Environmental Evaluation of

Integrated Mosquito and Vector Control Programs for the Santa Clara County Vector Control District

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Santa Clara County Vector Control District
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Executive Summary

This document is an Environmental Evaluation of the Santa Clara County Vector Control District's Integrated Vector Management Program (IVMP or Program). The purpose of this evaluation is to analyze the Program's effects on the environment and disclose that information to the public. This report was not prepared pursuant to the California Environmental Quality Act (California Public Resources Code § 21000 et seq.). Santa Clara County's vector-control plan was approved by the Board of Supervisors in 2007. It was adopted through a Notice of Exemption (NOE) because the program is exempt from review under the California Environmental Quality Act (CEQA). Even though CEQA rules do not legally require the County to perform any additional impact studies, the Vector Control District (VCD) voluntarily entered into a coordinated planning process for a Programmatic Environmental Impact Report (PEIR) template, in conjunction with eight other Bay Area Counties in 2012. The goal of this effort was to better inform local residents about VCD's activities. However, upon further review of the options available to accomplish this goal for local residents, the County has instead decided to issue a locally-focused, comprehensive environmental study, instead of the PEIR, that will thoroughly inform the public about the environmental impacts associated with the VCD's activities authorized under the vector-control plan, specific to this County. VCD intends to prepare written responses to all public comments to consider and address all public concern.

ES.1 Program Objectives and Purpose

The District undertakes vector control activities through its Program to manage the following vectors of disease and/or discomfort in the Program Area: mosquitoes, cockroaches, fleas, flies, rats, mice, ticks, yellow jacket wasps, Africanized honeybees, other biting/stinging insects (including mites and bed bugs), and nuisance wildlife (skunks, raccoons, opossum).

The Program's specific objectives are as follows:

> Reduce the potential for human and animal disease caused by vectors

> Reduce the potential for human and animal discomfort or injury from vectors

> Accomplish effective and environmentally sound vector management by means of:

- Surveying for vector abundance/human contact
- Establishing treatment criteria
- Appropriately selecting from a wide range of Program tools or components

Most of the relevant vectors are quite mobile and cause the greatest hazard or discomfort at a distance from where they breed. Each potential vector has a unique lifecycle, and most of them occupy several types of habitats. To effectively control them, an IVMP must be employed. District policy is to identify those species that are currently vectors, to recommend or execute techniques for their prevention and control, and to anticipate and minimize any new emerging vector issues in the county.

The District has, for at least the past two decades, taken an integrated systems approach to mosquito and vector control, utilizing a suite of tools that consist of surveillance, vegetation management, and physical, biological, and chemical controls along with public education. These Program components are described further in Chapter 1 (Introduction) and 2 (Program Description).

ES.2 Previous Outreach Regarding This Evaluation

As noted above, the Santa Clara County Vector Control District (District) distributed an NOP of a Draft PEIR for the Program pursuant to the California Environmental Quality Act (CEQA) Guidelines (Section

15082) on June 7, 2012. The NOP was sent to 40 agencies, organizations, and individuals, including the following state responsible and trustee agencies. Although this is not a CEQA document, comments received during scoping are nevertheless addressed in the resource chapters of this Environmental Evaluation. The comments are contained in a Draft Report on Public Scoping for the PEIR, which is located on the Vector Control District's web site at: http://www.sccgov.org/sites/vector/Pages/vcd.aspx.

ES.3 Areas of Known Public Environmental Concerns

The areas of greatest public controversy based on comments received from public scoping are:

> Use of Pesticides for Vector Control: Members of the public are distrustful of pesticide use for vector control. They prefer other methods such as, eliminate suitable habitat to deal with mosquito problems rather than spraying pesticides. If adulticides must be used, ensure use is justified with documented, mosquito-borne disease activity or within flight range of the tidal marsh. Concern exists about pesticide applications drifting into backyards where the property owner wants to ensure their area is pesticide-free. The concern is not only with impacts to humans and "sensitive populations" but also to domestic animals and wildlife including nontarget insects.

> Use of Biological Control Agents: Controversy exists over the use of some proposed biological control agents, in particular the use of mosquitofish and potential for them to harm sensitive species such as the California red-legged frog.

> District's Authority to Enter Public and Private Property for Control Activities: Regionally, some public agencies want Districts to obtain Encroachment Permits with notification of Park Supervisors for activities such as surveillance, physical control, or vegetation management where access to parkland is needed. US Fish and Wildlife Services' Refuge Mosquito Management Plans are placing strict regulations on mosquito surveillance and control activities within refuge areas where in certain cases mitigation for "take" has been imposed.

ES.4 Uses of This Document

This Environmental Evaluation is primarily a public information document on the environmental aspects of the Vector Control District's Program of activities, including detailed descriptions of:

- the District's strategies and methodologies for managing vectors;
- the procedures the District uses to minimize potential harm to the environment;
- the environmental effects of Program activities in key issue areas (Urban and Rural Land Uses, Aquatic and Terrestrial Biological Resources, Ecological and Human Health, Public Services and Hazard Response, Water Resources, Air Quality, Greenhouse Gases (GHGs), and Noise).

The analysis and conclusions in the Environmental Evaluation are supported by technical appendices, including a Biological Resources Technical Report, an Ecological and Human Health Risk Assessment, an Air Quality and GHG Emissions Technical Report, and an Alternatives Analysis. Preparation of these technical reports involved a review of relevant scientific literature, which are sourced and listed in references chapters of each technical report as well as the Environmental Evaluation.

1 Introduction

This chapter provides an overview of the Santa Clara County Vector Control District's Integrated (Mosquito and) Vector Management Program (IVMP or Program), including the purpose of its vector control activities and the legal and regulatory authority under which the District operates. This chapter also summarizes the vector control activities covered by this Environmental Evaluation, describes the scoping process and environmental concerns expressed by the public, and explains the organization of the overall report.

1.1 History and Background

This section presents the history of why the District was established in 1988 to control the vectors transmitting diseases to humans and their domesticated animals within the District's Service Area. It begins with a description of the diseases of concern, the potential for human and animal illness to occur, and the legislative and regulatory actions leading to the District's establishment of an Integrated Mosquito and Vector Management Program (IVMP or Program).

1.1.1 Vector-Borne Diseases in Program Area

The District's IVMP is designed to protect the public health from the following potential diseases organized by vector. A *vector is* an insect or other organism that transmits a pathogenic fungus, virus, bacterium, etc. such as a mosquito, tick, or rat. According to the California Health and Safety Code [Section 2002(k)], "vector" means any animal capable of transmitting the causative agent of human disease or capable of producing human discomfort or injury, including, but not limited to, mosquitoes, flies, mites, ticks, other arthropods, and rodents and other vertebrates.

1.1.1.1 Mosquitoes

Diseases of concern within the District's Service Area that are spread by mosquitoes include the following at present: West Nile virus (WNV), Western equine encephalomyelitis (WEE), St. Louis encephalitis (SLE), malaria, and dog heartworm disease. The potential for the introduction of new diseases exists at any time.

1.1.1.1.1 West Nile Virus

WNV is transmitted during blood-meal feeding by mosquitoes that have previously fed on the blood of infected birds. Humans, horses, and most other mammals are all potential incidental hosts (CDC 2004a). Approximately 80 percent of people who become infected with WNV develop no clinical illnesses or symptoms and, of those who do develop symptoms, most develop what has been termed West Nile fever. Depending on the degree to which the central nervous system is affected, other more severe diseases could develop including West Nile meningitis, West Nile encephalitis, and West Nile poliomyelitis (CDC 2004b). Out of 429 reported human cases of WNV in 2012 in California, 19 persons died from the disease.

