4.3.1.2 California Clean Air Act

The California Clean Air Act of 1988 (Cal HSC § 44243) outlines and directs California's air quality goals, planning mechanisms, regulatory strategies and standards under Titles 13 and 17 of the CCR. CARB is the agency responsible for air quality monitoring, planning and control throughout California. CARB sets the California air quality standards and control measures, approves the regional air quality management/attainment plans, makes area attainment designations, and establishes new standards for vehicles and fuel specifications to reduce vehicle emissions. As required by the federal Clean Air Act, CDPR estimates and tracks emissions of volatile organic emissions (VOCs) that contribute to the production of smog and increase cancer risk associated with breathing polluted air.

Ambient air quality standards have been set by both the USEPA and CARB to protect public health. Air pollutants emitted into the air by mobile and stationary sources are regulated by both federal and state law and are referred to as "criteria air pollutants." USEPA and CARB have established ambient air quality standards for common criteria air pollutants (Table 4-6). These standards represent safe levels that avoid specific adverse health effects associated with each pollutant (see Chapter 3.2.6). CARB and local air districts monitor regional air quality and compare monitoring data to these standards to determine areas that are considered in attainment of or non-attainment of federal and state standards. Yuba and Sutter Counties have been designated non-attainment of state PM_{10} standards, non-attainment-transitional for state ozone standards, and non-attainment of federal standards for $PM_{2.5}$ (Table 4-7).

Table 4-6. State and federal ambient air quality standards. Source: CARB 2010a.

Pollutant	Averaging Time	California Standards Concentration	Federal Standards Concentration	Potential Sources
Ozone	1-hour 8-hour	0.09 ppm* 0.070 ppm	---- 0.075 ppm	Motor vehicles, paints, coatings, solvents
Respirable Particulate Matter (PM_{10})	24 hour Annual	50 µg/m^3 20 µg/m^3	150 µg/m^3 -----	Industrial and agricultural activities, construction, transportation
Fine Particulate Matter ($PM_{2.5}$)	24 hour Annual	No separate State standard 12 µg/m^3	35 µg/m^3 15 µg/m^3	Industrial and agricultural activities, construction, transportation
Carbon Monoxide (CO)	8-hour 1-hour	9.0 ppm 20 ppm	9 ppm 35 ppm	Gasoline, diesel fuel
Nitrogen Dioxide (NO_2)	Annual (Arithmetic Average) 1-hour	0.030 ppm 0.18 ppm	0.053 ppm -----	Fuel combustion
Sulfur Dioxide (SO_2)	Annual (Arithmetic Average) 24-hour 1-hour	----- 0.04 ppm 0.25 ppm	0.030 ppm 0.14 ppm -----	Combustion of sulphurous fossil fuels
Lead	30 day calendar quarter	1.5 µg/m^3 --------	----- 1.5 µg/m^3	Lead smelters, battery manufacturers
Visibility Reducing Particles	8 hour	Extinction coefficient of 0.23 per km visibility ≥ 10 miles	No federal standard	Wildfires, waste-burning, fugitive dust
Sulfates	24-hour	25 µg/m^3	No federal standard	Industrial processes
Hydrogen Sulfide	1-hour	0.03 ppm	No federal standard	Paper manufacturing, sewage treatment, landfills, concentrated animal feed operations
Vinyl Chloride	24-hour	0.01 ppm	No federal standard	Manufacture of PVC plastic and vinyl products

* ppm = parts per million

Table 4-7. Yuba and Sutter Counties air quality attainment status, 2010. Source: CARB 2010b, FRAQMD 2010.

Pollutant	Attainment Classification California Standard	Federal Standard
Ozone	Nonattainment-transitional	Unclassified/Attainment
Carbon monoxide	Sutter: Attainment Yuba: Unclassified	Unclassified
Nitrogen dioxide	Attainment	Unclassified
Sulfur dioxide	Attainment	Unclassified
PM_{10}	Nonattainment	Unclassified
$PM_{2.5}$	Attainment	Nonattainment
Lead	Attainment	Attainment
Sulfates	Attainment	*
Hydrogen sulfide	Unclassified	*
Vinyl chloride	*	*
Visibility reducing particles	Unclassified	*

*not enough data to make a determination.

4.3.1.3 The California Environmental Quality Act - Significance Thresholds

CEQA requires lead agencies to examine the impact of projects or programs on air quality and has established the following thresholds of significance for assessing impacts on air quality. Appendix G of the 2010 CEQA Guidelines specifies that a project is considered to have a significant impact on the environment with respect to air quality if it would:

a) conflict with or obstruct implementation of an 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 nonattainment under an applicable federal or state standard (including releasing emissions which exceed quantitative thresholds for ozone precursors);

d) expose sensitive receptors to substantial pollutant concentrations; and/or

e) create objectionable odors affecting a substantial number of people.

4.3.1.4 Feather River Air Quality Management District Thresholds

The Feather River Air Quality Management District is the regional entity responsible for managing air quality within Sutter and Yuba Counties. FRAQMD has adopted thresholds of significance to assist lead agencies in determining whether a project may have a significant impact on air quality (Table 4-8).

Table 4-8. Feather River Air Quality Management District's operational thresholds of significance. Source: FRAQMD 2011.

	Criteria Pollutant

	ROG	NO_X	PM_{10}	$PM_{2.5}$	Greenhouse Gases (CO_2, CH_4)
FRAQMD Threshold (lbs/day)	25	25	80	Not Yet Established	Not Yet Established

4.3.2 Methodology

The project being analyzed in this PEIR document is the vector control program of SYMVCD. The activities of the District that contribute most significantly to the generation of air pollutants include the operation of the vehicle fleet for ground application of insecticides, operation of small aircraft for the aerial application of insecticides, and the use of insecticides themselves. Other District equipment, such as all-terrain vehicles, may generate air pollutants. The District owns four ATVs and one Polaris Ranger, which are used infrequently (less than 40 times per year with less than 100 miles traveled in total) to access areas inaccessible by truck for surveillance and ground treatments; these were excluded from the analysis because their emissions were considered to contribute negligibly to overall emissions generated by the District's operations. The backpack sprayers are manually pumped and the truck mounted systems used by SYMVCD for ULV applications of pesticides are electric; therefore, they were also not part of this analysis.

Vehicle emissions were modeled using the standard URBEMIS (version 9.2.4) air quality modeling program to generate air quality for on-road vehicle use (Appendix D). The SYMVCD operates a fleet of 34 light-duty pick-up trucks for the application of mosquito larvicides and adulticides over a 152 days control season. Average round-trip mileage for 2010 was 10-40 miles and estimated annual vehicle mileage was 9,827 miles per vehicle. Mileage was converted to an estimate of 6 trips per vehicle (204 trips per day total) and the fleet was set to 100% catalyst engine light-duty trucks; project was set to rural with average trip length of 40 miles for the URBEMIS model. All other values were the default values used by URBEMIS.

An emissions factor provided by FRAQMD for agricultural aircraft derived from USEPA's AP-42 Compilation of Air Pollutant Emission Factors (1995), Table II-1-7, for a 0-320 Lycoming and 0-200 Continental aircraft engines was used to estimate emissions for the use of small aircraft for aerial application of mosquito pesticides. Emissions were calculated as EM (lbs/day TOG) = gal/year aircraft fuel x 76.979 lbs/thousand gals TOG/365 days/year. The District contracts small agricultural aircraft for the aerial application of mosquito larvicides and adulticides. In 2010, three airplanes (Cessna 188 AgTruck, Cessna 188 AgWagon, and Ayres Turbo Thrush) were flown for a total of 217.5 hours using 3,700 gallons of fuel to apply mosquito larvicides and adulticides to areas within the District.

Air emissions from the use of pesticides also result from the volatile nature of many of the active ingredients, solvents, other additives or the dusty nature of certain formulations (USEPA 1995). Emissions may result directly during application of the pesticide or later as the chemicals volatilize over time from deposits on soil or vegetation. Environmental factors, such as windspeed, temperature and moisture, as well as the method of application (e.g., aerial or ground), pesticide formulation (aqueous or dry, powder or pelleted), and chemical properties related to environmental fate and transport (vapor pressure, rapid photolysis or breakdown in water, soil binding), all influence the amount of volatile organic compound emitted into the air.

CDPR maintains a database of the emissions potentials of the majority of pesticides registered in California in accordance with the State Implementation Plan (SIP) to reduce VOCs from all sources as required by the federal Clean Air Act (CDPR 2008d). Emissions from pesticide applications were calculated using the following equation potential VOC emissions (pounds ROG) = (pounds product applied) X emissions potential (CDPR 2002) to yield an estimate of emissions from pesticide use. Actual emissions are expected to differ depending on the specific application method, chemical persistence and soil binding properties and environmental conditions during application.

4.3.3 Impact Analysis

District operations do not conflict with existing air quality plans and are a continuance of an ongoing program. Part of the District area (southern portion of Sutter County) falls within the Sacramento Non-attainment Area for the federal 8-hour ozone standard. Strategies for progress toward attaining standards outlined in the 2008 draft Sacramento Regional 8-hour Ozone 2011 Reasonable and Further Progress Plan and Northern Sacramento Valley Planning Area 2009 Triennial Air Quality Attainment Plan generally focus on transportation planning conformity with air quality regulations as motor vehicle emissions are the largest contributor to the production of ozone precursors in this area.

The SIP for pesticides requires CDPR to develop and maintain an emission inventory to track pesticide VOC emissions and reduce emissions 20% from the base years in four of five non-attainment areas and by 12% in the fifth non-attainment area (Neal et al. 2011). The Sacramento Metro Non-attainment Area is one of the five non-attainment areas and includes the southern portion of Sutter County in its boundary. The emission inventory for this and the other non-attainment areas include all agricultural and structural use of pesticides but do not include home, industrial or institutional use or applications for vector control purposes or veterinary use. The District's integrated vector management approach seeks to reduce the need for application of chemicals to control vectors through the use of a combination of source reduction, education, and biological control methods. Therefore, the continued evolution of the program toward less dependence on insecticides facilitates reduction of the overall air pollutant emissions associated with on-road vehicle and aircraft use to apply the insecticides for public health, as well as the emissions from the insecticides themselves.

4.3.3.1 Pollutant Emissions

The URBEMIS model results for on-road vehicle use (Table 4-9) fell below FRAQMD operational thresholds and reflect a negligible fraction of total emissions projected for light-duty truck operation within the FRAQMD (Table 4-10). Emissions from use of small agricultural aircraft were calculated to be 0.780 lbs per day total organic gases. There are presently no federal regulatory guidelines addressing aircraft engine-related organic gases (USEPA 2009a), and regional and local thresholds for evaluating the contribution of these emissions do not currently exist, although emissions from aircraft engine use are thought to contribute significantly to the production of greenhouse gases. The contribution of the District aircraft operation to TOG production can be considered to be less than significant, however, at

0.04% of the estimated overall emissions from aircraft with the FRAQMD, which are on the order of almost a ton per day (See Table 4-10).

VOC emissions from the District's application of insecticides (Table 4-11, Table 4-12) were calculated based on the annual amounts used by the District in 2009 and 2010. The SIP goal is 2.2 tons per day for the Sacramento Metropolitan region for agricultural and structural pesticide applications. The Sacramento Metro Non-attainment Area showed a decrease in pesticide VOC emissions from 2.784 tons per day in 1990 to 0.960 tons in 2009 (Neal et al. 2011), a level below the SIP reduction goal. The estimated VOC emissions from the products applied by SYMVCD were at the FRAQMD threshold for ROG (which are virtually the same as VOCs) and are predominantly from two products, Vectobac (Bti) and Trumpet® (naled). VOC emissions data for the area of the District outside the Sacramento Metro Non-Attainment Area are currently not inventoried by CARB as this area is considered in attainment of VOC standards. Trumpet® has the highest emission potential of the chemical control agents currently used by the District; substitution of another adulticide would help reduce the VOC emissions in years when larger application of adulticides than were made in 2009 may be necessary.

4.3.3.2 Toxic Air Contaminants/Hazardous Air Pollutants

None of the pesticides used by SYMVCD are listed on CARB's list of toxic air contaminants (CARB 2010b). The following common toxic air contaminants are measurable in the exhaust of aircraft engines: 1,3 butadiene, acetaldehyde, acrolein, benzene, ethylbenzene, formaldehyde, isopropylbenzene, methanol, m-xylene, p-xylene, naphthalene, o-xylene, phenol, proprionaldehyde, styrene, toluene, benzaldehyde, and 2-methyl-napthalene (USEPA 2009a). However, the District's use of small aircraft is limited and a small percentage of aircraft use within the FRAQMD.

Table 4-9. Urbemis model results for vehicle operation by SYMVCD, 2011.

Source	ROG	NO_X	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
Summer lbs/day	1.28	1.32	19.50	0.01	0.10	0.06	1,370.28
Winter lbs/day	1.55	2.20	20.53	0.01	0.10	0.06	1,173.94
Annual tons/year	0.25	0.29	3.62	0.00	0.02	0.01	238.13

Table 4-10. Estimated annual mobile source emissions within FRAQMD, 2008. Source: CARB 2011.

	Tons pollutant per day							
On-road motor vehicles	**TOG**	**ROG**	**CO**	**NOx**	**SOx**	**PM**	**PM_{10}**	**$PM_{2.5}$**
Light duty passenger	1.29	1.19	10.94	0.96	0.01	0.06	0.06	0.03
Light duty trucks - 1	0.9	0.84	8.04	0.78	0	0.03	0.03	0.02
Light duty trucks - 2	0.72	0.66	6.68	0.85	0	0.04	0.04	0.03
Medium duty trucks	0.31	0.28	3.21	0.43	0	0.02	0.02	0.01
Light heavy duty gas trucks – 1	0.14	0.13	0.98	0.16	0	0	0	0
Light heavy duty gas trucks - 2	0.06	0.06	0.41	0.05	0	0	0	0
Medium heavy duty gas trucks	0.19	0.18	1.39	0.1	0	0	0	0
Heavy heavy duty gas trucks	0.09	0.08	1.23	0.1	0	0	0	0
Light heavy duty diesel trucks - 1	0.01	0.01	0.06	0.27	0	0	0	0
Light heavy duty diesel trucks - 2	0.01	0.01	0.03	0.16	0	0	0	0
Medium heavy duty diesel trucks	0.02	0.02	0.17	0.82	0	0.02	0.02	0.02
Heavy heavy duty diesel trucks	0.51	0.45	1.83	6.66	0.01	0.27	0.27	0.23
Motorcycles	0.23	0.22	1.72	0.06	0	0	0	0
Heavy duty diesel urban buses	0	0	0	0.03	0	0	0	0
Heavy duty gas urban buses	0	0	0.02	0	0	0	0	0
School buses	0.01	0	0.05	0.08	0	0	0	0
Other buses	0.01	0.01	0.06	0.03	0	0	0	0
Motor homes	0.02	0.02	0.44	0.06	0	0	0	0
Total on-road mobile sources	4.52	4.16	37.26	11.6	0.02	0.44	0.44	0.34
Other mobile sources								
Aircraft	0.92	0.82	3.43	0.39	0.06	0.04	0.04	0.04
Trains	0.15	0.12	0.39	1.8	0.01	0.05	0.05	0.05
Recreational boats	1.74	1.64	8.87	0.43	0	0.13	0.11	0.09
Off-road recreational vehicles	0.44	0.41	2.08	0.03	0	0.01	0	0
Off-road equipment	0.75	0.67	4.79	2	0	0.12	0.12	0.1
Farm equipment	0.88	0.76	4.08	3.79	0	0.23	0.23	0.21
Fuel storage and handling	0.1	0.1	0	0	0	0	0	0
Total other mobile sources	**4.98**	**4.52**	**23.64**	**8.44**	**0.07**	**0.58**	**0.55**	**0.49**
Total mobile sources	**9.5**	**8.68**	**60.9**	**20.04**	**0.09**	**1.02**	**0.99**	**0.83**
Grand total FRAQMD	**38.84**	**18.86**	**19.59**	**25.6**	**.33**	**42.40**	**23.11**	**7.34**

Table 4-11. Estimated VOC emissions from application of mosquito insecticides, 2009.