1.1.1.1.2 Western Equine Encephalomyelitis

WEE virus primarily cycles between birds and mosquitoes infecting humans and horses. Horses infected with WEE do not develop a significant viremia[1] and are true dead-end hosts, meaning the horse is a host from which infectious agents are not transmitted to other susceptible hosts.

WEE can also cycle between mosquitoes and blacktail jackrabbits. WEE usually shows no symptoms or is mild in adults, with nonspecific signs of illness and few deaths. The disease is most severe in children,

[1] Viremia is a medical condition where viruses enter the bloodstream and, hence, have access to the rest of the body.

particularly infants under 1 year of age. Infants under 3 months most often experience permanent, severe neurological damage. Horses can also experience asymptomatic infections or mild symptoms; however, more severe infections can occur. Horses that recover from encephalitis have a high incidence of residual symptoms (Iowa State University 2008).

1.1.1.1.3 St. Louis Encephalitis (SLE)

The SLE virus is transmitted to mosquitoes while feeding on the blood of infected birds. Humans and domestic mammals can acquire SLE infection, but are dead-end hosts, hosts that do not develop a significant viremia to be passed on (CDC 2009a). Most SLE infections show no signs, with clinical infections resulting in less than 1 percent of infections that can range from mild nonspecific fever to meningitis or encephalitis. Older age increases the risk of severe disease and fatality. According to the Centers for Disease Control and Prevention (CDC 2009b), almost 90 percent of elderly persons with SLE develop encephalitis.

1.1.1.1.4 Malaria

Malaria parasites are transmitted to humans after being bitten by an infected female Anopheles mosquito. It is endemic to tropical and subtropical parts of the world where climatic factors favor mosquito and parasite development. The mosquito must have been infected by previously feeding on the blood of an infected person. Uncomplicated malaria manifests in patients as flu-like symptoms while severe malaria can cause neurologic abnormalities, anemia, kidney failure, acute respiratory distress syndrome, and hypoglycemia (CDC 2012a). The parasite is most often seen in travelers and immigrants from countries where malaria is endemic; however, outbreaks of locally transmitted cases have been observed; and due to the existence of suitable vectors, the potential risk for the disease to reemerge is present, especially in the southern states (CDC 2010a).

1.1.1.1.5 Dog Heartworm Disease

Heartworm disease is caused by a parasitic worm and results in severe lung disease, heart failure, organ damage, and death in domesticated mammals, mainly dogs and cats. Worms are spread through blood-meal feeding of mosquitoes, with adults maturing in the heart, lungs, and associated blood vessels. The severity of heartworm disease is correlated to how many worms are living inside the animal, how long the animal has been infected, and the animal's response to the heartworms' presence. Signs of the disease can range from no symptoms to tiredness, coughing, and heart failure. The most severe cases are known as caval syndrome in which blood flow to the heart is blocked by a large worm mass. If left untreated, heartworm disease will progress and damage to internal organs will eventually cause death. In some rare cases, humans have contracted heartworms after being bitten by an infected mosquito; however, larvae usually die before they can migrate to the heart or lungs (United States Food and Drug Administration 2010).

1.1.1.2 Other Arthropod Vectors

Other arthropod vectors of concern to the District are ticks and flies.

1.1.1.2.1 Lyme Disease

This disease is caused by Lyme disease bacterium and is spread by the bite of infected ticks. Immature or nymphal ticks most commonly infect humans since they are tiny and difficult to see. Dogs and cats can contract Lyme disease and bring infected ticks in close contact with pet owners (CDC 2013a). Early signs of the bacteria are a red, expanding rash, flu-like symptoms, and swollen lymph nodes. Untreated, the disease can cause inflammation in a variety of tissues in the body including joints, face, spinal cord, and heart. Approximately 10 to 20 percent of patients with Lyme disease have symptoms that worsen and last months to years. This condition is known as Post-treatment Lyme Disease syndrome and is thought to be

an autoimmune response (CDC 2013b). In the United States, most infections occur in the northeast and mid-Atlantic, north central states, and northern California (CDC 2013c).

1.1.1.2.2 Babesiosis

Babesiosis is a parasitic disease caused by parasites that infect and destroy red blood cells in humans and domestic animals, mainly in parts of the northeast and upper Midwest (CDC 2012b). The life cycle of this parasite involves two hosts, a rodent, primarily the white-footed mouse, and a tick. A tick infects a mouse allowing the parasite to complete part of its life cycle. Another tick feeds on the mouse ingesting the partially developed parasite, after which that infected tick can feed on a human delivering the parasite to finish its life cycle (CDC 2012c). Many people who are infected with babesiosis develop no symptoms, while a smaller group of people develops nonspecific flu-like symptoms. The disease can be severe in people who have a compromised immune system, have another serious health condition, or are elderly. Complications can include low and unstable blood pressure, hemolytic anemia, low platelet count, and malfunction of vital organs (CDC 2012d).

1.1.1.2.3 Ehrlichiosis

Ehrlichiosis is a tick-borne bacterial infection of white blood cells caused by three bacterial species in the genus *Ehrlichia*, *E. chaffeensis*, *E. ewingii*, and *E. muris*. The tick bite in most cases is not detected due to the small size of the nymphal tick and symptoms usually develop in 1 to 2 weeks. The symptoms for this group of infections can vary greatly depending on the person, but generally they are flu-like, with 30 percent of adults and 60 percent of children developing rashes (CDC 2011a). Immune-compromised people could experience a more severe case of ehrlichiosis with the fatality rate of those infected being approximately 1.8 percent. The disease is most commonly reported in the southeastern and south central United States (CDC 2011b).

1.1.1.2.4 Rocky Mountain Spotted Fever

Rocky Mountain spotted fever is a tick-borne disease caused by the bacterium *Rickettsia rickettsii*. The bacterium infects the endothelial cells that line the blood vessels. Symptoms are similar to other tick-borne diseases, generally flu-like with 90 percent of cases having an associated rash. Patients who have a severe infection can have long-term health complications where damage to the brain or other vital organs from bleeding or clotting may occur (CDC 2010b). According to the CDC, from 2000 to 2010 Rocky Mountain spotted fever had a fatality rate of 0.5 percent. Cases of this disease have been reported from all 50 states (CDC 2012e).

1.1.1.2.5 Anaplasmosis

Anaplasmosis is a tick-borne disease caused by the bacterium *Anaplasma phagocytophilum*. The western black-legged tick (*Ixodes pacificus*) is the primary vector in Northern California. The symptoms of anaplasmosis are general, nonspecific flu-like symptoms; however, rashes are rarely reported and may signify a coinfection with other tick-borne diseases. The severity of the disease depends in part on the patient's immune system condition (CDC 2012f). According to the CDC, since anaplasmosis became a reportable disease in 1999 the number of cases reported per year has increased steadily. However the case fatality rate has remained low at less than 1 percent. The disease is most frequently reported from the upper midwestern and northeastern part of the country (CDC 2012g).

1.1.1.2.6 Tularemia

Tularemia is a bacterial infection of animals and humans caused by the bacterium *Francisella tularensis*. The disease can be transmitted by tick and deerfly bites, handling infected animals, and more rarely inhaling dust or drinking water contaminated with the bacterium (CDC 2011d). Tularemia manifests itself depending on how the bacterium enters the body. Ulcers and lymph gland inflammation are common symptoms mainly from infected animal handling and insect bites. Inhaled tularemia is the most severe

form causing chest pain and trouble breathing. This condition can also result from other forms of tularemia being left untreated. Rabbits and domestic cats are very susceptible to tularemia (CDC 2011e).

1.1.1.3 Mammals

1.1.1.3.1 Hantavirus

Hantavirus Pulmonary Syndrome (HPS) is a respiratory disease in humans caused by an infection with hantavirus. The *Sin Nombre* hantavirus causes the majority of cases of HPS in the United States, and the host of this virus is the deer mouse (*Peromyscus maniculatus*), although several other hantaviruses with associated hosts exist. Rodents spread the disease through their urine, droppings, and saliva. The virus is mainly transmitted through airborne transmission, with people inhaling air contaminated with the virus. Other ways people may become infected are when they touch their nose or mouth after touching something contaminated with the virus, eat something that is contaminated, and very rarely bitten by an infected rodent (CDC 2012h). Early symptoms of the viral infection are flu-like, with later symptoms of shortness of breath, evidence of the lungs filling with fluid. According to the CDC the mortality rate for HPS is 38 percent (CDC 2012i). Hemorrhagic fever with renal syndrome is another disease cause by hantavirus and is transmitted in similar ways. Early symptoms are flu-like, with some individuals developing inflammation or redness in the face. Later symptoms can include low blood pressure, acute shock, and kidney failure (CDC 2011f).

1.1.1.3.2 Plague

Plague is a disease caused by the bacterium *Yersinia pestis* that affects humans and other mammals. Bites from infected rodent fleas are the most common way of transmitting the plague (bubonic or septicemic plague); however, the bacterium can also be transmitted through contact with infected animals (septicemic plague) or breathing in infectious droplets for instance after an infected animal coughs (pneumonic plague). Cats are particularly susceptible to plague and can be infected by eating infected rodents, posing a risk to humans they come in contact with (CDC 2012j). All forms of the plague develop flu-like symptoms. With bubonic and septicemic plague swelling of lymph nodes and tissue necrosis respectively can occur near where the bacterium entered the body. Pneumonic plague is the most serious form causing shortness of breath and chest pain from bacteria spreading in the lungs. It can develop from untreated bubonic and septicemic plague and is the only form that can spread person to person (CDC 2012k).

1.1.1.3.3 Rabies

Rabies is a viral disease transmitted to humans and domestic animals through close contact with infected animals, usually saliva from bites or scratches. In the United States, bats are the most common source of human rabies deaths. Initial symptoms of rabies are generally fever and unusual sensation at the wound site. The virus then spreads through the central nervous system causing fatal inflammation of the brain and spinal cord. From here, the disease can manifest in two ways: (1) individuals with furious rabies can show signs of hyperactivity and agitation with death resulting by cardiorespiratory arrest or paralytic rabies, where muscles gradually become paralyzed with a coma slowly developing and eventual death; and (2) paralytic rabies, which runs a less dramatic and usually longer course than the furious form with the muscles gradually becoming paralyzed, then a coma slowly develops, and eventually death occurs. (World Health Organization 2013).

1.1.1.3.4 Raccoon Roundworm

Raccoon Roundworm, *Baylisascaris procyonis*, is an infection caused by the ingestion of roundworm eggs. The primary host for the roundworm is raccoon; however, other small mammals and birds can become infected. Dogs can also become infected by eating an infected animal, potentially passing worm eggs through their feces. Anyone who is exposed to areas where raccoons frequent is potentially at risk; however, children and the developmentally disabled are at higher risk as they are more likely to put soil

and contaminated fingers and objects in their mouths (CDC 2012l). Larvae hatch in the intestines and migrate throughout the body affecting the brain and spinal cord, the eyes, and other organs (CDC 2012m). Tissue damage and symptoms tend to be severe due to the larval roundworm size, their ability to migrate throughout the body, and that they do not die readily (CDC 2012n).

1.1.2 Potential for Human and Animal Illness

To avoid or manage the risk to human and animal health from the diseases listed above requires effective vector-borne disease surveillance and control strategies that may fluctuate temporally and regionally. Such factors include mosquito and pathogen biology, environmental factors, land use patterns, and resource availability to support production of the vectors in quantities that threaten human and animal health. For example, detecting and monitoring WNV activity is accomplished by testing mosquitoes, dead birds, sentinel chickens, horses, and humans. The District identifies the mosquito species present, its locations and densities within the Service Area, and then the disease potential.

The District engages in activities and management practices to control mosquitoes and other vectors and to address the specific situations within its Service Area. These management practices emphasize the fundamentals of integrated pest management (IPM) wherein source reduction, habitat modification, and biological control are used when appropriate before resorting to pesticides. When pesticides are used, they are applied in a manner that minimizes risk to human health and ecological health.

1.1.3 Legislative and Regulatory Actions

A number of legislative and regulatory actions form the basis for the District's authority to engage in vector control. The District is a regulatory agency formed pursuant to California Health and Safety Code Section 2000 et seq. State law charges the District with the authority and responsibility to take all necessary or proper steps for the control of mosquitoes and other vectors in the District.

Pursuant to Sections 2040-2045, the District may conduct all of the following activities:

(a) Conduct surveillance programs and other appropriate studies of vectors and vector-borne diseases.

(b) Take any and all necessary or proper actions to prevent the occurrence of vectors and vector-borne diseases.

(c) Take any and all necessary or proper actions to abate or control vectors and vector-borne diseases.

(d) To purchase the supplies and materials, employ the personnel, and contract for the services that may be necessary or proper to carry out the purposes and intent of this chapter.

(e) To build, repair, and maintain on any land the dikes, levees, cuts, canals, or ditches that may be necessary or proper to carry out the purpose and intent of this chapter.

(f) To engage necessary personnel, to define their qualifications and duties, and to provide a schedule of compensation for the performance of their duties.

(g) To participate in, review, comment, and make recommendations regarding local, state, or federal land use planning and environmental quality processes, documents, permits, licenses, and entitlements for projects and their potential effects on the purposes and intent of this chapter.

(h) A district may contract with other public agencies and federal agencies to provide any service, project, or program authorized by this chapter within the district's boundaries. A district may contract with other public agencies to provide any service, project, or program authorized by this chapter within the boundaries of the other public agencies and federal agencies.

In accordance with California Health and Safety Code Section 2053:

(a) A district may request an inspection and abatement warrant pursuant to Title 13 (commencing with Section 1822.50) of Part 3 of the Code of Civil Procedure. A warrant issued pursuant to this section shall apply only to the exterior of places, dwellings, structures, and premises. The warrant shall state the geographic area which it covers and shall state its purposes. A warrant may authorize district employees to enter property only to do the following:

(1) Inspect to determine the presence of vectors or public nuisances.

(2) Abate public nuisances, either directly or by giving notice to the property owner to abate the public nuisance.

(3) Determine if a notice to abate a public nuisance has been complied with.

(4) Control vectors and treat property with appropriate physical, chemical, or biological control measures.

(b) Subject to the limitations of the United States Constitution and the California Constitution, employees of a district may enter any property, either within the district or property that is located outside the district from which vectors may enter the district, without hindrance or notice for any of the following purposes:

(1) Inspect the property to determine the presence of vectors or public nuisances.

(2) Abate public nuisances pursuant to this chapter, either directly or by giving notice to the property owner to abate the public nuisance.

(3) Determine if a notice to abate public nuisance has been complied with.

(4) Control vectors and treat property with appropriate physical, chemical, or biological control measures.

1.1.3.1.1 Cooperative Agreement between the California Department of Public Health and Local Vector Control Agencies

Due to their public health mission, the California Department of Pesticide Regulation's (CDPR's) Pesticide Regulatory Program provides special procedures for vector control agencies that operate under a Cooperative Agreement with the California Department of Public Health (CDPH). The application of pesticides by vector control agencies is regulated by a special and unique arrangement among the CDPH, CDPR, and County Agricultural Commissioners. CDPR does not directly regulate vector control agencies. CDPH provides regulatory oversight for vector control agencies that are signatory to the Cooperative Agreement. Signatories to the agreement use only pesticides listed by CDPH, maintain pesticide use reports, and ensure that pesticide use does not result in harmful residues on agricultural products.