Product	Acres treated	No. applications	lbs Product applied	Emission Potential (%)	Estimated VOC emissions
AGNIQUE® MMF	5.75	3	324.94	7.3	23.72
ALTOSID® Pellets	18.0289	56	1210.77	2.82	34.14
ALTOSID® SBG	198.765	55	9616	3.7	355.79
ALTOSID® XR Briquets	4.202	2088	169.7734	5.18	8.79
ANVIL® 10+10	48520	913	865.65	5.71	49.43
AQUAHALT™	149949	11	879.7856	4.8	42.23
DIMILIN® 25W	9	6	1.76565	1.85	0.03
DRAGNET®	384.79	1409	380.90	100	380.90
DUET™	95763	663	465.29	5.71	26.57
FYFANON®	7257.3	77	799.69	7.3	58.38
GB-1111	411.253	764	15168.57	3.47	526.35
PYRENONE® 25-5	9.19	11	0.73	7.3	0.05
PYROCIDE®	49285.74	1473	2163.22	23.7	512.68
TRUMPET®	190011	18	12514.22	31.62	3,957.00
VECTOBAC® 12AS	131735	1658	55708.58	5.71	3,180.96
VECTOLEX® CG	0.15	16	2.8125	3.7	0.10
VECTOMAX® CG	3	3	30	3.7	1.11
VECTOBAC® WDG	0.5	1	0.75	3.7	0.03
				Total lbs VOCs 2009	**9,158.28**
				lbs per day	**25.09**
				Tons per day	**0.013**

Table 4-12. Estimated VOC emissions from mosquito insecticide application, 2010.

Product	Acres treated	No. applications	lbs Product applied	Emission Potential (%)	Estimated VOC emissions (lbs)
AGNIQUE® MMF	161.5103	156	1199.76	7.3	87.58
AGNIQUE® MMFG	144.225	102	2809	7.3	205.06
ALTOSID® Pellets	404.81	84	3231.438	2.82	91.13
ALTOSID® SBG	1209.18	29	9711.999	3.7	359.34
ALTOSID® XR Briquets	4.31	2365	175.1913	5.18	9.07
ALTOSID® XRG	37.67	10	369.9375	3.7	13.69
ANVIL® 2+2	242	3	12.42	7.3	0.91
ANVIL® 10+10	191391.3	3447	6768.90	5.71	386.50
AQUAHALT™	109156	8	172.85	4.8	258.71
BIOMIST® 4+4	24323	185	1782.50	4.88	86.99
DIMILIN® 25W	19.6	11	3.906	1.85	0.07
DRAGNET®	342.28	1229	322.27	100	322.27
DUET™	18392.5	117	639.57	5.71	36.52
DURSBAN® 2 CG	4.2	8	21	3.7	0.78
FYFANON®	1201	11	178.29	7.3	13.02
GB-1111	87.0068	326	3220.05	3.47	111.74
PYRENONE® 25-5	3.74	4	0.15	7.3	0.01
PYROCIDE®	472.63	522	19.78	23.7	4.69
TRUMPET®	55939	7	2545.13	31.62	804.77
VECTOBAC® 12 AS	126112	1610	41236.24	5.71	2,354.59
VECTOBAC® G	260.31	22	1888	3.7	69.86
VECTOLEX® CG	1.021	76	18.09375	3.7	0.67
VECTOMAX® CG	2	2	22	3.7	0.81
ZENIVEX® E20	174	2	0.45313	No data	No data
				Total lbs VOCs 2010	**5,218.77**
				lbs per day	**14.30**
				Tons per day	**0.01**

4.3.3.3 Odors and Sensitive Receptors

As treatment with insecticides in vector control are temporary events and the product used varies over time and space, any noxious odors that may result are transient in nature and will not affect large numbers of people.

Assessment of the likelihood that sensitive receptors are exposed to significant air pollutants by the vector control program involved consideration of the timing and location of applications as well as properties of the chemicals. Mosquito adulticides are applied at ULV concentrations near the ground or aerially over more rural areas of the District (predominantly irrigated pasture, rice lands and wetlands) and away from most hospitals and schools in the two counties (Figure 4-1, Figure 4-2, Figure 4-3). The adulticides are applied at times when mosquitoes are most active, i.e., from dusk to dawn; these times reduce the likelihood that sensitive receptors such as small children or the infirm are outside to be exposed to sprays. Furthermore, research has shown that there are very few detectable air concentrations of adulticide sprays one hour after application and no detectable concentrations between one and 12 hours, suggesting that the adulticides measured either fell rapidly to the ground or degraded quickly under environmental conditions (Schleier III and Peterson 2010a).

In summary, the SYMVCD's programs are not found to conflict with or obstruct implementation of an applicable air quality plan, violate any air quality standard or contribute substantially to an existing or projected air quality violation, result in a cumulatively considerable net increase of any criteria pollutant for which the project region is nonattainment, expose sensitive receptors to substantial pollutant concentrations or create objectionable odors affecting a substantial number of people.

The results of the above analysis indicate the effects of the SYMVCD's program on air quality are less than significant under CEQA.

4.3.4 MITIGATIONS

No significant adverse impacts have been identified with continued compliance with local air quality regulations; no mitigations related to air quality are warranted.

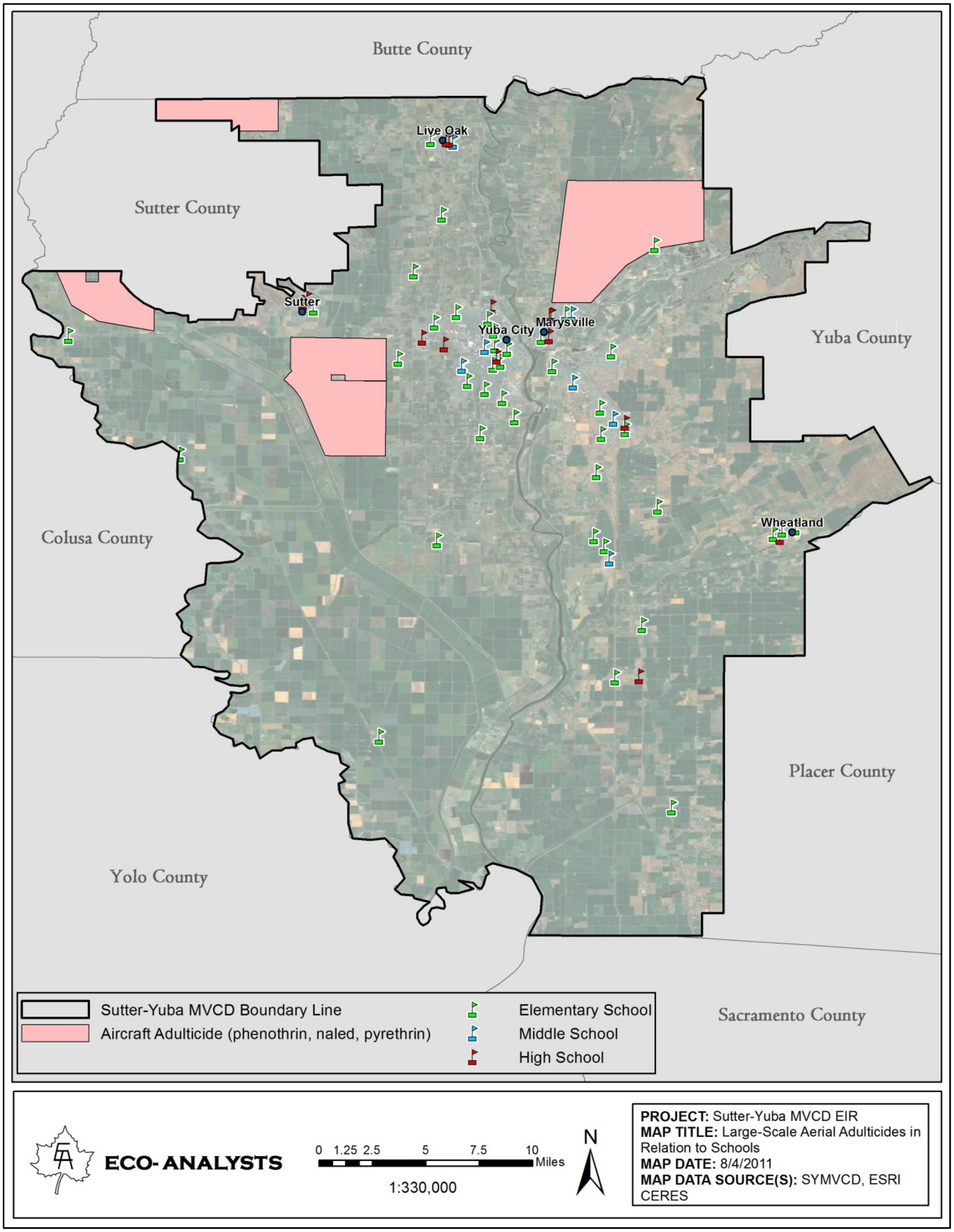

Figure 4-1. Location of sensitive receptors (schools and hospitals) in relation to SYMVCD treatment areas for large-scale aerial adulticides.

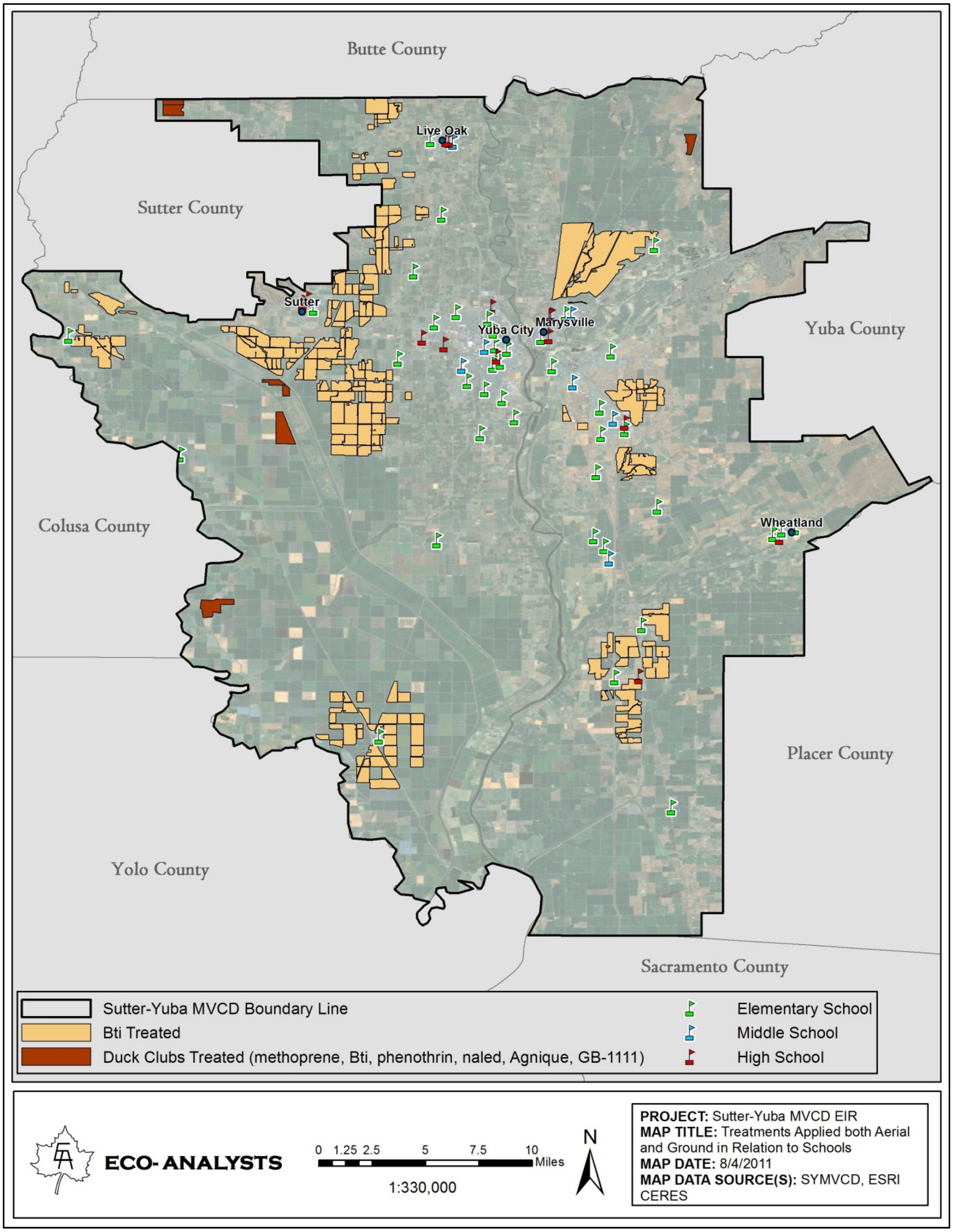

Figure 4-2. Location of sensitive receptors (schools and hospitals) in relation to SYMVCD treatment areas for adulticides and larvicides applied from the ground and by air.