The District maintains a cooperative agreement with CDPR. Its employees are certified by CDPH as vector control technicians, which help to ensure that employees are adequately trained regarding safe and proper vector control techniques including the handling and use of pesticides and compliance with laws and regulations relating to vector control and environmental protection

1.1.3.1.2 California Pesticide Regulatory Program

CDPR regulates the sale and use of pesticides in California. CDPR is responsible for reviewing the toxic effects of pesticide formulations and determining whether a pesticide is suitable for use in California through a registration process. Although CDPR cannot require manufacturers to make changes in labels, it can refuse to register products in California unless manufacturers address unmitigated hazards by amending the pesticide label. Consequently, many pesticide labels that are already approved by the United States Environmental Protection Agency (USEPA) also contain California-specific requirements.

Pesticide labels defining the registered applications and uses of a chemical are mandated by USEPA as a condition of registration. The label includes instructions telling users how to make sure the product is applied only to intended target pests, and includes precautions the applicator should take to protect human health and the environment. For example, product labels may contain such measures as restrictions in certain land uses and weather (i.e., wind speed) parameters.

1.2 Program Objectives/Purpose and Need

1.2.1 Program Objectives

The District undertakes vector control activities through its Program to control the following vectors of disease and/ or discomfort in the Program Area: mosquitoes, cockroaches, fleas, flies, rats, mice, ticks, yellowjacket wasps, Africanized honeybees, other stinging/biting insects (including mites and bed bugs), and nuisance wildlife (skunks, raccoons, opossum).

The Program's specific objectives are as follows:

> Reduce the potential for human and animal disease caused by vectors

> Reduce the potential for human and animal discomfort or injury from vectors

> Accomplish effective and environmentally sound vector management by means of:

- Surveying for vector abundance/human contact
- Establishing treatment criteria
- Appropriately selecting from a wide range of Program tools or components

Most of the relevant vectors are quite mobile and cause the greatest hazard or discomfort at a distance from where they breed. Each potential vector has a unique life cycle, and most of them occupy several types of habitats. To effectively control them, an IVMP must be employed. District policy is to identify those species that are currently vectors, to recommend techniques for their prevention and control, and to anticipate and minimize any new interactions between vectors and humans.

1.2.2 Purpose and Need

The District was established in 1988 to reduce the risk of vector-borne disease and discomfort to the residents of its Service Area. In addition to being nuisances by disrupting human activities and enjoyment of public and private areas, certain vectors can transmit a number of diseases. A vector is defined by the State of California as "any animal capable of transmitting the causative agent of human disease or capable of producing human discomfort or injury, including, but not limited to, mosquitoes, flies, other insects, ticks, mites, and rats, but not including any domesticated animal…" [California Health and Safety Code Section 2200(f)]. The diseases of most concern in the Program Area are as follows, by the vector they are associated with:

> Mosquito-transmitted illnesses: WNV, WEE, SLE, dog heartworm, and malaria

> Tick-transmitted illnesses: Lyme disease, babesiosis, ehrlichiosis, tularemia, Rocky Mountain spotted fever, anaplasmosis

> Rodent/rat-transmitted illnesses: leptospirosis, HPS, tularemia, plague

> Other vector-transmitted illnesses: rabies transmitted by skunks, plague and murine typhus transmitted by fleas (usually on rats), raccoon roundworm

Depending on the disease, both human and domestic animal health can be at risk of disability, illness, and/or death. Furthermore, potential exists for introduction of new disease vectors into the District's Service Area.

1.3 Vector Control Components Analyzed in this Environmental Evaluation

The District's Program is an ongoing series of related actions for control of mosquitoes and other vectors of human disease and discomfort. The District's activities involve the identification of vector problems; responsive actions to control existing populations of vectors, prevent new sources of vectors from developing, and manage habitat to minimize vector production; education of landowners and others on measures to minimize vector production or interaction with vectors; and provision and administration of funding and institutional support necessary to accomplish District objectives.

For at least the past two decades, the District has taken an integrated systems approach to mosquito and vector control utilizing a suite of tools that consist of:

> Surveillance

> Physical Control

> Vegetation Management

> Biological Control

> Chemical Controls

- Larvicides
- Adulticides
- Other

> Other Nonchemical Control/Trapping

> Public Education

These first six tools are called "components," are part of the ongoing Program. These components are described in detail in Chapter 2, Program Description. Program implementation is weighted heavily towards vegetation management and physical and biological control, in part to minimize use of chemical control. To realize effective and environmentally sound vector management, vector control must be based on several factors:

> Carefully monitoring or surveying vector abundance and/or potential contact with people

> Establishing treatment criteria (thresholds)

> Selecting appropriate tools from a wide range of control methods

This Program consists of a dynamic combination of surveillance, treatment criteria, and use of multiple control activities in a coordinated program with public education that is generally known as integrated pest management (IPM) or specifically for the District as Integrated Vector Management (IVM).

The District's IVMP, like any IPM program, seeks by definition to use procedures that will minimize potential harm to the environment. The District's Program employs IPM principles by first identifying the species and abundance of mosquitoes/vectors through evaluation of public service requests and field surveys of immature and adult mosquito/vector populations and, then, if the populations exceed predetermined criteria, using the most efficient, effective, and environmentally sensitive means of control. Public education is an important control strategy for all mosquito species. In some situations, water management or other physical control activities can be instituted to reduce mosquito-breeding sites. The District also uses biological control such as the planting of mosquitofish in some settings: ornamental fish ponds, water troughs, water gardens, fountains, and unmanned swimming pools. When these approaches are not effective, or are otherwise deemed inappropriate, then pesticides are used to treat specific pest-producing or pest-harboring areas.

Three core tenets are essential to the success of a sound IVMP.

> *First*, a proactive approach is necessary to minimize adverse effects and maximize successful vector management. Elements such as thorough surveillance and a strong public education program make all the difference in reducing potential human vector interactions.

> *Second*, long-term environmentally based solutions (e.g., water management, reduction of harborage and food resources, exclusion, and enhancement of predators and parasites) are optimal as they reduce the potential pesticide load in the environment.

> *Lastly*, utilizing the full array of options and tools (public education, surveillance, physical control, biological control, and when necessary chemical control) in an informed and coordinated approach supports the overall goal of an environmentally sensitive vector management program.

1.4 Public Input

Even though CEQA rules do not legally require the County to perform any additional impact studies, the Vector Control District (VCD) voluntarily entered into a coordinated planning process for a Programmatic Environmental Impact Report (PEIR) template, in conjunction with eight other Bay Area Counties in 2012. The goal of this effort was to better inform local residents about VCD's activities. However, upon further review of the options available to accomplish this goal for local residents, the County has instead decided to issue a locally-focused, comprehensive environmental study, instead of the PEIR, that will thoroughly inform the public about the environmental impacts associated with the VCD's activities authorized under the vector-control plan, specific to this County. VCD intends to prepare written responses to all public comments to consider and address all public concern.

Prior to determining that a PEIR was not required under the circumstances, the Santa Clara County Vector Control District had on June 7, 2012 distributed a Notice of Preparation (NOP) of a Draft PEIR. The NOP was sent to 40 agencies, organizations, and individuals, including the following state responsible and trustee agencies: CA Department of Parks and Recreation, CA Department of Forestry and Fire Protection, CA Department of Fish and Wildlife, CA Department of Public Health, CA Department of Pesticide Regulation, CA Department of Transportation and CA State Lands Commission.

Other agencies, organizations, and individuals the NOP was sent to include:

> US Fish and Wildlife Service, US Army Corps of Engineers

> US Dept of Interior, Bureau of Reclamation

> San Francisco Regional Water Quality Control Board

> San Francisco Bay Conservation Development Commission

> Alameda County Planning Office

> San Mateo County Planning Office

> Santa Cruz County Planning Department

> San Benito County Planning Office

> Santa Clara Planning Office

> Santa Clara County Parks and Recreation

> Santa Clara Valley Water District

> Midpeninsula Open Space District

> Central Coast Regional Water Quality Control Board, Baykeepers
> Cupertino City Manager
> Gilroy City Manager
> Los Altos City Manager
> Los Altos Hills City Manager
> Los Gatos City Manager
> Milpitas City Manager
> Monte Sereno City Manager
> Morgan Hill City Manager
> Mountain View City Manager
> Palo Alto City Manager
> San Jose City Manager
> Santa Clara City Manager
> Saratoga City Manager
> Sunnyvale City Manager

The NOP provided a description of the Program, the location of Program activities, and the resources and environmental concerns planned for analysis. The notice announced a public scoping meeting and requested the comments on the content be submitted within 30 days of receipt. The public scoping meeting was held at the following location and time:

- Berger Auditorium, San Jose, on June 28, 2012 from 6:00 p.m. - 8:00 p.m.

A total of 10 comments were received: two from government agencies (the United States Department of Interior - Fish and Wildlife Services; and the California State Lands Commission) and eight from individuals. These comments, which are addressed throughout this document, are contained in the Draft Report on Public Scoping for the PEIR, which is available on the District's web site at: **www.sccgov.org**/sites/**vector**.

1.4.1 Areas of Known Public Concern

The areas of greatest public concern and debate are based on comments from public scoping and comments made during other District activities. These areas of controversy are explained here and then incorporated into the preceding Summary chapter:

> Use of Pesticides for Vector Control: Members of the public are distrustful of pesticide use for vector control. They prefer other methods to eliminate suitable habitat to deal with mosquito problem rather than spraying pesticides. If adulticides must be used, ensure use is justified with documented, mosquito-borne disease activity within or within flight range of the tidal marsh. Concern exists about pesticide applications drifting into backyards where the property owner wants to ensure their area is pesticide-free. The concern is not only with harmful effects to humans and "sensitive populations" but also to domestic animals and wildlife including nontarget insects.

> Use of Herbicides for Vegetation Management: Request for specific vegetation management information about the proposed chemical vegetation control agents (herbicides), the types, amounts and locations of chemical stored, application methods and rates, and their effects on the environment.

> Use of Biological Control Agents: Controversy exists over the use of some proposed biological control agents, in particular the use of mosquitofish and potential for them to harm sensitive species such as the California red-legged frog.

> District's Authority to Enter Public and Private Property for Control Activities: Some public agencies want the District to obtain an Encroachment Permit with notification of Park Supervisors for activities such as surveillance, physical control, or vegetation management where access to parkland is needed. Water districts insist that mosquito abatement materials and practices proposed for use on watershed lands must be thoroughly vetted and approved by CDPH.

Section 1.5, Environmental Concerns, presents a summary of the environmental concerns by resource or issue area.

1.5 Environmental Issue Areas

Below is a listing of environmental concerns by resource, including but not limited to issues raised by agencies and the public. It should be noted that because this document is not a CEQA document, it does not address impacts and mitigations per CEQA requirements but rather assesses the District's activities in relation to environmental issues.

1.5.1 Urban and Rural Land Uses

The following concerns are associated with land uses, including for both urban/developed lands and rural/open space/undeveloped lands. They are addressed primarily in Chapter 3, Urban and Rural Land Uses:

> Need to analyze and minimize aspects of the Program that diminish recreational experience of park visitors of the regional parks and trails within the Program Area.

> Discuss the population density (age, health, disabilities, etc.) within the designated residential developments and list the effects of pesticides on their health and daily activity.

> Expressed concern on impacts at school sites.

> Address local community regulations regarding pesticides. Biological Resources-Aquatic

1.5.2 Biological Resources-Aquatic

The following concerns are associated with biological resources in aquatic environments and are addressed in Chapter 4 of this evaluation or in Appendix A, Biological Resources Technical Report:

> Employ techniques associated with the physical control of vectors and their habitat that conform to Habitat Conservation Plan (HCP) avoidance, minimization, and mitigation measures.

> Consider direct/indirect effects of using mosquitofish as control. Do not stock mosquitofish (*Gambusia affinis*) in ponds, creeks, or reservoirs. As the mosquitofish used (*Gambusia affinis)* are nonnative predatory fish, describe how their impact on native fish populations is considered.

> Include a detailed description and complete assessment of the biological control impacts (current and future, direct and indirect) on habitats (including endangered, threatened, and locally unique species and sensitive habitats) and on species (sensitive fish, wildlife, or plants).

> Include a detailed description and complete assessment of the chemical control impacts (current and future, direct and indirect) on habitats (including endangered, threatened, and locally unique species and sensitive habitats) and on species (sensitive fish, wildlife, or plants).

> Include appropriate measures to ensure complete take avoidance of protected species while coordinating with United States Fish and Wildlife Service (USFWS), United States Department of Agriculture, Forest Service (USFS), and California Department of Fish and Wildlife (CDFW).

1.5.3 Biological Resources-Terrestrial

The following concerns are associated with biological resources in terrestrial environments and are addressed in Chapter 5 of this evaluation or in Appendix A, Biological Resources Technical Report:

> Discuss potential impacts on insect pollinators/bees from chemicals in treatment applications.

> Describe the effects of all chemicals that are used and/or proposed for use on wildlife and natural ecosystems, including insect prey, birds, mammals, fish, vegetation and site topography. The loss of prey for birds is a particular concern. Also, consider unwanted effects of the “inactive” portion of the pesticides. What effects will the carrier portion of the chemicals have on the environment?

> Discuss the potential impact of Bs/Bti products on native species.

> Describe the role of mosquitoes within the food chain, and subsequent impacts if they were removed in terms of amphibians, birds, reptiles, fish and insects. This issue is also addressed in Section 6.2.

> Pesticides can also kill the natural predators of mosquitoes, which have great difficulty in recovery from pesticides.

> Pesticide efficacy attenuation and possible long-term resistance is an issue for all chemically based mosquito control programs. It is addressed by the use of different control methods and different agents over time where possible (BMP and IVM techniques are designed to identify these issues early and modify applications as appropriate and feasible.

> Note that the Program Area includes potential habitat for several California and federally threatened and other sensitive plant and wildlife species including, but not limited to, California tiger salamander and Santa Cruz long-toed salamander and, as such, comprehensive biological studies should be implemented.

> Coordinate with CDFW, California Natural Diversity Database, USFWS, and USFWS’ Information, Planning, and Conservation planning tool to identify special-status plant or wildlife species.

> A primary concern is the environmental impact on natural resources in terms of vegetation removal, soil erosion, and possible wildlife impact.

> Ensure mosquito abatement staff minimizes impact to tidal marsh and vernal pool habitats (especially during breeding season). Restrict operation of vehicles to levees and existing roads, and avoid vernal pool plants during blooming season (March–June).

> Concern for spread of invasive weeds, erosion, and sedimentation.

> Include a detailed description and complete assessment of the biological control impacts (current and future, direct and indirect) on habitats (including endangered, threatened, and locally unique species and sensitive habitats) and on species (sensitive fish, wildlife, or plants).

> Include a detailed description and complete assessment of the chemical control impacts (current and future, direct and indirect) on habitats (including endangered, threatened, and locally unique species and sensitive habitats) and on species (sensitive fish, wildlife, or plants).

> Includes all appropriate measures to ensure complete take avoidance of protected species while coordinating with USFWS, USFS, and CDFW.

1.5.4 Ecological Health Hazards

The following concerns are associated with ecological health and are addressed in Chapter 6 of this document in Appendix B, Human and Ecological Health Assessment Report:

> Require additional information regarding bait blocks, chemical agents, and poisons in sanitary sewers concerning components and effects.