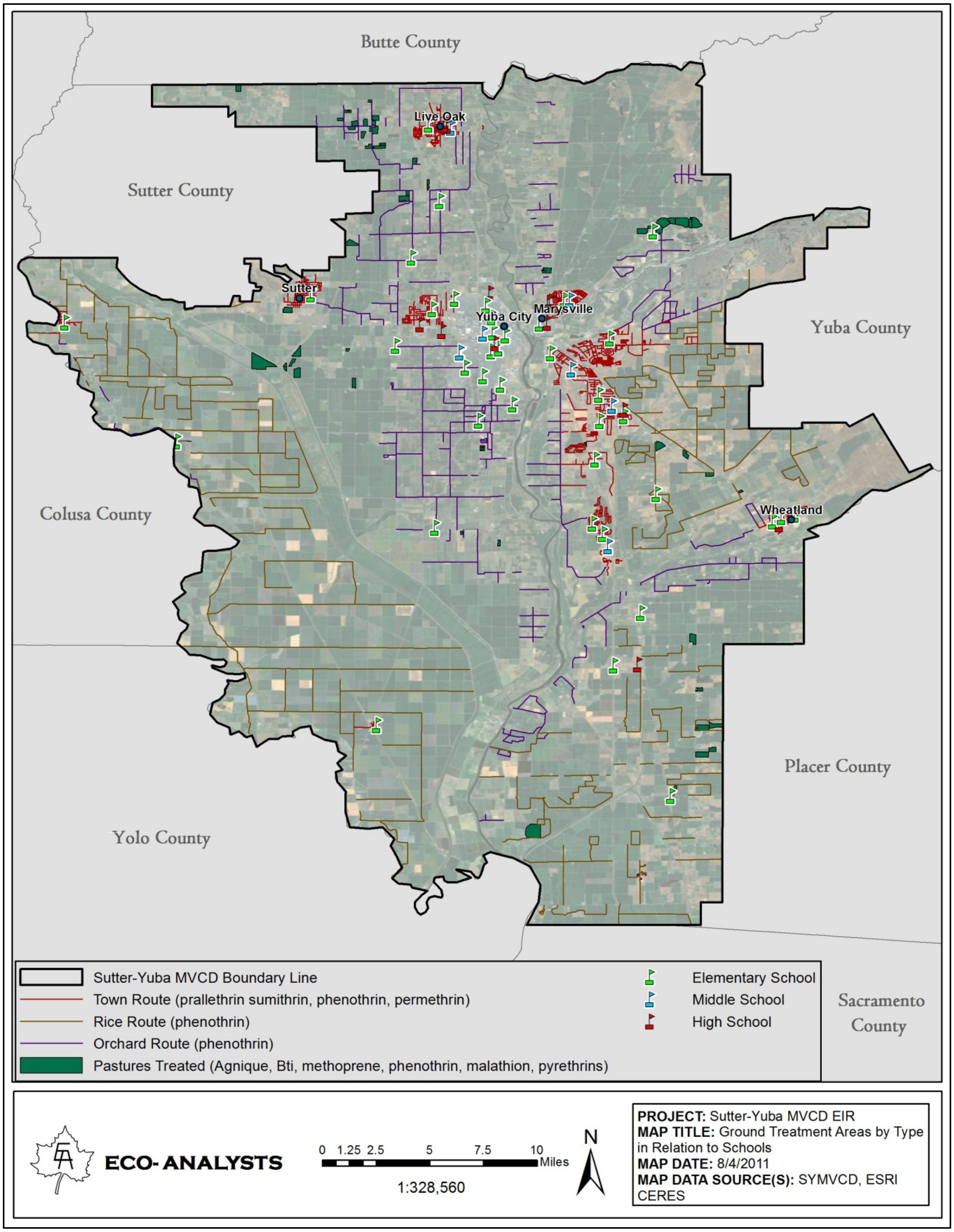

Figure 4-3. Location of sensitive receptors (schools and hospitals) in relation to SYMVCD treatment routes for mosquito larvicides and adulticides applied from the ground.

4.4 GREENHOUSE GASES AND CLIMATE CHANGE

4.4.1 REGULATORY SETTING

In 2007, the State of California added Section 21083.05 to the Public Resources Code, which calls for assessment of projects and their possible contribution to greenhouse gases and global warming. The Global Warming Solutions Act of 2006 (AB 32) requires CARB to determine the statewide level of greenhouse gas emissions in 1990 and set that as a limit to be achieved by 2020. The Climate Change Scoping Plan (CARB 2008) identifies broad policies and a wide array of tools aimed at meeting the requirements of AB 32. On September 23, 2010, CARB adopted GHG emissions targets for 2020 and 2035; for the Sacramento region, the targets are a 7% reduction by 2020 and 16% reduction by 2035. While GHG emissions targets have been set and broad policies to achieve them identified, specific guidance for determining significance in impact analyses and achieving mitigation is still lacking or under development by individual Air Districts. The California Air Pollution Control Officers Association (CAPCOA) has recommended various alternatives for evaluating the contribution of various types of CEQA projects to GHG emissions when Air District thresholds are lacking (CAPCOA 2008).

4.4.1.1 The California Environmental Quality Act - Significance Thresholds

A project would be considered to have a significant adverse impact on GHG emissions if it would:

a) Generate GHG emissions, either directly or indirectly, that may have a significant impact on the environment;

b) Conflict with an applicable plan, policy or regulation adopted for the purpose of reducing the emissions of GHG.

4.4.2 METHODOLOGY

A standard URBEMIS v. 9.2 model was used to generate CO_2 emissions per year from on-road vehicle use by the District.

4.4.3 IMPACT ANALYSIS

Based on the URBEMIS model run for the air quality analysis for this EIR, on-road vehicle use was predicted to generate approximately 238.13 tons of CO_2 emissions per year at an estimated 204 vehicle trips per day for a fleet of 34 light-duty trucks. Quantitative significance thresholds that can be applied to CEQA analysis of GHG emissions do not currently exist for projects falling under the jurisdiction of FRAQMD. CAPCOA (2008) has proposed several threshold options that can be used in CEQA analysis of GHG production by projects. The GHG emissions of SYMVCD were evaluated in terms of the efficiency-based threshold option proposed by CAPCOA. At an approximate combined population of 166,892 persons (US Census Bureau 2010) served by this agency, the efficiency of this program can be considered high. As the program has been ongoing and has no plans to increase fleet size significantly, there should not be an appreciable net increase in GHG emissions generated by the program. The District is limited in its ability to reduce vehicle and air miles traveled as part of vector control operations, but the integrated vector management model seeks to reduce the need for insecticide application to control vectors and thus over the long-term should reduce air quality emissions related to use and application of insecticides.

4.4.4 *MITIGATIONS*

No mitigations related to Greenhouse Gases are warranted based on the prediction of no net increase in GHG emissions, high efficiency of the program and compliance with FRAQMD's measures to reduce air pollutants and greenhouse gases.

4.5 BIOLOGICAL RESOURCES

The following section assesses the potential ecological impact of the District's programs on a range of biological species, including rare and endangered species, through a review of the literature on this topic and assessment of the conformity of District policies and practices with pertinent regulations.

4.5.1 *REGULATORY SETTING*

4.5.1.1 US Endangered Species Act

The US Endangered Species Act of 1973 (7 USC § 136, 16 USC § 1531 et seq.), a comprehensive law designed to protect plant and animal species from extinction, requires federal agencies to ensure actions they carry out, fund or authorize do not jeopardize species listed by the federal government as threatened or endangered or adversely modify habitat critical to their survival. Section 9 of the Endangered Species Act also makes it unlawful for any person or private or public entity to "take" any individual of a species that is listed under the law as endangered or threatened. According to the Act, to "take" means to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct." The word "harm" has been further defined in federal regulations as any act that "actually kills or injures fish or wildlife." Such an act may include "significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavior patterns, including breeding, spawning, rearing, migrating, feeding or sheltering" (50 CFR 222.102). While the taking prohibition does not apply to plants, it is illegal under the Act to remove an endangered plant from federal land; the Act also federalizes state laws prohibiting the taking of plants. Some take of listed species is allowed with a federal permit if it is determined not to jeopardize the species and is incidental to otherwise lawful activity requiring a federal permit. The law is administered and enforced by the Department of the Interior (USFWS) and Department of Commerce (National Oceanic and Atmospheric Association through the NMFS).

4.5.1.2 The California Endangered Species Act

The California Endangered Species Act (Cal FGC § 2050-2069), established in 1984 and administered by the California Department of Fish and Game, also prohibits the "take" of listed species. A "take" is defined in the law as to "hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture or kill." While the state law lacks the "harm" provision of the federal law and allows for take incidental to other projects, it also prohibits the taking of species that are being petitioned for listing. The state law applies to both plants and animals and emphasizes early consultation to avoid negative impacts on listed species (CDFG 2010).

4.5.1.3 Pesticide Regulation and the Endangered Species Acts

As a federal agency, the USEPA is legally required by Section 7 of the US Endangered Species Act to ensure that its actions do not jeopardize threatened or endangered species or adversely modify their designated critical habitat. USEPA considers effects on non-target and endangered species in its analysis of pesticides during the pesticide registration and re-registration review processes and includes information relevant to these species when it is available in its registration eligibility decisions for pesticides. If the USEPA finds through these reviews that a pesticide "may affect" a listed species or its critical habitat, the agency must consult with the USFWS, or NMFS in the case of marine species and anadromous fish (i.e., fish that migrate from oceans to freshwater). After review of all pertinent information during the formal consultation process, USFWS or NMFS will produce a biological opinion that details how jeopardy to listed species can be avoided. Pesticide use requirements may be modified or restricted based on information from biological opinions. Since 1998, the USEPA has maintained the Endangered Species Protection Program, an effort that geographically restricts application of certain pesticides within the critical habitat of certain threatened and endangered species. As part of this program, the USEPA maintains an internet bulletin system, "Bulletins Live!" (http://www.epa.gov/espp/bulletins.htm), with which users may access pesticide use limitations by county up to six months prior to the date of pesticide application. The bulletins have constituted enforceable use limitations under FIFRA when referenced on pesticide label since November 2005 when USEPA published the final notice for the Program.

The CDPR is the state agency within California that has the authority to refuse, revoke or suspend the license of any pesticide that harms or is likely to harm endangered species. CDPR has drafted the California State Plan for Protection of Endangered Species from Pesticide Exposure (CDPR 1995) to protect threatened and endangered species in California from effects of pesticides. Pesticide risks to endangered species within California are evaluated by an interagency network that includes CDPR, the CDFG Pesticide Investigation Unit, CDFA, the Pesticide Registration and Evaluation Committee, and the County Agricultural Commissioners as well as the USEPA and USFWS. Under the State Plan, protection strategies and local plans that resolve pesticide use conflicts are developed using information on pesticide use distribution, endangered species distributions and life history information, and USFWS biological opinions relating to pesticide use effects on endangered species. The State Plan is implemented through the USEPA County Bulletins (Bulletins Live!) that incorporate the local plans as needed. Interim Measures Bulletins for California counties are listed under the Endangered Species Project of the CDPR website (http://www.cdpr.ca.gov/docs/endspec/index.htm) and also provide information on pesticide use limitations via the Pesticide Regulation's Endangered Species Custom Realtime Internet Bulletin Engine (PRESCRIBE). The PRESCRIBE database is also accessible through CDPR's California Pesticide Information Portal (CALPIP) available at http://calpip.cdpr.ca.gov. Pesticide use limitations implement limitations specified in USFWS biological opinions, limitations determined by USEPA to preclude a "may affect" determination for pesticide effects on listed species, and limitations developed within local plans as alternatives to USEPA and USFWS use limitations (CDPR 1995).

Pesticide use limitations have been developed by CDPR to protect two endangered, four threatened and 11 rare species within Sutter County and two endangered, seven threatened and 15 rare species in Yuba County. Use limitations apply on Township, Range and Section basis and vary with chemical product and active ingredient. For example, limitations may require buffers for chemical application, additional drift precautions be observed or that use of the chemical be prohibited within occupied habitat of listed species.

In addition, temporary pesticide buffer zones may exist as a result of court injunctions. For example, no-spray zones (20 yards for ground application and 100 yards for aerial application) adjacent to streams, rivers, other water bodies known to support 23 subgroups of listed salmon species were established in a 2004 injunctive order by the Western US District Court in Washington. This citizen suit filed against the USEPA by a group of environmental organizations (*Washington Toxics Coalition et al. v. USEPA*) alleged that the USEPA violated the US Endangered Species Act by failing to consult with the NMFS when it registered 54 different pesticide active ingredients under FIFRA. No-spray buffers of 20 yards for ground application and 100 yards for aerial application have been ordered in California, Oregon, and Washington until analysis of each active ingredient has been concluded under consultation with NMFS. General exceptions to the injunctive buffer are provided for certain specific uses such as public health vector control programs administered by a public entity. These injunctive buffers are not enforceable under FIFRA but remain voluntary. The injunctive buffers and the exemptions to them are superseded by the final effects determinations for each active ingredient, which may impose changes to label requirements. Any such requirements become enforceable under FIFRA at the time they are implemented by the pesticide manufacturers and registrants.

4.5.1.4 The California Environmental Quality Act - Significance Thresholds

CEQA requires lead agencies to examine the impact of projects or programs on the biological environment and has established the following thresholds of significance for assessing impacts on biological resources. Under CEQA, a project would be considered to have a significant adverse biological impact if it would:

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 US Fish and Wildlife Service;

b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations or by the California Department of Fish and Game or US Fish and Wildlife Service;

c) Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means;

d) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites;

e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance; or

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.

4.5.2 *Methodology*

To assess the ecological impacts of the District's vector control program, we considered aspects of the District's program in relation to the CEQA significance thresholds for biological resources. The aspects of the program evaluated include the use of individual mosquito adulticides and larvicides, stocking water bodies with mosquitofish as a biological control method for mosquitoes, and source reduction, specifically clearing emergent vegetation. While the District does not perform any vegetation clearing itself, it may advise landowners to remove emergent vegetation to reduce mosquito production in certain areas or to limit growth through improved irrigation and/or drainage.

The effect of each program component was assessed for potential adverse impacts on a list of state or federally endangered and threatened species and species of special of concern generated for Sutter and Yuba Counties from the CNDDB using Rarefind (version 3.1.1), as well as sensitive habitats and federally protected wetlands. We also researched potential adverse impacts of District practices on keystone species such as pollinators.

The following information aided the evaluation, particularly with respect to impacts of individual pesticides:

- acute and chronic toxicity data for broad classes of organisms available primarily from USEPA registration data but also summary data from pesticide databases such as EXTOXNET and the PAN Pesticides Database;
- a literature review of risk assessments of various mosquito control techniques and scientific field studies published in scholarly journals;
- conclusions of biological opinions/effects determinations made by the USFWS and NMFS regarding the impact of pesticides or other relevant District practices on federally threatened and endangered wildlife and plants;
- information from endangered and threatened species recovery plans or other literature indicating potential for adverse impacts from a program component on species or important components of their habitat;

- distribution of species' occurrences and habitats, including federally designated critical habitat, within District boundaries in relation to District treatment maps;
- life history information for each listed species that would indicate greater potential for pesticide exposure or sensitivity, sensitivity to mosquitofish, and/or susceptibility to vegetation removal;
- Rates of application of each insecticide and application practices of the District for each insecticide, as well as specifics of mosquitofish stocking.

If we determined from this information that there was potential for adverse impacts from any of the District's program components, we reviewed whether mitigations imposed by regulatory agencies, BMPs adopted by the District, or regulatory review or agreements are presently in place that would reduce the adverse impact to a less than significant level under CEQA. If none was available or existing mitigations were insufficient to reduce potential impacts to less than significant levels, we proposed new mitigations to reduce the significance of the impacts.