> Describe the effects of all chemicals that are used and/or proposed for use on wildlife and natural ecosystems, including insect prey, birds, mammals, fish, vegetation, and site topography. The loss of prey for birds is a particular concern.

> Discuss the potential impact of *Bacillus sphaericus* on native species. What would justify its use? What native species would be impacted?

> Discuss impacts on bees from chemicals in treatment applications.

> Concern over the “inactive” portion of the pesticides. What effects will the carrier portion of the chemicals have on the environment?

> Address the effect of pesticides on the natural predators of mosquitoes.

> The continued spray program leads to survival of mosquitoes resistant to pesticides – “the pest mill”.

> Describe the role of mosquitoes within the food chain, and subsequent impacts if they were removed in terms of amphibians, birds, reptiles, fish, and insects.

> Upon application and broadcast of pesticides, what is the fate and transport of these chemicals? Look at droplet size, dispersal patterns given wind, conversion products (both in storage and environment), and impacts of conversion products. Discuss the persistence of proposed treatment substances in the environment as well as the potential for bioaccumulation.

> Include monitoring programs that are designed to validate assumptions regarding the environmental fate and transport of materials.

> Include a detailed description and complete assessment of the chemical control impacts (current and future, direct and indirect) on habitats (including endangered, threatened, and locally unique species and sensitive habitats) and on species (sensitive fish, wildlife, or plants).

> Include a detailed description and complete assessment of the biological control impacts (current and future, direct and indirect) on habitats (including endangered, threatened, and locally unique species and sensitive habitats) and on species (sensitive fish, wildlife, or plants).

1.5.5 Human Health Hazards

The following concerns are associated with human health and are addressed in Chapter 7 of this document in Appendix B, Human and Ecological Health Assessment Report.

> Address Program impacts on people and pets through ingestion and absorption pathways and proposed mitigation. Address impacts on chemically sensitive people and sensitive populations such as children, the elderly, and pregnant women. Exposure to pesticides can result in compromised immune system, which would allow for development of allergies or autoimmune disorders.

> List any and all biological or chemical agents proposed for use.

> Require additional information regarding bait blocks, chemical agents, and poisons in sanitary sewers concerning components and effects.

> Concern over public safety and health with regards to existing vegetable gardens and fruit trees within the Program Area. Local swimming holes could be a potential habitat for breeding mosquitoes, and chemical treatment could impact humans.

> Concerned with use of Zenivex; it mimes chrysanthemums but is a harmful neurotoxin.

> Concerned that adulticides may present danger to humans, as many pesticides are known carcinogens and endocrine disruptors.

> Concerned that pyrethrins may disrupt the normal functioning of sex hormones while piperonyl butoxide (PBO) may affect the functioning of hormone-related organs.

> In addition to short-term effects, what are the long-term effects of repeated exposure to these chemicals?

1.5.6 Public Services and Hazard Response

While no scoping comments directly dealt with public services and hazard responses, the following issues are addressed in Chapter 8 of this document:

> Risk of aerial equipment failure during applications of pesticides.

> Safe storage and disposal of chemical-related materials.

1.5.7 Water Quality

Chapter 9, Water Resources, addresses concerns related to the following potential impacts to surface water and groundwater resources:

> Concern for spread of invasive weeds, erosion and sedimentation.

> CDPH must thoroughly vet and approve mosquito abatement materials and practices proposed for use on watershed lands.

> The Water Agency requests to integrate “Source Reduction” strategies in Water Agency-owned flood control channels with our Stream Maintenance Program approaches. (Sonoma County Water Agency)

> The Water Agency and the District requests the opportunity to review environmental documents and design plans for “Source Reduction” strategies when they become available.(Sonoma County Water Agency)

> Describe, quantify, and evaluate impacts of dredge or fill activities.

> Potential for drift from aerial and ground applications on water bodies.

> Identify watershed impacts from aerial and ground applications including the potential to impact drinking water supplies.

1.5.8 Air Quality and Climate Change

The following environmental concerns are addressed in Chapter 10, Air Quality, and Chapter 11, Greenhouse Gases and Climate Change, in this document in Appendix C, Air Quality and GHG Technical Report:

> Spraying/fogging will adversely affect air quality for humans and pets alike.

> Address impacts of emissions of air pollutants from control and treatment methods and combustion of fuels.

> Discuss impacts on greenhouse gases and climate change.

1.5.9 Noise

The following environmental concerns are addressed in Chapter 12, Noise, in this document and in Appendix D, Noise Analysis Technical Report:

> Evaluate noise-related impacts on humans, in particular consistency with local noise regulations.

> Evaluate noise-related impacts on wildlife. For example, describe the impact of using motorized vehicles in marshes. Can these sites be treated in other ways to reduce or eliminate impact?

1.6 Report Organization

This Environmental Evaluation provides an assessment of the District's Program in the following environmental resource areas: human health, ecological health, agricultural economics and land use, nonagricultural land uses, public services/hazard response, water quality (surface water and groundwater), air quality, climate change (greenhouse gas production), noise, and biological resources. The human and ecological risk assessments are technical appendices with results summarized in the appropriate sections of this Environmental Evaluation.

> Chapter 1, Introduction, provides the Program's history and authority, Program objectives, a summary of public involvement activity and the public's concerns, and the organization of the overall document.

> Chapter 2, Program Description, presents the Program objectives, chemical treatment and nonchemical treatment components, and best management practices (BMPs). It also describes equipment use, public education, and required permits and agency coordination.

> Chapter 3, Urban and Rural Land Uses, explains the environmental setting and provides an environmental assessment for each component.

> Chapter 4, Biological Resources – Aquatic, explains the environmental setting and provides an environmental assessment for each component.

> Chapter 5, Biological Resources – Terrestrial, explains the environmental setting and provides an environmental assessment for each component.

> Chapter 6, Ecological Health, explains the environmental setting and provides an environmental assessment for each component.

> Chapter 7, Human Health, explains the environmental setting and provides an environmental assessment for each component.

> Chapter 8, Public Services and Hazard Response, explains the environmental setting and provides an environmental assessment for each component.

> Chapter 9, Water Resources, explains the environmental setting and provides an environmental assessment for each component.

> Chapter 10, Air Quality, explains the environmental setting and provides an environmental assessment for each component.

> Chapter 11, Greenhouse Gases and Climate Change, explains the environmental setting and provides an environmental evaluation for each component.

> Chapter 12, Noise, explains the environmental setting and provides an environmental evaluation for each component.

> Chapter 13, Report Preparers, lists the persons and organizations involved in the preparation of this Environmental Evaluation.

> Chapter 14, References, identifies the organizations and persons consulted and references cited in this Environmental Evaluation.

> Appendix A, Biological Resources Technical Report

> Appendix B, Ecological and Human Health Risk Assessment

> Appendix C, Air Quality and Greenhouse Gas Emissions Technical Report

> Appendix D, Noise Analysis Technical Report

> Appendix E, Alternatives Analysis

1.7 Environmental Evaluation Methodology

Because the exact location and timing of potential vector control activities are unknown, the analysis in each of the environmental issue chapters has been conducted in general terms. Each chapter contains an Environmental Background section, which describes environmental and regulatory setting for the issue area being covered. The Environmental Evaluation section analyzes the environmental effects of vector control activities under each of the Program Components, and discusses measures used to minimize those effects.

2 Program Description

2.1 Program Area and Vicinity

The Santa Clara County Vector Control District (Lead Agency and Program Sponsor) is preparing this Environmental Evaluation to analyze the environmental effects of the continued implementation of a suite of control strategies and methods prescribed in its Integrated (Mosquito and) Vector Management Program (IVMP or Program). The District implements its Program primarily within a jurisdiction or Service Area of 1,312 square miles. The activities described herein are conducted throughout Santa Clara County.

Cities in Santa Clara County encompass 355 square miles of the county and include: Campbell, Cupertino, Gilroy, Mountain View, Los Altos, Los Altos Hills, Los Gatos, Milpitas, Monte Sereno, Morgan Hill, Palo Alto, San Jose, Santa Clara Saratoga, Sunnyvale, Unincorporated zones encompass 950 square miles and include Henry Coe State Park and numerous county parks and federal lands encompassing about 9,619 acres or 15 square miles of south San Francisco Bay wetlands and Moffet Federal Airfield. Eight thousand acres of commercial salt ponds were recently acquired by US Fish and Wildlife Service and managed by the Don Edwards Refuge System.

Under California law, the District can also take direct but limited action in adjacent areas bordering its Service Area (Alameda County, San Mateo County, Santa Cruz County, San Benito County, Stanislaus County and Merced County), if needed to provide control of mosquitoes and other vectors originating in adjacent areas for the health and safety of residents of the immediate Service Area [California Health and Safety Code Section 2270(a)]. Control activities may also be provided in adjacent areas upon request of the adjacent jurisdictions to protect the health and safety of residents in adjacent jurisdictions. Actions that would be taken outside of the Service Area are the same types of actions undertaken within the Service Area and in similar types of habitats or sites. In summary, the Program occurs in an area that is somewhat larger than the District's Service Area; this larger area is called the Program Area. The Program Area and its location within the State of California are shown on Figure 2-1, Santa Clara County Vector Control District Program Area.

Mosquito and/or vector control activities are conducted at a wide variety of locations or sites throughout the District's Service Area, including tidal marshes, duck clubs, other diked marshes, lakes and ponds, rivers and streams, vernal pools and other seasonal wetlands, stormwater detention basins, flood control channels, spreading grounds, street drains and gutters, wash drains, irrigated pastures, or agricultural ditches, as well as animal troughs, artificial containers, tire piles, fountains, ornamental fishponds, swimming pools, liquid waste detention ponds, and urban harborage (such as covered wood piles, residential and commercial landscape, trash receptacles). Within the larger Program Area, activities would be conducted at similar sites.

2.2 Program Objectives

2.2.1 Purpose and Need

The District was established in 1988 to reduce the risk of vector-borne disease and discomfort to the residents of its Service Area. In addition to being problematic by disrupting human activities and enjoyment of public and private areas, certain vectors can transmit a number of diseases. A vector is defined by the State of California as "any animal capable of transmitting the causative agent of human disease or capable of producing human discomfort or injury, including, but not limited to, mosquitoes, flies, other insects, ticks, mites, and rats, but not including any domesticated animal…" [California Health

and Safety Code Section 2200(f)]. The diseases of most concern in the Program Area are as follows, by the vector they are associated with:

> **Mosquito-transmitted illnesses:** WNV, WEE, SLE, dog heartworm, and malaria

> **Tick-transmitted illnesses:** Lyme disease, babesiosis, ehrlichiosis, tularemia, Rocky Mountain spotted fever, anaplasmosis

> **Rodent/Rat:** leptospirosis, hantavirus pulmonary syndrome (HPS), tularemia, plague

> **Other vector-transmitted illnesses:** rabies transmitted by skunks, raccoon, bats coyotes, plague and murine typhus transmitted by fleas (on rats and opossum) and raccoon roundworm

Depending on the disease, both human and domestic animal health can be at risk of disability, illness, and/or death. Furthermore, potential exists for introduction and transmission of new diseases by current vectors and for new disease vectors to be introduced into the District's Service Area.

2.2.2 Program Objectives

The District undertakes vector control activities through its Program to control the following vectors of disease and/or discomfort in the Program Area: mosquitoes, cockroaches, fleas, flies, rats, mice, ticks, yellowjackets, Africanized honeybees, other stinging/biting insects (including mites and bedbugs), coyote, skunks, raccoons, and opossum.

The Program's specific objectives are as follows:

> Reduce the potential for human and animal disease caused by vectors

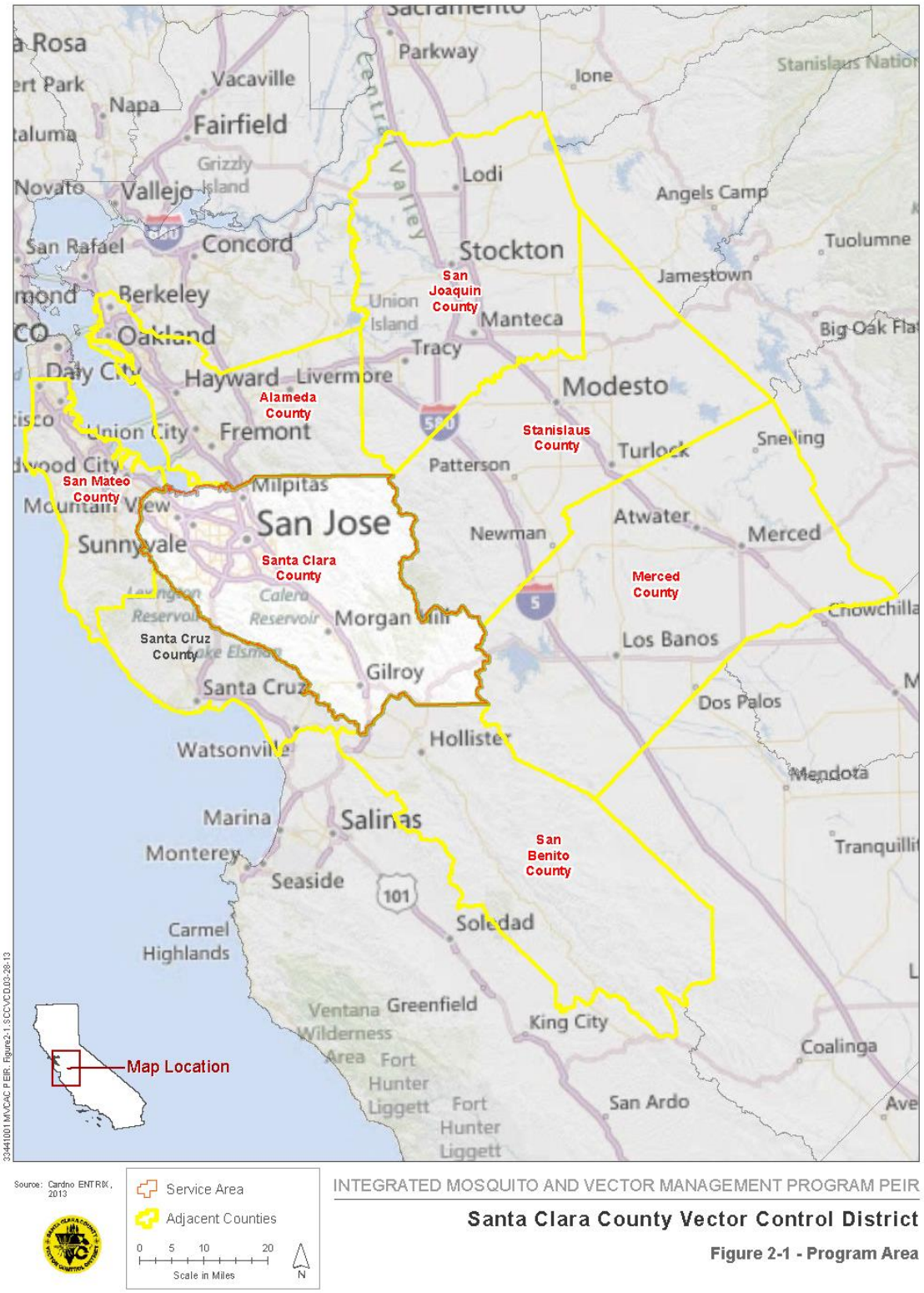
> Reduce the potential for human and animal discomfort or injury from vectors

> Accomplish effective and environmentally sound vector management by means of:

- Surveying for vector abundance/human contact
- Establishing treatment criteria
- Appropriately selecting from a wide range of Program tools or components

Most of the relevant vectors are quite mobile and cause the greatest hazard or discomfort at a distance from where they breed. Each potential vector has a unique life cycle, and most of them occupy several types of habitats. To effectively control them an IVMP must be employed. District policy is to identify those species that are currently vectors, to recommend techniques for their prevention and control, and to anticipate and minimize any new interactions between vectors and humans and domestic animals.