4.5.3 *Impact Analysis*

4.5.3.1 *Review of Pesticide Literature*

Background

The literature consulted used a variety of methods to assess potential impacts of different pesticides on non-target species, including laboratory assays, risk assessment models and field studies. Studies that apply high doses of pesticides to mammals, fish, birds and sometimes invertebrates in laboratory settings are used to evaluate acute (i.e., single dose) and chronic (i.e., multiple doses over a period of time) toxicity of pesticides to major groups of organisms. Such studies are also used to test for a wide array of harmful effects of a pesticide, such as low birth-weight, fetal abortion, endocrine disorders, chromosomal abnormalities and cancers, on the subject species. Results of the laboratory studies are used by USEPA along with other information on pesticide effects in risk assessments to evaluate risk to groups of wild animals compared to regulatory levels of concern (Table 4-13) for major classes of organisms. These laboratory studies point to the potential for environmental harm from pesticides, but the value of generalizing from this research to vector control programs is limited by the difference between the laboratory setting and the field setting in which concentrations of chemicals and the exposure of wild species to them are radically different.

Two types of analysis attempt to estimate the effects of pesticides on non-target organisms in a field setting: risk assessment and natural or experimental field studies. Risk assessment is a method of analysis that combines information about known toxicities (dose-response relationships) of substances to specific species with information on exposure pathways (e.g., ingestion, inhalation and grooming) to estimate potential levels of exposure and characterize the overall risk of a given pesticide application on the species. Risk assessment often uses risk quotients (RQ) to characterize this risk. RQs are derived by dividing an estimated environmental concentration or actual environmental concentration by an estimated toxicity endpoint, such as an LC_{50} (the concentration that is lethal to 50% of subjects) or the "no-observed-effect" concentration. The ratios produced are then compared to regulatory levels of concern to quantify the level of risk posed by the pesticide to various groups of organisms.

The strength of risk assessment is its attempt to predict the potential effects of pesticides on species in the natural setting. One weakness is that toxicity endpoints are derived using exposure methods different from those experienced in the field. For example, one method used to calculate an LC_{50} for invertebrates is to place organisms in a test tube coated with known quantities of the potential toxic substance. Thus, the estimated exposure is often greater than the actual exposure an organism would experience in the natural environment and tends to overestimate risk, as demonstrated for invertebrates in a risk assessment performed for a mosquito control scenario using ground ULV spraying of pesticides by Schleier III and Peterson (2010b). A second line of research uses natural or experimental field studies in which the mortality of organisms exposed to actual spray events are observed and compared to control groups that are not sprayed. These studies more closely approximate the conditions under which species are exposed in natural settings. However, field experiment settings can also diverge from natural conditions when study subjects are placed in cages that restrict their movements for subsequent observation. Surrogate species are often used to develop toxicity endpoints and tested in the field experiments to avoid harm to rare or protected species; however, the sensitivity of the surrogate species compared to the protected species is usually unknown and may not accurately represent the sensitivity of the species of interest (Sappington et al. 2001, Dwyer et al. 2004). Despite these shortcomings, these methods remain the best available means to assess the impacts of potentially toxic chemicals on wild organisms.

Table 4-13. USEPA risk quotient levels of concern. Source: USEPA 2008b.

Levels of Concern	Wild Mammals	Birds	Aquatic animals	Terrestrial , Semi-Aquatic and Aquatic Plants
Acute risk (Non-endangered species)	0.5	0.5	0.5	1.0
Acute risk (restricted use pesticide)	0.2	0.2	0.1	---
Acute risk (endangered species)	0.1	0.1	0.05	1.0
Chronic	1.0	1.0	1.0	---

Laboratory Studies- Toxicity Data

Acute toxicity information and USEPA toxicity category level gathered from USEPA registration eligibility decisions for each pesticide used by the District in 2009 or 2010 showed that the majority of mosquito adulticides and larvicides used by the District are non-toxic or relatively non-toxic on an acute basis to mammals and birds (Table 4-14, Table 4-15, Table 4-16), the organophosphate adulticides being the exception. The chemicals used by the District vary in their acute toxicity to other classes of organisms, i.e., fish, invertebrates, bees and marine organisms (Table 4-14, Table 4-15, Table 4-16), with the bacterial larvicides having the lowest acute toxicity for all groups (Table 4-15).

Toxicity testing is conducted on amphibians less often than on other taxa despite the fact that amphibians as a group have experienced global declines in recent decades (Sparling et al. 2000). Fish have historically served as surrogates for this group in USEPA toxicity testing; thus, toxicity information for amphibians is lacking from the tables on acute toxicity. Amphibians are generally considered more sensitive to pesticides than other taxa because of their permeable skins and aquatic life stages. Widespread presence of pesticides in the environment and drift of pesticides from agricultural areas are thought to be contributing factors to amphibian declines in California (Davidson et al. 2002, Davidson and Knapp 2007, Sparling et al. 2001). Recent research suggests that combinations of low concentrations of chemicals in the environment (largely from agricultural and landscape use) pose greater threats to amphibians than the individual chemicals in isolation (Hayes et al. 2006) and may have synergistic or interactive adverse impacts when coupled with other environmental stressors such as presence of predators (Relyea 2004, Sih et al. 2004). Most literature on pesticide toxicity to amphibians, however, has examined herbicides and other chemicals that are not typically used in vector control applications and has not specifically examined ULV public health pesticide applications.

Risk Assessments

Risk assessments of mosquito insecticide applications have not predicted the effects observed in laboratory studies because the exposure of wildlife to the pesticides at the ULV concentrations used in mosquito control is much lower than direct exposure in the lab. In a risk assessment examining the potential effect of six mosquito adulticides (d–phenothrin, resmethrin and permethrin, pyrethrins, malathion and naled) on small mammals (shrews, mice, voles and rats), birds (quail, mallard duck and pheasant), fish (bluegill sunfish and rainbow trout) and one amphipod (*Daphnia magna*), the RQs associated with both acute and chronic (10 day) pesticide applications were below USEPA LOCs for all species except for amphipods exposed to organophosphates (Davis et al. 2007). A similar risk assessment of six pesticides (phenothrin, resmethrin and permethrin, pyrethrin, malathion and naled) on horses also showed RQs below LOCs (Schleier III et al. 2008a).

Field Studies - Effects on Vertebrates

Relatively few field studies have examined effects of mosquito control treatments on vertebrates. A field study of the effects of the larvicide GB-1111 on mallard ducklings in Alameda County, California, found no difference in mass changes in the control and treatment ducks, though some oiling of feathers by the pesticide was observed (Miles et al. 2002). Jensen, Lawler and Dritz's (1999) field study of ULV applications of pyrethrin, malathion and permethrin on mosquitofish found that pyrethrin and permethrin were not detected in water samples (detection limit = 0.02 ppm) and none of the sentinel mosquitofish died, likely because of the low concentration of the pesticide used.

Table 4-14. Acute toxicity of mosquito larvicide chemicals used by SYMVCD in 2010 to wildlife. Source: USEPA Registration Eligibility Decisions and others.*

				Acute Toxicity					
Product Name	**Active Ingredient**	**oral LD_{50}**	**USEPA Toxicity Class**	**Mammals**	**Birds**	**Freshwater Fish**	**Freshwater invertebrates**	**Bees**	**Marine Organisms**
AGNIQUE® MMF	alcohol ethoxylated surfactant	> 2,000 mg/kg	III	practically non-toxic	practically non-toxic	practically non-toxic	practically non-toxic	virtually non-toxic	practically non-toxic
AGNIQUE® MMF G	alcohol ethoxylated surfactant	> 5,000 mg/kg	III	practically non-toxic	practically non-toxic	practically non-toxic	practically non-toxic	virtually non-toxic	practically non-toxic
ALTOSID® PELLETS	s-methoprene	> 34,000 mg/kg (rat)	IV	non-toxic	practically non-toxic	moderately toxic (warm water) slightly toxic (cold water)	very highly toxic	non-toxic	slightly toxic to very highly toxic
ALTOSID® SBG	s-methoprene	> 34,000 mg/kg(rat)	IV	non-toxic	practically non-toxic	moderately toxic (warm water) slightly toxic (cold water)	very highly toxic	non-toxic	slightly toxic to very highly toxic
ALTOSID® XR BRIQUETS	s-methoprene	> 34,000 mg/kg (rat)	IV	non-toxic	practically non-toxic	moderately toxic (warm water) slightly toxic (cold water)	very highly toxic	non-toxic	slightly toxic to very highly toxic
ALTOSID® XR-G	s-methoprene	> 34,000mg/kg(rat)	IV	non-toxic	practically non-toxic	moderately toxic (warm water) slightly toxic (cold water)	very highly toxic	non-toxic	slightly toxic to very highly toxic
DIMILIN® 25W	diflubenzuron	> 40 g/kg(rat)	III	slightly toxic	practically non-toxic	practically non-toxic	very highly toxic	non-toxic	very highly toxic
DURSBAN° 2 COATED GRANULES	chlorpyrifos	82 mg/kg(rat)	II	moderately toxic	very highly toxic	moderate to highly toxic	very highly toxic	highly toxic	very highly toxic
GOLDEN BEAR-1111	petroleum distillate oil	> 28,000 mg/kg (rat) [1]	III	non-toxic	non-toxic	non-toxic	variable toxicity	non-toxic	toxic

*Csondes 2004; Stark 2005; Toxnet 2003; USEPA 1997, 2001, 2002, 2007b.

Table 4-15. Acute toxicity of bacterial larvicides used by SYMVCD in 2010 to wildlife. Source: USEPA Registration Eligibility Decisions and others.*

				Acute Toxicity					
Product Name	**Active Ingredient**	**oral LD_{50}**	**USEPA Toxicity Class**	**Mammals**	**Birds**	**Freshwater Fish**	**Freshwater invertebrates**	**Bees**	**Marine Organisms**
VECTOBAC® WDG	*Bacillus thuringiensis israelensis*	> 5,000 mg/kg (rat)	IV	non-toxic	practically non-toxic	practically nontoxic	moderately toxic	minimal toxicity	practically nontoxic
VECTOBAC® G	*Bacillus thuringiensis israelensis*	> 5,000 mg/kg (rat)	IV	non-toxic	practically non-toxic	practically nontoxic	moderately toxic	minimal toxicity	practically nontoxic
VECTOLEX® CG	*Bacillus sphaericus*	> 5,000 mg/kg (rat)	IV	slightly toxic	*	*	*	*	*
VECTOMAX® CG	*Bacillus sphaericus, Bacillus thuringiensis israelensis*	> 5,000 mg/kg (rat)	IV	slightly toxic	*	*	*	*	*
Natular™ G30	spinosad	> 5,000 mg/kg (rat)	IV	*	*	*	*	highly toxic[1]	*
Natular™ XRT	spinosad	> 5,000 mg/kg (rat)	IV	*	*	*	*	highly toxic[1]	*

** Kollman 2002; Pan Pesticide Database – *Bacillus sphaericus*; USEPA 1998a, 1998b; * Registered as "reduced risk" pesticide. Specific toxicity data not available but assumed to be comparable to VectoBac. [1] Morandin et al. 2005. Spinosad has been shown to be highly toxic to bees on contact with wet formulations but presents much less risk when dry.

Table 4-16. Acute toxicity of mosquito adulticides used by SYMVCD in 2010 to wildlife. Source: USEPA Registration Eligibility Decisions and others.*

Product Name	Active Ingredient	oral LD_{50}	USEPA Toxicity Class	Acute Toxicity					
				Mammals	Birds	Freshwater Fish	Freshwater invertebrates	Bees	Marine Organisms
ANVIL® 2+2	phenothrin, piperonyl butoxide	> 5,000 mg/kg(rat)	IV	non-toxic	practically non-toxic	highly toxic	very highly toxic	highly toxic	highly toxic
ANVIL® 10+10	phenothrin, piperonyl butoxide	> 5,000 mg/kg(rat)	IV	non-toxic	practically non-toxic	highly toxic	very highly toxic	highly toxic	highly toxic
AQUAHALT™	pyrethrins piperonyl butoxide	500-5,000 mg/kg(rat)	III	practically non-toxic	practically non-toxic	highly toxic	highly toxic	highly toxic	highly toxic
BIOMIST® 4+4	permethrin piperonyl butoxide	> 5,000 mg/kg	III	practically non-toxic	practically non-toxic	highly toxic	highly toxic	highly toxic	highly toxic
PBO *synergist in certain formulations	piperonyl butoxide	4,570 mg/kg (male rat)	III	practically nontoxic	practically nontoxic	moderately toxic	moderately toxic to highly toxic	practically nontoxic	moderately toxic
DRAGNET®	permethrin	3580 mg/kg(rat)	III	practically non toxic	practically nontoxic	highly toxic	highly toxic	highly toxic	highly toxic
DUET™	sumithrin® (phenothrin, piperonyl butoxide) prallethrin	> 5,000 mg/kg(rat)	III	non-toxic	practically non-toxic	highly toxic	very highly toxic	highly toxic	highly toxic
FYFANON®	malathion	~ 5,500 mg/kg(rat)	III	slightly toxic	moderately toxic	moderate to very highly toxic	highly toxic	highly toxic	highly toxic (benthic)
PYRENONE® 25-5	pyrethrins piperonyl butoxide	> 5,000 mg/kg	III	low in toxicity	practically nontoxic	acutely toxic	highly toxic	highly toxic	highly toxic
PYROCIDE® MOSQUITO ADULTICIDE	pyrethrins piperonyl butoxide	> 3,000 mg/kg(rat)	III	low in toxicity	practically nontoxic	acutely toxic	highly toxic	highly toxic	highly toxic
TRUMPET®	naled	235 mg/kg(rat)	I	moderately toxic	moderately to highly toxic	moderately to very highly toxic	very highly toxic	highly toxic	highly toxic
ZENIVEX®	etofenprox	> 5,000 mg/kg rat	IV	low toxicity	low toxicity	high toxicity	high toxicity	highly toxic	slightly toxic

*USEPA 2006a,2006b, 2006c, 2006d, 2007a, 2008a;Clarke 2008 (MSDS Duet); Pan Pesticide Database-etofenprox.

A French study of House Martins (*Delichon urhicum*) in areas treated with the microbial agent, Bti, versus control areas found that martins consumed significantly fewer Nematocera (midges), Araneae (jumping spiders) and Odonata (dragonflies/damselflies) and more Hymenoptera (flying ants) and experienced lower clutch sizes and fledging rates in treated areas versus controls (Poulin et al. 2010). The authors of this study attributed the lower success of House Martins breeding at treated sites to lower food availability during breeding periods as a result of a decline in the number of invertebrates sensitive to Bti. In contrast, Hanowski et al. (2007) did not find evidence of an effect on reproduction, growth or foraging behavior of Red-winged Blackbirds (*Agelaius phoeniceus*) nesting in wetlands treated with Bti and methoprene in Minnesota.

Effects on Invertebrates and Invertebrate Communities

The bulk of field research on effects of mosquito control has examined invertebrates or invertebrate communities. The results of studies testing the effect of actual mosquito control treatments in the field on caged surrogate terrestrial and aquatic invertebrates or indicator species have varied with some showing reductions of small-bodied terrestrial invertebrates (Boyce et al. 2007) or reductions in certain families of insects (primarily Dipterans in the family Chironomidae) within wetlands treated with methoprene and Bti (Hershey et al. 1998), while a number of others have found no difference in terrestrial or aquatic invertebrates between treated plots and untreated controls or showed only short-term effects on invertebrate populations from mosquito pesticides. For example, Davis and Peterson (2008) examined the impact of several common mosquito pesticides (permethrin and d–phenothrin with PBO, Bti and methoprene) at the level of families, orders and functional guilds. A test using a single, ULV spraying found no treatment effect on amphipods (*Gammarus spp.*), water boatmen (Hemiptera), beetles (Coleoptera: Dytiscidae), flies (Diptera: Chironomidae and Culicidae) and dragonflies and damselflies (Odonata). In addition, no treatment effect was found for the benthic sample that included amphipods, beetles, and non-biting midge larvae (Diptera: Chironomidae). Studies of Bti effects on wetlands in Sweden (Lundström et al. 2010a, 2010b; Persson Vinnersten et al. 2010) found no long-term differences in Chironomid species richness or production between wetlands treated with Bti and untreated controls. Lawler et al. (2000) found no difference in control groups of water boatmen and those exposed to Bti, methoprene and sustained-release methoprene in ponded areas and a pothole near salt marshes. Water boatmen from treatment and control groups also maintained similar sex ratios and similar proportions of females carried eggs in their bodies. Similarly, Miles et al. (2002) examined the impact of the larvicide, GB-1111, on water boatmen placed in cages in a salt marsh. Counts of water boatmen (*Trichocorixa reticulata*) on two pre- and seven post-spraying days revealed that nearly all water boatmen in treatment areas died in the first three days following spraying; however, populations rebounded quickly and no differences were found in water boatmen numbers between control and treatment areas 3-15 days or 15-22 days after spraying.

Lawler et al. (2008) studied the effect of applications of PBO-synergized pyrethrin on the survival of the zooplankton, *Daphnia magna,* and the aquatic mayfly, *Callibaetis californicus*. Using mesocosms to simulate a natural setting, they found two ULV applications of synergized pyrethrin by the Colusa Mosquito Abatement District produced no differences in mortality of control and treatment groups for these two species. Jensen et al. (1999) studied the impact of the application of pyrethrin, malathion and permethrin on a range of wetland macroinvertebrates, including beetles (Dystiscidae and Hydrophilidae), snails (Gastropoda), water boatmen (Corixidae), midges (Chronomidae), damselfly and dragonfly nymphs (Odonata) and mayfly nymphs (Ephemeroptera) and found that flying insect abundance decreased on the night of spraying but rebounded within 24 hours.

Lawler et al. (1999a) studied the effect of Bti, methoprene and temephos on non-target populations of amphipods (Talitridae) and flying insects in Florida mangrove marshes and found no treatment effect on non-target species. Boyce et al. (2007) studied the impact of pyrethrin synergized with PBO on several non-target arthropod species, including dragonflies (*Sympetrum corruptum*), yellow garden spiders (*Argiope aurantia*), alfalfa butterflies (*Colias eurytheme*) and honeybees (*Apis mellifera*). While mortality of sentinel mosquitoes varied between 10 and 100%, no statistically significant difference was found in the survival of caged butterflies or honeybees between treatment and control areas, and there was 100% survival of dragonflies and spiders.

Few studies have attempted to examine the effect of interactions among pesticides within the environment, but at least one study suggests they may occur. Weston et al. (2006) used water and sediment samples from rivers near Sacramento following the application of a 60% PBO and 6% pyrethrin mix by planes over the city in response to a 2005 West Nile virus outbreak. While these authors found no evidence of pyrethrins in the water column 10 hours after spraying, sediment concentrations of pyrethrins increased significantly in the same period. It was not known if these levels of pyrethrins were toxic to the amphipod, *Hyalella azteca*, but the interaction of PBO with sediments in laboratory settings was found to synergize already present bifenthrin to levels toxic to this species. However, the laboratory setting used 10-day exposure to sediments that may not accurately approximate the length of exposure in creeks after spraying.

In summary, most studies investigating the impact of pesticide use for mosquito control have concluded that the use of these pesticides in integrated vector management represents minimal threat to non-endangered species because of lack of bioaccumulation and limited persistence of the chemicals in the environment and the absence of scientific evidence demonstrating widespread harmful effects when the chemicals are applied in the manner specified by safety labels and at the ultra-low concentrations used by integrated vector management programs. Cumulative impacts may be possible in areas due to the widespread presence of many pesticides in the environment largely from agricultural and landscape use; however, very little research to date has examined cumulative impacts of pesticides on wild species or ecosystems.

4.5.3.2 Potential Effects on Rare and Endangered Species

The potential exists for pesticides to impact some threatened and endangered species. Low population numbers and the restricted habitat ranges of these species contribute to this potential. While studies of effects of mosquito control pesticides on surrogate species suggest that they do not pose threats above the levels of concern established by USEPA for many non-endangered species, sub-lethal doses could have direct and indirect impacts on species for which populations are already limited by other factors such as habitat loss.

Wildlife species vary in their sensitivity to pesticides based on their taxonomy and ecology (Tiebout 1991). Species with very small body sizes, insectivorous species, and those with aquatic life stages or dependent on aquatic habitats will have greater exposure to the pesticides used in mosquito control and are potentially more sensitive to them than other species. These taxonomic differences are generally reflected in the levels of concern set by USEPA for acute risk (see Table 4.3). Thus, one would expect the insects, shrews and other small-bodied mammalian insectivores such as bats, insect-eating birds and reptiles, amphibians, fish and invertebrates to represent the wildlife taxa with the greatest potential to experience effects of pesticides used in mosquito abatement. The threat posed by various pesticides to populations of listed wildlife will depend not only on toxicity of the chemical but also on the size and viability of the populations, the types of habitats used by the species and the ability of the species to utilize multiple or alternate habitats. Indirect effects of pesticides, such as reduced food availability, increased susceptibility to pathogens or disease, growth retardation or abnormal behavior from exposure to pesticides, could further threaten already stressed populations, though few investigations have attempted to measure such indirect effects on endangered wildlife or surrogate species. Because many threatened and endangered wildlife have not been studied thoroughly, specific impacts of a particular pesticide or practice on their populations are poorly understood. In addition, it is not always possible to know the location of habitats occupied by rare and endangered species or to avoid the application of pesticides in the habitat they may inhabit.

Pesticide Effects Determinations for Threatened and Endangered Species

The impacts of certain pesticides on endangered and threatened species have been analyzed in detail by the USFWS/NMFS as a result of consultation between these agencies and the USEPA in the pesticide registration process when the USEPA determines that a pesticide “may affect” threatened or endangered species. The end result of this consultation is a biological opinion that includes an “effects determination” by the USFWS/NMFS that summarizes the agencies conclusions regarding impacts of the action, i.e. pesticide registration, on the species in question. Effects determinations result in one of three potential conclusions: that federal action will have “no effect,” may affect but is “not likely to adversely affect,” or is “likely to adversely affect” the species in question. When a “likely to adversely affect” determination is made, the final biological opinion will contain a list of “reasonable and prudent alternatives” (RPAs) that upon adoption should reduce the likelihood that continued use of the pesticide will further jeopardize the species. A pesticide product’s registration may be cancelled, the formulation revised, geographical use limitations may be imposed and/or warnings may be incorporated into the label as a result of the outcome of the consultation process.

There are effects determinations in various stages of completion for seven of the insecticides the District employed during 2009-2010 involving the impacts on seven species that occur within the Sutter and/or Yuba counties; 14 have “likely to adversely affect” conclusions (Table 4-17). The effects determinations examined vector control applications along with all other potential uses. Effects determinations with conclusions of “likely to adversely affect” have also been made for permethrin and naled on species closely related to the Giant Garter Snake and the Black Rail, the California Clapper Rail (*Rallus longirostris obsoletus*) and San Francisco Garter Snake (*Thamnophis sirtalis tetrataenia)*, respectively.

The “likely to adversely affect” conclusion for naled on the California Clapper Rail did not include public health pesticide applications.

The impacts of several of the pesticides on threatened and endangered wildlife are under review at the present time as the result of a San Francisco Bay area lawsuit in 2007 (*Center for Biological Diversity v. USEPA*, Case #07-2794-JCS ND Cal) and effects determinations and potential consequent reasonable and prudent alternatives are still pending. The biological opinions for chlorpyrifos and malathion on the salmonids, which include Central Valley Steelhead, Central Valley Spring-run Chinook Salmon and Sacramento River Winter-run Chinook Salmon, are the only opinions for the pesticides in Table 4-17, for which there are final at present and include reasonable and prudent alternatives. The RPAs include vector control applications and call for buffers of 500 feet for ground application and 1,000 feet for aerial application of chlorpyrifos and malathion (NMFS 2008).

Though the final biological opinion was issued in 2008, the RPAs have not yet been instituted as label changes by USEPA because a group of pesticide manufacturers filed suit under the Administrative Procedure Act, alleging that the biological opinion was not based on the “best scientific data available” as required by the Endangered Species Act before the USEPA had made a registration determination based on the biological opinion. On March 2, 2011, the United States Court of Appeals for the Fourth Circuit held that the biological opinion issued is immediately reviewable under the Administrative Procedure Act, reversing the lower court decision (*Dow Agrosciences LLC v. National Marine Fisheries Service*, Case No. 09-1968). Adherence to buffers remains voluntary until any pesticide label changes required by USEPA are implemented by the pesticide registrants.

Table 4-17. Effects determinations applicable to chemicals currently applied by SYMVCD related to listed species that occur within Yuba or Sutter Counties. Sources: NMFS 2008, 2010; USEPA 2007d, 2008c, 2008d, 2008e, 2009b, 2009c, 2010a, 2010b, 2010c.

Common Name (*Scientific Name*)	**Federal Status**	**State Status**	**methoprene**	**sumithrin (d-phenothrin)**	**permethrin**	**diflubenzuron**	**chlorpyrifos**	**malathion**	**naled**
Central Valley Steelhead (*Oncorhynchus mykiss*)	T					No effect	Likely to adversely affect	Likely to adversely affect	No effect
Chinook Salmon - Central Valley Spring-run ESU (*Oncorhynchus tshawytscha*)	T	T				No effect	Likely to adversely affect	Likely to adversely affect	Not likely to adversely affect
Chinook Salmon – Sacramento River Winter-run ESU (*Oncorhynchus tshawytscha*)	E	E					Likely to adversely affect	Likely to adversely affect	No effect
Delta Smelt *(Hypomesus transpacificus)*	T	T	P	P	P		P	Likely to adversely affect	P
California Tiger Salamander (*Ambystoma californiense*)	T	T, SC	P	P	P		P	Likely to adversely affect	P
California Red-legged Frog *(Rana draytonii)*	T	SC	Not likely to adversely affect		Likely to adversely affect	Likely to adversely affect		Likely to adversely affect	Likely to adversely affect
Valley Elderberry Longhorn Beetle (*Desmocerus californicus dimorphus*)	T		P	P	Likely to adversely affect		P	P	Likely to adversely affect

ESU= evolutionarily significant unit; T= Threatened, SC = Species of Concern, P= effects determination pending outcome of consultation for Bay area species required by Centers for Biological Diversity v. USEPA; Red font indicates those effects determinations for which a final biological opinion with prudent alternatives presently exists.

Pesticide Use Limitations for Sutter and Yuba Counties

CDPR lists pesticide use limitations to protect 18 rare, threatened or endangered species in Sutter County and 24 in Yuba County (Table 4-18). The use limitations involve six pesticides in the two Counties (Table 4-19) and all specify the limitations provided in Table 4-20.

Species Sensitivity and Potential for Exposure

Out of the 33 wildlife species listed as threatened or endangered by the state or federal government or as a species of concern in California that occur in Sutter or Yuba Counties (see Table 3-6), 24 were considered to have some potential to be affected by mosquito control because they are invertebrates, small insectivorous species or dependent on aquatic habitats and they or their habitats are known to occur within the District's boundaries. It was assumed that larger vertebrates are much less likely to be affected because of the lack of bioaccumulation of the mosquito adulticides and larvicides. It was also assumed that those species that are not resident within the District in spring and summer when insecticide applications occur are unlikely to be affected.

Delta Smelt are not thought to occur within District boundaries. Historically, the Foothill Yellow-legged Frog and the California Red-legged Frog were widespread throughout California and probably occurred within the District, but these species were extirpated from habitats on the Central Valley floor some time around the 1950s and 1960s (Jennings and Hayes 1994). Occupied habitat for both species now occurs outside the District's boundaries in the Sierra Nevada Foothills. Similarly, there is only one historical record of California Tiger Salamander in the CNDDB from Gray Lodge Wildlife Management Area in 1965, and this species is presumed to have been extirpated from the District (CNDDB 2011). The Mountain Plover and the Greater Sandhill Crane are only resident in winter when the District does not treat for mosquitoes. The Sacramento River Winter-run Chinook ESU is not likely to be present in large numbers during the majority of the District's spring and summer treatment period.

Conclusions presented below are based upon an analysis that used the acute toxicity data (see Table 4-14, Table 4-15, Table 4-16) along with life history information on diet, habitat and breeding season to rank species' sensitivity and exposure to mosquito larvicides (methoprene/diflubenzuron, bacterial products, surface films), adulticides (pyrethrin/pyrethroids and organophosphates), the use of mosquitofish for biological control and source reduction best management practices for landowners that recommend removal of emergent vegetation (Appendix E). Surveillance activities were not considered to have potential adverse impacts to species because the District's vector control technicians operate within assigned zones to minimize cross-contamination of water samples with exotic organisms and are careful not to trample habitats when sampling.

Table 4-18. Species protected by CDPR's pesticide use limitations in Sutter and Yuba Counties. Source: PRESCRIBE database 2011.

Common Name/Scientific Name	Sutter County	Yuba County
Central Valley Steelhead (*Oncorhynchus mykiss*)	✓	✓
Chinook Salmon - Central Valley Winter-Run ESU (*Oncorhynchus tshawytscha*)	✓	✓
Chinook Salmon - Central Valley Spring-Run ESU (*Oncorhynchus tshawytscha*)	✓	✓
Sacramento Splittail (*Pogonichthys macrolepidotus*)	✓	
Vernal Pool Fairy Shrimp (*Branchinecta lynchi*)	✓	✓
Vernal Pool Tadpole Shrimp (*Lepidurus packardi*)	✓	✓
California Red-Legged Frog *(Rana draytonii)*		✓
Giant Garter Snake (*Thamnophis gigas*)	✓	✓
Burrowing Owl (*Athene cunicularia*)	✓	✓
Swainson's Hawk (*Buteo swainsoni*)	✓	✓
Western Yellow-billed Cuckoo (*Coccyzus americanus occidentalis*)	✓	✓
Greater Sandhill Crane(*Grus canadensis tabida*)	✓	
Bald Eagle (*Haliaeetus leucocephalus*)		✓
California Black Rail (*Laterallus jamaicensis coturniculus*)	✓	✓
Bank Swallow (*Riparia riparia*)	✓	✓
Pacific Fisher (*Martes pennanti (pacifica) DPS*)		✓
Valley Elderberry Longhorn Beetle (*Desmocerus californicus dimorphus*)	✓	✓
Brandegee's Clarkia (*Clarkia biloba ssp. brandegeeae*)		✓
Butte County Fritillary (*Fritillaria eastwoodiae*)		✓
Ahart's Dwarf Rush (*Jucus leiospermus var. ahartii*)		✓
Colusa Layia (*Layia septentrionalis*)	✓	
Layne's Ragwort		✓
Legenere (*Legenere limosa*)		✓
Quincy Lupine (*Lupinus dalesiae*)		✓
Veiny Monardella (*Monardela douglasii var. venosa*)	✓	✓
Baker's Navarretia (*Navarretia leucocephala ssp. bakeri*)	✓	
Sticky Pyrrocoma (*Pyrrocoma lucida*)		✓
San Francisco Campion (*Silene verecunda ssp. verecunda*)	✓	
El Dorado County Mule Ears (*Wyethia reticulata*)		✓

Table 4-19. Chemicals used by SYMVCD in 2010 that have CPPR pesticide use limitations to protect rare and endangered species. Source: PRESCRIBE database 2011.

Chemical Product	Use Limitation Code
Biomist 4+4 ULV	10 , 15 , 16 , 17
Dimilin 25W For Mosquitoes	10 , 15 , 16 , 17
Dragnet Residual Insecticide	10 , 15 , 16 , 17
Dursban 2 Coated Granules*	10 , 15 , 16 , 17
Fyfanon ULV Mosquito	10 , 15 , 16 , 17
Trumpet EC Insecticide	10 , 15 , 16 , 17

* Product no longer manufactured and District no longer uses.

Table 4-20. Specific pesticide use limitations for chemicals listed in Table 4-18 in Yuba and Sutter Counties. Source: PRESCRIBE database 2011.

Code	Use Limitations
10	Do not use in currently occupied habitat (see Species Descriptions table for possible exceptions).
15	Provide a 20-foot minimum strip of vegetation (on which pesticides should not be applied) along rivers, creeks, streams, wetlands, vernal pools and stock ponds or on the downhill side of fields where run-off could occur. Prepare land around fields to contain run-off by proper leveling, etc. Contain as much water "on-site" as possible. The planting of legumes, or other cover crops for several rows adjacent to off-target water sites is recommended. Mix pesticides in areas not prone to runoff, such as concrete mixing/loading pads, disked soil in flat terrain, or graveled mix pads, or use a suitable method to contain spills and/or rinsate. Properly empty and triple-rinse pesticide containers at time of use.
16	Conduct irrigations efficiently to prevent excessive loss of irrigation waters through run-off. Schedule irrigations and pesticide applications to maximize the interval of time between the pesticide application and the first subsequent irrigation. Allow at least 24 hours between application of pesticides listed in this bulletin and any irrigation that results in surface run-off into natural waters. Time applications to allow sprays to dry prior to rain or sprinkler irrigations. Do not make aerial applications while irrigation water is on the field unless surface run-off is contained for 72 hours following the application.
17	For sprayable or dust formulations: when the air is calm or moving away from habitat, commence applications on the side nearest the habitat and proceed away from the habitat. When air currents are moving toward habitat, do not make applications within 200 yards by air or 40 yards by ground upwind from occupied habitat. The County Agricultural Commissioners may reduce or waive buffer zones following a site inspection, if there is an adequate hedgerow, windbreak, riparian corridor or other physical barrier that reduces the probability of drift.

4.5.3.3 Impacts of Mosquito Insecticide Use by the District

Organophosphate Insecticides

The listed species most susceptible (i.e., those with three or more factors listed in the table in Appendix E) to use of organophosphates (naled, malathion and chlorpyrifos) include the fish, the fairy shrimp and Valley Elderberry Longhorn Beetle, amphibians and the wetland and riparian nesting bird species, as well as the bats (Table 4-21). The organophosphates are highly toxic to bees on contact, but their application at night during times bees are inactive and their relatively rapid environmental degradation (see Table 4-4, Table 4-5) are expected to reduce the risk of impacts to pollinators. The District does not treat vernal pools because they usually do not produce significant mosquito populations; thus, the risk to fairy shrimp species is expected not to be significant.

The District applied chlorpyrifos only to tires and dehydrator sump pumps and drains (only 21 lbs were used in 2011), which reduced the risk to wildlife. This product is no longer manufactured, and the District exhausted its supplies in 2011; therefore, the risk to listed species is considered not to be significant.

Malathion is used only in irrigated pastures; some pastures are adjacent to critical habitat for the Central Valley steelhead and Chinook salmon- Central Valley spring-run ESU (see Figure 3-6), which have been identified as being likely to be adversely affected by use of chlorpyrifos and malathion (NMFS 2008). USEPA (2007d, 2009b) also has concluded malathion and chlorpyrifos are likely to adversely affect the California Red-Legged Frog, which has been extirpated from the District.

Naled is the organophosphate adulticide the District presently employs the most. It is applied aerially as a ULV spray over duck clubs and rice fields, and its use is only permitted in the Sutter National Wildlife Refuge if West Nile virus is detected on the refuge. USEPA has concluded that naled is likely to adversely affect the Valley Elderberry Longhorn Beetle (USEPA 2010a) and the California Red-Legged Frog (USEPA 2008d), which has been extirpated from historical habitat within the District.

CDPR pesticide use limitations specify that naled, malathion, and chlorpyrifos not be used within occupied habitat of any of the species listed in Table 4-18 that have habitat within sections specified by the use limitations, as well as additional measures that reduce the likelihood that these materials will enter these species' habitats. Buffers of 500 feet for ground application and 1,000 feet for aerial application of chlorpyrifos and malathion (NMFS 2008) may also apply to vector control applications when final reasonable and prudent alternatives are implemented by the pesticide registrants.

A difficulty in complying with the pesticide use limitations is determining whether habitat is occupied by species, as many species are secretive and not well surveyed so occurrence data are patchy and likely underrepresent total occupied habitat. Therefore, there is potential for use of malathion by the District to affect some listed species adversely, particularly the Central Valley Steelhead and Chinook Salmon-Central Valley Spring-run ESU, and for naled to adversely affect Valley Elderberry Longhorn Beetle, as well as for incidental take of individuals of listed species to occur with the use of these chemicals.

Table 4-21. Listed species in Sutter and Yuba Counties most susceptible to organophosphate use by the SYMVCD.

Taxon	Species	Probable Occurrence within District*
Fish	Green Sturgeon	Yes
	Central Valley Steelhead	Yes
	Chinook Salmon-Central Valley Spring-Run ESU	Yes
	Sacramento River Winter-run Chinook ESU	Yes
	Delta Smelt	No
	Sacramento Splittail	Yes
Invertebrates	Conservancy Fairy Shrimp	Yes, Habitat Not Treated
	Vernal Pool Fairy Shrimp	Yes, Habitat Not Treated
	Vernal Pool Tadpole Shrimp	Yes, Habitat Not Treated
	Valley Elderberry Longhorn Beetle	Yes
Amphibians	California Tiger Salamander	Presumed Extirpated
	Foothill Yellow-Legged Frog	Presumed Extirpated
	California Red-Legged Frog	Presumed Extirpated
	Western Spadefoot	Yes
Birds	Tricolored Blackbird	Yes
	Long-Eared Owl	Yes
	Swainson’s Hawk	Yes
	Northern Harrier	Yes
	Western Yellow-Billed Cuckoo	Yes
	Yellow Warbler	Yes
	California Black Rail	Yes
	Purple Martin	Yes
	Bank Swallow	Yes
Bats	Pallid Bat	Yes
	Western Red Bat	Yes

* Based on CNDDB records and NMFS 2009 for Central Valley Steelhead and Chinook salmon – Central Valley spring-run ESU.

The District applies malathion to pastures near salmonid critical habitat only from the ground on the land side of levees and has not observed any drift into waterways with this method of application. Continuation by the District of its application practices for malathion to avoid drift and compliance with any pesticide application buffers for salmonids when they are implemented by USEPA will reduce the potential impact of malathion use on the listed salmonids to less than significant.

Valley Elderberry Longhorn Beetles are completely dependent on the host plant, the elderberry, which is a common component of riparian habitats in the Central Valley. The District aerially applies naled over rice fields and duck clubs, which typically do not contain the elderberry bushes the beetle depends on or occur adjacent to the riparian habitat occupied by the beetle. Also, the District’s application of naled typically takes place between July and September and does not coincide with the activity of adult beetles, which occurs from late May to early June. Shortly after hatching, the larvae bore into the wood stems of the elderberry plant where they spend one to two years developing and are not likely to be exposed to insecticides during this stage. The risk to Valley Elderberry Longhorn Beetle from District's use of naled is, therefore, expected to be less than significant.

Pyrethrin/Pyrethroid Adulticides and Barrier Sprays

The species most sensitive to the pyrethrins/ pyrethroids include the fish (Green Sturgeon, Central Valley Steelhead, Central Valley Spring-run Chinook ESU), the amphibians (California Tiger Salamander, California Red-Legged Frog, Foothill Yellow-Legged Frog, Western Spadefoot), the Valley Elderberry Longhorn Beetle and bees. Impacts to bees are expected to be reduced by spraying occurring at night and rapid environmental degradation of the products used.

Pyrethrins and pyrethroids are applied from the ground and small agricultural aircraft in duck clubs and rice fields and from the ground along routes in towns, orchards, and pastures. USEPA (2008e) has concluded that the use of permethrin is likely to adversely affect the California Red-legged Frog and the Valley Elderberry Longhorn Beetle. The California Red-Legged Frog is presumed extirpated from the District, as are the California Tiger Salamander and Foothill Yellow-Legged Frog. Pesticide use limitations prohibit use of Dragnet® and Bio mist® 4+4 (products that contain permethrin) in occupied of habitat of the species included in Table 4-18.

Surface Films and Oils as Larvicides

The species considered most sensitive to the use of surface oils/films are the Western Spadefoot toad and the Black Rail. These species are susceptible primarily because their life history requirements increase potential to contact oil at the surface of the water or for eggs and young to be oiled. GB-1111, the petroleum distillate oil the District has used in the past, is no longer manufactured and remnants of stocks are being exhausted. The monomolecular surface film, Agnique®, has been used in its place. There are no pesticide use limitations for either of these products. Risks to the listed waterfowl and wading birds from the use of Agnique® have not been evaluated (Stark 2005). If the District uses remaining stocks of GB-1111, it should avoid use in breeding habitat of the Western Spadefoot and Black Rail habitat to minimize risks to these species. Western Spadefoot habitat consists of rain pools lasting at least three weeks that do not contain bullfrogs, fish, or crayfish in open habitats (Jennings and Hayes 1994), and Black Rails use emergent wetlands greater than 0.25 acres in size (Richmond et al. 2010). Use of Agnique® in the habitats of these species should also be avoided, particularly during critical life stages (eggs or young present), when possible.

Bacterial Larvicides

Impacts of bacterial larvicides, Bti and Bs, are expected to be limited to indirect effects on invertebrate prey of listed species and are not expected to be significant based on studies of the effects of Bti on non-target invertebrates (Hanowski et al. 2007; Hershey et al. 1998; Lawler et al. 1999, 2000; Davis and Peterson 2008; Lundström et al. 2010a, 2010b; Persson Vinnersten et al. 2010).

An experiment that exposed bumblebees (*Bombus impatiens* Cresson) to spinosad bacteria showed lethal impacts when the bees ingested high concentrations and reduced foraging ability at medium concentrations (Morandin et al. 2005). The study attempted to use concentrations of spinosad (25 -150 g active ingredient per hectare or 0.022 to 0.133 lbs active ingredient per acre) equivalent to concentrations expected from spinosad products typically used on a variety of crops. Spinosad is highly toxic to bees when they encounter a wet formulation, but the risk to bees is much reduced when the product is dry and applied at ULV concentrations (Mayes et al. 2003). The spinosad products the District will apply to catch basins and irrigated pastures (Natular XRT and Natural G-3, respectively) are both applied dry. The impact of the use of spinosad by the District is, therefore, expected to be less than significant.

Methoprene

The listed species most susceptible to larvicides containing methoprene include the invertebrates, through direct impacts, and the same amphibian, bat and bird species listed in Table 4-21, through indirect effects on insect prey. The District does not treat vernal pools, avoiding impacts to fairy shrimp. The indirect effects on listed species are expected to be insignificant because methoprene degrades rapidly in the environment (Csondes 2004) and the birds and bats prey upon a wide range of species and are highly mobile so are unlikely to be subject to reduced food supplies.

USEPA (2008c) has concluded that use of methoprene is not likely to adversely affect the California Red-Legged Frog. Biological opinions are being prepared for the impact of methoprene on Delta Smelt and the California Tiger Salamander, which do not occur within the District, and the Valley Elderberry Longhorn Beetle. There are no CDPR pesticide use limitations for any of the methoprene products used by the District at the present time. Use of methoprene by the District for mosquito control in an integrated vector management program is not expected to constitute a significant adverse impact to listed species.

Diflubenzuron

The listed species within the District that are most susceptible to diflubenzuron include the amphibians, the California Red-Legged Frog, California Tiger Salamander, Foothill Yellow-Legged Frog, and the Western Spadefoot. Only the Western Spadefoot presently is thought to occur within the District.

The use of diflubenzuron is expected to cause adverse acute and chronic effects to both freshwater and estuarine/marine invertebrates, including endangered species. Studies showed that diflubenzuron affects reproduction, growth and survival in freshwater invertebrates as well as reproduction in marine/estuarine invertebrates (USEPA 1997). To mitigate these risks, the USEPA/CDPR requires a 25-foot vegetative buffer strip to decrease runoff and to serve as a buffer zone for spray drift from ground applications. For aerial applications, a 150-foot buffer zone is required. USEPA (2009c) has also concluded that use of diflubenzuron is likely to adversely affect the federally threatened California Red-legged Frog, primarily because there is a significant risk to terrestrial and aquatic invertebrate prey.

CDPR pesticide use limitations also specify that the product Dimilin® 25W not be used in occupied habitat of the species listed in Table 4-18.

SYMVCD only uses Dimilin® 25W in limited amounts (< 4 lbs used in 2010) within wastewater treatment ponds; therefore, significant adverse impacts on rare or endangered species are not expected from its use by the District.

Impacts to Listed Plant Species and Sensitive Habitats from Pesticide Use

Potential adverse impacts to listed plants will be predominantly indirect effects from reductions in populations of pollinating insects due to the use of pesticides. CDPR lists plants in its pesticide use limitations that are presumably affected by other chemicals in the database that the District does not use, such as herbicides. Based on the available data, significant adverse impacts from pesticides on plants are not expected. While some studies have demonstrated changes in invertebrate species assemblages in wetlands with the use of mosquito pesticides (Hershey et al. 1998, Jensen et al. 1999), persistent adverse changes to food webs or habitats from these practices are not clear from the studies.

4.5.3.4 Impacts of Biological Control of Mosquitoes Using Mosquitofish

Laboratory and field studies of mosquitofish suggest that they are opportunistic feeders consuming a wide range of food items, including zooplankton, copepods, cladocerans and immature stages of many insect species (Ahmed et al. 1970, Walton and Mulla 1991, Lawler et al. 1999). Mosquitofish in experimental pools have been shown to have significant impacts on endemic fish, amphibians and fairy shrimp in these simplified settings (Lawler et al. 1999, Swanson et al. 1996, USFWS 1997, Leyse et al. 2003). Mosquitofish can affect native fauna by competing for food and cover, behaving aggressively toward native species, consuming aquatic species of concern, causing growth retardation of species of concern (through competition for food) and eliminating habitat through over-consumption of food. Two studies in California (Gamradt and Kats 1996, Goodsell and Kats 1999) suggest that mosquitofish may have contributed to localized declines of populations of the California newt (*Taricha torosa*) and the Pacific tree frog *(Hyla regilla*). The release of mosquitofish into natural environments has also been identified as a potential threat to vernal pool ecosystems (USFWS 1998, 2005, 2006, 2007).

Ecological risk assessment methods have also been applied to evaluate the potential effect of a biological control method of introducing mosquitofish into Montana watersheds (Schleier III et al. 2008b). Effects in this study were defined as mosquitofish establishing themselves in a river and potentially out-competing native fish or affecting fauna so as to reduce habitat for native species and were examined across a range of seasonal temperatures and habitat conditions (i.e., whether or not the river had a dam). According to this risk assessment, rivers with the highest temperatures were the most likely locations for the establishment of *Gambusia* populations; however, they were not necessarily the most likely locations for impacts to native minnows or species of concern.

The District does not plant mosquitofish into vernal pools and refrains from introducing mosquitofish into aquatic sources suspected or known to be habitats for endangered or threatened species. Mosquitofish are used to control mosquito larvae primarily in artificial systems, such as unmaintained swimming pools, ornamental ponds and containers, roadside ditches and in rice fields. The District has provided mosquitofish to the public for their use in ornamental ponds and swimming pools and advises them that it is against California Department of Fish and Game regulations for private citizens to plant mosquitofish into California waters without a permit. The District is considering discontinuing the practice of providing mosquitofish to the public.

The listed species that occur within the District that are potentially at risk of adverse impacts from mosquitofish include the Sacramento Splittail, the Western Spadefoot, and the three fairy shrimp species. Impacts to fairy shrimp are expected to be less than significant because the District does not stock vernal pools and mosquitofish are unlikely to persist long-term in vernal pools if they become accidentally introduced, because vernal pools dry completely in summer. There is the potential for adverse impacts to Western Spadefoot and smaller native fish if mosquitofish enter habitats of these species, where they may consume eggs, tadpoles and fry. Western Spadefoot breed in a variety of temporary habitats, including rain pools lasting three weeks or more, as well as more permanent habitats like streams (CNDDB 2011). The temporary nature of many of the Spadefoot's breeding habitats coupled with the District's practice of placing mosquitofish into habitats where they can successfully reproduce over the treatment season reduces the likelihood that the District would place mosquitofish into occupied Spadefoot habitat. However, there is no information at the current time on the distribution of the Spadefoot in relation to naturalized populations of mosquitofish within the District to allow adequate assessment of the significance of the potential impact of mosquitofish on this species.

4.5.3.5 Impacts of Source Reduction

The District does not usually conduct any physical manipulation of habitat to reduce breeding sources of mosquitoes, other than emptying of artificial containers. However, the District reserves the right to maintain access to mosquito breeding sources should the need arise. It also recommends several types of physical control in its Best Management Practices Manual for landowners to use to reduce mosquito production sources on private property, agricultural lands and managed wetlands.

The BMPs that are most likely to have an effect on listed species are those that specify elimination or reduction of emergent vegetation, particularly in managed wetlands, because of the potential for direct impacts to breeding species and indirect impacts to habitat. The following BMPs recommend vegetation control:

> DD-2 Keep ditches clean and well maintained. Periodically remove accumulated sediment and vegetation. Maintain ditch grade to prevent areas of standing water.
>
> DA-9 Vegetation should be controlled regularly to prevent emergent vegetation and barriers to access. This includes access paths and/or road, interior pond embankments and any weed growth that might become established within the pond surface. An approved vegetation management plan should be on file with the District.

RI-5 Wherever feasible, control vegetation on the outer most portions of field levees and checks, specifically where they interface with standing water.

RI-6 Control algae and weed growth as effectively as possible.

SW-4 Perform routine maintenance to reduce emergent plan densities to facilitate the ability of mosquito predators (i.e., mosquitofish) to move throughout vegetated areas.

SW-9 Vegetation should be controlled (by removal, thinning or mowing) periodically to prevent barriers to access.

MW-2 Provide reasonable access on existing roads and levees to allow mosquito abatement technicians access for monitoring, abatement, and implementation of BMPs. Make shorelines of natural, agricultural, and constructed water bodies accessible to maintenance and vector control crews for periodic maintenance, control and removal of emergent vegetation, as well as for routine mosquito and monitoring procedures.

MW-15 Control floating vegetation conducive to mosquito production (i.e. water hyacinth, water primrose, parrot's feather, *Eichornia* spp., duckweed, *Lemna* and *Spirodela* spp., and filamentous algal mats).

MW-16 Perform routine maintenance to reduce problematic emergent plant densities to facilitate the ability of mosquito predators (i.e., fish) to move throughout vegetated areas and to allow good penetration of chemical control agents.

Rare and Endangered Species

The wildlife species most susceptible to source reduction include the Black Rail, Yellow Warbler, Western Yellow-billed Cuckoo, Tricolored Blackbird, Giant Garter Snake and Western Spadefoot. Removal of emergent or riparian vegetation within occupied habitats of these species, particularly if it occurs during the species' breeding seasons, could result in incidental take of individuals or adverse impacts to species.

No state or federally listed plant species are recognized within wetlands located within SYMVCD's operational boundaries; however, several plants are listed by the California Native Plant Society as occurring in wetlands are within the boundaries of SYMVCD. CEQA provides protection not only for state-listed species but also for any species that can be shown to meet the criteria for state listing (CEQA Guidelines Section 15380; California Association of Environmental Professionals 2011). CDFG recognizes that CNPS lists 1A, 1B, and 2 consist of plants that may qualify for listing, and CDFG recommends they be addressed in CEQA projects. Although CDFG has no required mitigations for those species occurring only on CNPS List 1A, 1B, and 2, these species meet the criteria for listing and satisfy conditions for rarity under CEQA Section 15380.

Of the special-status plants noted to occur within SYMVCD boundaries, only Woolly Rose-mallow and the Brownish Beaked-rush present any likelihood of occurring within potential source reduction areas and being significantly impacted by source reduction activities recommended by District BMPs (Table 4-22). Other special-status wetland species are either limited to vernal pools (which are not treated, or recommended for treatment by the District, because they do not present major sources of mosquitoes) or of such small size that source reduction activities would not be expected to significantly affect them. The District can improve its policies and best management practices relating to vegetation clearing to reduce the potential risks to listed plants and wildlife by including disclaimers that these measures should not be undertaken within the habitat of listed species and that the public should consult CDFG and USFWS before performing these BMPs if listed species' presence is suspected.

Riparian Habitat or Sensitive Natural Communities

Sensitive natural communities can be identified in local or regional plans, including Habitat Conservation Plans and Natural Community Conservation Plans, or identified by the CDFG or USFWS. Although no HCP/NCCPs currently exist within the boundaries of the SYMVCD, several sensitive habitats, critical habitats, and essential fish habitats occur within the service area. USFWS has identified critical habitat in association with endangered species. Within the SYMVCD, critical habitat has been designated for Vernal Pool Fairy Shrimp, Vernal Pool Tadpole Shrimp, Central Valley Steelhead, Central Valley Spring-Run Chinook Salmon, and Sacramento River Winter-Run Chinook Salmon (see Section 3.3.2). Effects to these species and their habitat are discussed in this document under Impacts of Mosquito Insecticide Usage, Impacts of Biological Control and Impacts of Source Reduction.

Sensitive habitats are currently being described by CDFG through the California GAP Analysis Project, a government funded project assessing the status of biodiversity in California and other western states. Within the region this effort is being led by the Biogeography Lab of the University of California, Santa Barbara. Various regional GAP Analyses are concurrently being developed, and these efforts are coordinated by the National Biological Service of the US Department of the Interior. Habitat descriptions are derived from CDFG's California Wildlife-Habitat Relationship System.

Several sensitive habitats have been identified as occurring within SYMVCD boundaries through the GAP Analysis (CNDDB 2011). These include Coastal and Valley Freshwater Marsh (52410), Great Valley Cottonwood and Riparian Forest, Great Valley Mixed Riparian Forest, Great Valley Oak Riparian Forest, Great Valley Willow Scrub, and Northern Hardpan Vernal Pool. District activities that may affect habitat structure are limited to source reduction activities and recommended BMPs regarding source reduction.

<u>Coastal and Valley Freshwater Marsh (52410; Holland 1986)</u>
These aquatic systems are dominated by perennial, emergent monocots that grow to 4-5 m tall, often forming completely closed canopies. They are dominated by *Scirpus* (bull-rush) and *Typha* (cattail) species. They are most extensive in the upper portion of the Sacramento-San Joaquin River Delta and are common throughout rural portions of the District, especially in the vicinity of the Sutter Bypass and the Sacramento River. They are common in river oxbows and other areas on the flood plain.

Table 4-22. Special-status plant species potentially present in areas affected by source reduction activities with the SYMVCD.

Common Name	Scientific Name	List Status	Habitats Occupied	Notes
Dwarf Downingia	*Downingia pusilla*	CNPS 2.2	• Valley and foothill grassland (mesic) • Vernal pools	Unlikely to be impacted by disturbances to wetlands due to small size.
Woolly Rose-mallow	*Hibiscus lasiocarpos* var. *occidentalis*	CNPS 1B.2	• Marshes and swamps (freshwater)	This large, shrubby species could be impacted by vegetation clearing along wetlands.
Ahart's Dwarf Rush	*Juncus leiospermus* var. *ahartii*	CNPS 1B.2	• Valley and foothill grassland (mesic)	Unlikely to be impacted by vegetation clearing in wetlands due to small size.
Sticky Pyrrocoma	*Pyrrocoma lucida*	CNPS 1B.2	alkaline clay. • Great Basin scrub • Lower montane coniferous forest • Meadows and seeps	Unlikely to be impacted by vegetation clearing in wetlands due to small size.
Ferris' Milk-vetch	*Astragalus tener* var. *ferrisiae*	CNPS 1B.1	• Meadows and seeps (vernally mesic) • Valley and foothill grassland (subalkaline flats)	Unlikely to be impacted by disturbances to wetlands due to small size.
Legenere	*Legenere limosa*	CNPS 1B.1	• Vernal pools	Unlikely to be impacted by disturbances to wetlands due to small size.
Baker's Navarretia	*Navarretia leucocephala* ssp. *bakeri*	CNPS 1B.1	• Cismontane wood-land • Lower montane coniferous forest • Meadows and seeps • Valley and foothill grassland • Vernal pools	Unlikely to be impacted by disturbances to wetlands due to small size.
Brownish Beaked-rush	*Rhynchospora capitellata*	CNPS 2.2	• Lower montane coniferous forest • Meadows and seeps • Marshes and swamps • Upper montane coniferous forest	This medium-sized brushy species could be impacted by vegetation clearing along wetlands.
Wright's Trichocoronis	*Trichocoronis wrightii* var. *wrightii*	CNPS 2.1	• Meadows and seeps • Marshes/swamps • Riparian forest • Vernal pools	Unlikely to be impacted by disturbances to wetlands due to small size.

This habitat type can provide preferential breeding sites for mosquitoes, and several BMPs address control of fresh emergent vegetation, the typical vegetation type of marshes. Source reduction activities within the District have the potential to impact this habitat through recommended maintenance actions designed to reduce densities of emergent plants (such as thinning, mowing, or removal) to optimize penetration of aquatic larvicides and access of mosquitofish to mosquito larvae.

<u>Riparian Forests (61410, 61420, 61430)</u>
Several varieties of riparian forest are present within District boundaries, including Great Valley Cottonwood Riparian Forest (61410), Great Valley Mixed Riparian Forest (61420), and Great Valley Oak Riparian Forest (61430). The Cottonwood Riparian Forest is frequently flooded and supports dense understories, while the Mixed and Valley Oak Riparian forests sit further back and are less prone to understory disturbances due to flooding. These systems have been extensively cleared for agriculture, flood control, and urban expansion.

These habitats do not typically provide breeding habitats for mosquitoes and are not subject to source reduction policies. Accordingly, impacts to riparian forests are not considered likely due to District activities or recommendations.

<u>Great Valley Willow Scrub (63410)</u>
This habitat is a dense, broad-leafed, deciduous streamside thicket dominated by one or more of several *Salix* species. Stands usually have little understory or herbaceous components, although more open stands have grassy understories usually dominated by exotic species.

This habitat type does not typically provide breeding habitats for mosquitoes and is not subject to source reduction policies. Accordingly, impacts to willow scrub habitats are not considered likely due to District activities or recommendations.

<u>Northern Hardpan Vernal Pool (44110)</u>
These low, herbaceous communities dominated by herbs and grasses, often described as hogwallows, are filled by precipitation and emptied by evaporation. Shallow hardpans prevent the establishment of woody vegetation. Vernal pools can support a number of special-status plant and wildlife species, including Vernal Pool Fairy Shrimp, Vernal Pool Tadpole Shrimp, California Tiger Salamander, Baker's Navarretia, Legenere, and others. Many vernal pool landscapes have been identified as critical habitat in association with Vernal Pool Fairy Shrimp and Tadpole Shrimp.

SYMVCD does not treat vernal pools with biological or chemical control methods. Complex invertebrate communities in vernal pools lead to heavy competition and predation and do not provide good conditions for mosquito breeding. Accordingly, the District's activities are not likely to have an adverse impact on vernal pool habitats.

Federally Protected Wetlands

The USEPA and USACE jointly administer the Clean Water Act (33 USC §1251) and exercise jurisdiction over traditionally navigable waters and their tributaries, considered Waters of the United States

(WOTUS). Additionally, the Clean Water Act prohibits dredge or fill of waters, including wetlands, with a “significant nexus” to WOTUS without a permit for such activities. Any activities undertaken in WOTUS or wetlands with a significant nexus to WOTUS that have the potential to disrupt sediment and result in fill should only be undertaken after consultation with USACE and, if appropriate, acquisition of required permits or permissions.

Although the District does not engage in activities that would result in dredge or fill of wetlands or WOTUS, some BMPs recommended by the District involve vegetation clearing in federally jurisdictional features, such as tributaries to traditionally navigable waters (streams, ditches) or wetlands (marshes supporting fresh emergent vegetation). These recommended BMPs could lead landowners and managers to engage in wetland modification activities that require federal permits. To reduce the potential for adverse impacts to wetland habitats caused by dredge and fill activities arising from BMP implementation, the District should include information regarding federal prohibition of dredge and fill activities and the permits required for such activities in its BMP Manual.

4.5.3.6 Summary of Impacts

The SYMVCD does contractual work for both the state and federal governments and conducts vector control activities within state wildlife management areas and federal wildlife refuges as well within designated critical habitat for listed salmonids within Yuba and Sutter Counties.

As an ongoing public health program, the District’s practices involve rotation of a suite of currently available insecticides as well as incorporation of newly developed ones in order to reduce development of resistance in vector species and minimize adverse impacts on health of humans, wild species, and ecosystems. The District also operates throughout the diverse habitats of Yuba and Sutter Counties that support an array of listed rare and endangered species. The rare and endangered species’ list is also continually evolving; more species become added to the list as human activities negatively affect them or their habitats or as new information arises that suggests they are in danger of extinction, while others may reach recovery goals and be removed from the list. Because of the evolving nature of the District’s program and the environment in which it operates, the District must maintain an ongoing relationship with the agencies responsible for conserving and managing listed species and their ecosystems and remain abreast of information on listed species’ distributions, sensitive habitats, and potential impacts of current and newly developed insecticides to reduce potential adverse impacts to listed species to a level that is less than significant.

The SYMVCD can perform additional measures to minimize the potential for impacts on listed species throughout the District. These steps include regular access and updates of both state and federal sources of occurrence information for special status species, including CDFG’s California Natural Diversity Database, CDPR’s Endangered Species Protection Program and Pesticide Use Limitations, USFWS’s Critical Habitat Information Portal for threatened and endangered species, and any other reliable source of information accessible to District staff. These duties should be added to the job description of a supervisory biologist or equivalent to ensure regular (annual) execution. Pesticide application and recommendations for vegetation removal in areas known to support protected species should be reviewed by supervisory staff prior to initiation to determine if the proposed work or pesticide application has potential to impact protected species, and work should either be modified to reduce impacts or avoided in those areas. Information obtained from the above analysis or databases should be incorporated into annual training sessions for field personnel on protected species and sensitive habitats. Finally, a Habitat Conservation Plan for Yuba and Sutter Counties is in the beginning stages of development. The District would benefit by becoming a signatory to the plan, which will identify sensitive habitats of conservation priority in the area and mitigate incidental take from projects of signatory agencies and property owners.

Impact BIO-1: Use of the organophosphate insecticide, malathion, in areas adjacent to habitat of the Central Valley Steelhead and Central Valley Spring-run Chinook Salmon may adversely affect these species.

Impact BIO-2: Application of petroleum distillate oils in habitats where Black Rails or Western Spadefoot are present may significantly adversely impact these species or cause take and may impact other species of wetland nesting birds.

Impact BIO-3: Distribution of mosquitofish by SYMVCD to the public and subsequent unintended releases into natural environments have potential to adversely affect listed species of invertebrates, amphibians and/or fish in Sutter and Yuba Counties or result in incidental take.

Impact BIO-4: Vegetation management recommended in the District's Best Management Practices Manual may adversely affect listed wildlife (e.g., Black Rail, Yellow Warbler, Western Yellow-billed Cuckoo, Tricolored Blackbird, Giant Garter Snake and Western Spadefoot) and plants (e.g., Wooly Rose-mallow and Brownish Beaked-rush) if performed in occupied habitat of these species.

Impact BIO-5: Dredge or fill activities resulting from implementation of recommended BMPs occurring in wetlands or Waters of the United States could result in habitat degradation associated with water quality impacts and/or the need for permits from the US Army Corp of Engineers.

4.5.4 MITIGATIONS

Mitigation Measure Bio-1: Malathion application practices and compliance with buffers.
The District shall continue to apply malathion only from the ground on the land side of levees to avoid drift into critical habitat of the Central Valley Steelhead and Central Valley Spring-run Chinook Salmon and shall comply with any buffers for vector control application of malathion that may be adopted by USEPA to protect listed salmonids.

This mitigation measure addressed Impact 1.

Mitigation Bio-2: Prohibit petroleum distillate use within Black Rail and Western Spadefoot habitat.
The District shall develop and adopt a BMP that prohibits use of petroleum distillate oils within Black Rail and Western Spadefoot habitat to reduce the risk of impacts to these species.

This mitigation measure addresses Impact 2.

Mitigation Measure Bio-3: Limit mosquitofish release to isolated artificial systems.
Mosquitofish shall only be introduced into isolated systems that are not connected to natural waterways to prevent inadvertent introduction of mosquitofish into natural ecosystems by the District. Determination of whether a system is isolated or not shall be made by District supervisory personnel. If a determination cannot be made regarding the connectivity of a system to natural waterways, the system shall not be treated with mosquitofish.

This mitigation measure addresses Impact 3.

Mitigation Measure Bio-4: Avoid recommending BMPs that specify vegetation clearing in listed species habitats. Revise BMPs to include information on Endangered Species Acts and which species may be affected by vegetation clearing.
District personnel shall avoid recommending vegetation-clearing activities in areas supporting Woolly Rose-mallow, Wright's Trichocoronis, or any other plant species listed by state or federal Endangered Species Act listings, or CNPS List 1A, 1B, or 2, and habitat of Black Rail, Yellow Warbler, Western Yellow-billed Cuckoo, Tricolored Blackbird, Giant Garter Snake and Western Spadefoot. BMPs shall be revised to advise landowners that clearing vegetation may adversely affect rare and endangered species, if they are present, or their habitat and that landowners are prohibited from "taking" endangered species under the US and California Endangered Species Acts.

This mitigation measure addresses Impact 4.

Mitigation Measure Bio-5: Establish annual rare and endangered species sensitivity training course for District operators.
Compliance with CDPR and USEPA's pesticide use limitations and buffers determined through interagency consultation with USFWS/NMFS should reduce impacts to rare and endangered species to a level that is less than significant. However, a difficulty in complying with pesticide use limitation is that "occupied habitat" is rarely well-known. As the District needs to operate within a wide variety of habitats, many of which harbor rare and endangered species, establishment of the training program for personnel along with annual collaboration with USFWS and CDFG will help the District avoid potentially detrimental pesticides or practices in areas in which these species occur.

The District has begun to prepare a policy that requires consultation with and training by the USFWS and CDFG. The District will use power point presentations and develop guides to rare and endangered species habitats with resources from the agencies to use in the training. To aid in developing these guides and training, the SYMVCD shall regularly access and update both state and federal sources of listed species occurrence information, including information from CDFG's California Natural Diversity Database, CDPR's Endangered Species Protection Program and Pesticide Use Limitations, USFWS's Critical Habitat Portal for threatened and endangered species and any other reliable source of information accessible to staff. Guides and manuals are expected to be completed in 2011. Use of guides will help staff determine if pesticide application and vegetation maintenance are scheduled or

recommended to be performed in areas known or suspected to support protected species. It will also allow review by supervisory staff prior to initiation to determine if a potential for adverse impacts is indicated. If adverse impacts are possible, work shall either be modified to avoid impacts or not initiated in those areas.

<u>Mitigation Measure Bio-6: Establishment of MOUs with CDGF and USFWS</u>
SYMVCD shall continue to consult CDFG and USFWS for assistance in minimizing or eliminating impacts on rare and endangered species from the District's activities throughout lands within the District. The District will enter into MOUs with these agencies that will define allowable incidental take from SYMVCD's program operations.

These mitigation measures address Impacts 1-4.

<u>Mitigation Measure Bio-7: Modification of Best Management Practices Manual to include references to federal wetland-fill permitting</u>
The District shall modify its current BMP Manual to include information regarding federal prohibition of dredge and fill activities and information relevant to permits for such activities, including:

- **Definition of federally jurisdictional wetlands**
- **Description of activities requiring federal review and/or permits**
- **Contact information for local and regional USACE and USEPA offices**

This mitigation measure addressed Impact 5.

Compliance with these mitigations will ensure that the SYMVCD's programs have a less than significant impact on listed rare and endangered species and sensitive habitats in Sutter and Yuba Counties.

5 CEQA Required Assessment Conclusions

5.1 Cumulative and Growth-Inducing Impacts

The review of cumulative impacts is limited to the District's operational boundaries, which incorporate portions of Sutter and Yuba Counties. No major changes in activities or practices are currently being considered that would create additional impacts under the preferred alternative. None of the SYMVCD's operations or policies induces, facilitates or stimulates growth.

This PEIR focused on areas in which potential impacts may occur, including human health, water quality, air quality, greenhouse gases and climate change, and biological resources.

5.1.1 Human Health

Use of mosquito insecticides by the District as in the current vector control program has not been found to constitute a significant hazard to the public based upon the low acute toxicity of most chemicals and their limited persistence in the environment. The District uses very low volumes of insecticides in comparison with agricultural and private landscape and pest control applicators and has not been found to contribute significantly to cumulative persistence of environmental insecticides. Based on studies by USEPA, CDPR, CDPH and CDC, there will be no cumulative impacts to human health with continued use of the insecticides at label rates and following all label precautions specified by USEPA.

5.1.2 Water Quality

The District uses organophosphate insecticides, including naled and malathion. These chemicals are currently listed as contributing to water quality impairments within several water bodies and streams within District boundaries. Organophosphate insecticides used adjacent to streams, or used in a manner that could introduce these chemicals into streams, has the potential to contribute to existing water quality impairments. Mitigation Measure WQ-1, Organophosphate Limitations, is designed to reduce any cumulative impacts arising from the District's use of organophosphate insecticides. Accordingly, no significant cumulative impacts are identified with required mitigation measures applied.

5.1.3 Air Quality, Greenhouse Gases, and Climate Change

The Sacramento Metro Non-Attainment Area includes the southern portion of Sutter County and is within District boundaries. However, District operations do not conflict with existing air quality plans for this area. Contributions to total organic gases from the District's use of aircraft are small (< 1 lb/day, or 0.04% of estimated overall aircraft emissions within the Feather River Air Quality Management District) and are not considered significant. Minor impacts to air quality and greenhouse gases arising from vehicle use will continue at levels below action threshold levels for the FRAQMD and are not cumulatively considerable.

5.1.4 Biological Resources

Review of District's impact potential upon state and federally listed rare and endangered species has revealed practices that could add to cumulative impacts on these special status species, either through direct exposure to insecticides, increased competition with introduced species, and/or habitat modification.

Application of the organophosphate insecticide, malathion, adjacent to habitat of the Central Valley Steelhead and Central Valley Spring-Run Chinook Salmon may adversely affect these species. Compliance with Mitigation Measure Bio-1 and pesticide use limitation and buffers prescribed by NMFS in biological opinions will reduce this impact to less than significant.

Application of petroleum distillate oils in habitats where Black Rails or Western Spadefoot toads are present may result in take and, combined with existing challenges these species are subject to, result in a cumulatively significant adverse impact. Mitigation Measure Bio-2 prohibits petroleum distillate use within Black Rail and Western Spadefoot habitats and will reduce this potential impact to less than significant.

Distribution of mosquitofish has the potential to adversely affect listed species of invertebrates and amphibians, which could add cumulatively to existing impacts to these species. Mitigation Measure Bio-3 limits mosquitofish release into isolated artificial systems and will reduce future impacts to less than significant.

Source reduction BMPs recommending vegetation management have the potential to adversely affect listed plant and wildlife species if performed in habitats occupied by these species. Mitigation Measure Bio-4 revises these BMPs to inform landowners of the potential for adverse impact to rare and endangered species that could result from vegetation management, and District personnel shall avoid recommending these activities in occupied habitat. Adherence to all label requirements and pesticide use limitations designed to protect rare and endangered species combined with Mitigation Measure Bio-5 (annual rare and endangered sensitivity training), Mitigation Measure Bio-6 (Establishment of MOUs with CDFG and USFWS), and Mitigation Measure Bio-7 (Modification of BMPs to include references to federal wetland-fill permitting requirements) will reduce potential for significant cumulative impacts on biological resources.

SYMVCD will continue to use traps and field checks for surveillance, recommend source reduction where necessary (with changes to BMPs), apply insecticides to and over mosquito breeding areas, utilize biological control methods and continue educational programs.

In summary, no significant cumulative impacts arising from District operations as modified by the required mitigation measures provided in this document are identified.

5.2 Significant Unavoidable Adverse Impacts

No significant unavoidable adverse impacts are identified.

5.3 Significant Irreversible Environmental Changes

Limitations placed on source reduction work by the federal Clean Water Act have eliminated the irreversible changes in surface waters that once were a part of mosquito vector control. Limitations imposed by the US and California Endangered Species Acts on chemical and biological control methods used to control vector species, combined with the required mitigation measures provided in this document, serve to minimize impacts on non-target plants and animals. SYMVCD's activities do not create any irreversible changes to the environment.

5.4 Effects Not Found To Be Significant

The assessment for the Initial Study eliminated a number of areas of potential environmental effects because the project does not include new construction, any changes in land form or land use, or significant changes in activities. The project, as proposed, is a continuation of ongoing policies and activities.

Sufficient information was found during the preparation of the Initial Study to determine that there were no adverse impacts, including cumulative impacts, in the areas of aesthetics, agricultural resources, cultural resources, geology/soils, mineral resources, noise, population and housing, public services, recreation, transportation/traffic, or utilities/service systems.

Several areas have been identified in which there is some potential for significant impacts to arise from District operations, including human health, water quality, air quality, greenhouse gases and climate change, and biological resources. In each area in which significant or potentially significant adverse impacts were identified, appropriate mitigations to reduce the potential for adverse impacts to less than significant levels have been developed. Accordingly, no effects are considered potentially significant with implementation of all required mitigation measures provided in this report.

6 REFERENCES CITED BY EIR CHAPTER

This section organizes the references cited within the text by chapter of the PEIR. A full bibliography of references consulted in the preparation of this document is included in the Appendices (Appendix F).

6.1 CHAPTER 1 - INTRODUCTION

6.1.1 AUTHORITIES CITED

California Environmental Quality Act (CEQA), 14 CCR § 15126.6 (e)(3)(A);) Cal PRC §21000 et seq

Clean Water Act (CWA), 33 USC § 1251 et seq.

Divison 3: Pest Abatement, Cal HSC § 2000-2910

Federal Insecticide, Fungicide and Rodenticide and Act (FIFRA), 7 USC § 136 et seq.

General Provisions, Cal FAC § 11501

Headwaters Inc. v. Talent Irrigation District, 243 F. 3d 526, 529 (9th Cir. 2001).

National Cotton Council v. US Environmental Protection Agency, 553 F. 3d 927 (6th Cir. 2009).

National Environmental Policy Act (NEPA), 42 USC § 4321 et seq.

Order no. 2004-0008 DWQ General Permit 990004

Pesticide Container Recycling 2008, SB 1723, CCR Title 27

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6.1.2 LITERATURE CITED

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Sutter County. 2007. Sutter-Yuba Mosquito and Vector Control District municipal service report: sphere of influence update. Yuba City, CA.

Sutter-Yuba Mosquito & Vector Control District. 1993. Resolution no. 03-11-93: A resolution of the board of trustees of the Sutter-Yuba Mosquito Abatement District changing the district name. Yuba City, CA.

6.2 Chapter 2 - Alternatives

6.2.1 Authorities Cited

14 CCR § 15126.6 (e)(3)(A) – The California Environmental Quality Act

Cal HSC. § 2060-2067 – Mosquito and Vector Control: Abatement

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