Figure 2-1 Santa Clara County Vector Control District Program Area



2.3 Vector Control District Program

The District's Program is an ongoing series of related actions for control of mosquitoes and other vectors of human disease and discomfort. The District's activities involve the identification of vector problems; responsive actions to control existing populations of vectors, prevent new sources of vectors from developing, and manage habitat to minimize vector production; education of landowners and others on measures to minimize vector production or interaction with vectors; and provision and administration of funding and institutional support necessary to accomplish District objectives.

The District has, for at least the past two decades, taken an integrated systems approach to mosquito and vector control, utilizing a suite of tools that consist of surveillance, vegetation management, and physical, biological, and chemical controls along with public education. These Program "tools" or components are described in the subsequent subsection as "Program components.") Program implementation is weighted heavily towards vegetation management and physical and biological control, in part, to reduce the need for chemical control. To realize effective and environmentally sound vector management, vector control must be based on several factors:

> Carefully monitoring or surveying vector abundance and/or potential contact with people

> Carefully monitor and survey for vector diseases and their antecedent factors that initiate and/or amplify disease

> Establishing treatment criteria (thresholds)

> Selecting appropriate tools from a wide range of control methods

This Program consists of a dynamic combination of surveillance, treatment criteria, and use of multiple control activities in a coordinated program with public education that is generally known as Integrated Pest Management (IPM) or Integrated Vector Management (IVM).

While these Program components or tools together encompass the District's Program, it is important to acknowledge that the specific tools District staff use vary from day to day and from site to site in response to the vector species that are active, their population size or density, their age structure, location, time of year, local climate and weather, potential for vector-borne disease, proximity to human populations, including (a) proximity to sensitive receptors, (b) District staff's access to vector habitat, (c) abundance of natural predators, (d) availability and cost of control methods, (e) effectiveness of previous control efforts at the site, (f) potential for development of resistance in vector populations, (g) landowner policies or concerns, (h) proximity to special-status species, and (i) applicability of Endangered Species Recovery Plans, HCPs, Natural Community Conservation Plans (NCCPs), and local community concerns, among other variables. Therefore, the specific actions taken in response to current or potential vector activity at a specific place and time depend on factors of vector and pathogen biology, physical and biotic environment, human settlement patterns, local standards, available control methods, and institutional and legal constraints. While some consistent vector sources are exposed to repeated control activity, many areas with minor vector activity are not routinely treated, and most of the land within the District's Service Area has never been directly treated for vectors.

The District's IVM Program (or IVMP), like any IPM program, seeks by definition to use procedures that will minimize potential harm to the environment. The District's IVMP employs IPM principles by first determining the species and abundance of mosquitoes/vectors through evaluation of public service requests and field surveys of immature and adult mosquito/vector populations and, then, if the populations exceed predetermined criteria, using the most efficient, effective, and environmentally sensitive means of control. For all mosquito species, public education is an important control strategy. In some situations, water management or other physical control activities can be instituted to reduce mosquito-breeding sites. The District also uses biological control such as the planting of mosquitofish in some settings, such as ornamental fish ponds, water troughs, water gardens, fountains, and

unmaintained swimming pools. When these approaches are not effective, or are otherwise deemed inappropriate, then pesticides are used to treat specific pest-producing or pest-harboring areas.

Three core tenets are essential to the success of a sound IVMP.

> First, a proactive approach is necessary to minimize harm to the environment and maximize successful vector management. Elements such as thorough surveillance and a strong public education program make all the difference in reducing potential human vector interactions.

> Second, long-term environmentally based solutions (e.g., water management, reduction of harborage and food resources, exclusion, and enhancement of predators and parasites) are optimal as they reduce the potential pesticide load in the environment.

> Lastly, utilizing the full array of options and tools (public education, surveillance, physical control, biological control, and when necessary chemical control) in an informed and coordinated approach supports the overall goal of an environmentally sensitive vector management program.

The District's Program consists of the following components, which are general types of coordinated and component activities, as described below. The Program is a combination of these components with the potential for all of these components to be used in their entirety along with public education.

Chemical methods to control vectors and weeds, under the Vegetation Management and Chemical Control components described below) are employed independently at specific application sites. The pesticides used as part of the District's Program are applied at low concentrations to avoid potential effects to nontarget organisms from acute and/or chronic exposures. Manufacturers carefully establish application amounts mandated by product use requirements for treatment efficacy and low potential risk to nontarget organisms and they are substantially below the thresholds used for toxicity studies in the laboratory. The pesticides the District selects are designed to degrade rapidly in the environment, thereby reducing the opportunity for residual presence and environmental persistence. As different chemicals are selected for potential rotational use in a given area (i.e., larvicides first, followed by adulticides if needed), District staff take care both in the selection of the chemicals used and the application process so that co-exposures to nontarget receptors are highly unlikely. This type of practice reduces the probability of additive or synergistic effects that could occur as a result of simultaneous exposures to more than one chemical.

Synergists, and in some cases adjuvants (used with herbicides to also facilitate mixing and application), are applied to increase the efficacy of some chemical control measures. This application could lead to co-exposures of synergists such as PBO and primary chemical treatments. However, synergists allow for reduced treatment amounts of primary pesticide chemicals, since their performance is improved via conjunctive use. Another example of chemicals sometimes used together is the co-application of methoprene and Bti. This particular treatment is employed to prevent pesticide resistance and to ensure the control of all larval stages of nuisance mosquitoes.

2.3.1 Surveillance Component

Vector surveillance, which is an integral part of the District's responsibility to protect public health and welfare, involves monitoring vector populations and habitat, their disease pathogens, and human/vector interactions. Vector surveillance provides the District with valuable information on what vector species are present or likely to occur, when they occur, where they occur, how many they are, and if they are carrying disease or otherwise affecting humans. Vector surveillance is critical to an IVMP because the information it provides is evaluated against treatment criteria to decide when and where to institute vector control measures. Information gained is used to help form action plans that can also assist in reducing the risk of contracting disease. Equally important is the use of vector surveillance in evaluating the efficacy, cost effectiveness, and environmental effects of specific vector control actions.

2.3.1.1 Mosquito Surveillance

Mosquitoes in nature are distributed within their environment in a pattern following specific adaptations that maximize their survival to guarantee reproductive success. Immature stages develop in water and later mature to a winged adult that is capable of both long- and short-range dispersal. This duality of their life history presents vector control agencies with unique circumstances that require separate surveillance strategies for the aquatic versus terrestrial life stages.

Surveillance involves monitoring the abundance of mosquito populations, their habitat, mosquito-borne disease pathogens, and the interactions between mosquitoes and people over time and space. The District routinely uses a variety of traps for surveillance of adult mosquitoes, regular field investigation of known mosquito sources for direct sampling for immature stages, public service requests for adult mosquitoes, and low ground pressure ATVs to access these sites when necessary. The District conducts surveillance by way of a variety of activities that include:

> **Field counting/sampling and use of trapping**, along with the laboratory analysis of mosquitoes, their hosts, and pathogens to evaluate population densities and potential disease threats such as WNV, WEE, and SLE. Sampling of presence and abundance of mosquito populations tends to occur in areas where the citizenry would have a likelihood of exposure to them; field counts take place both at immature and adult stages of mosquito development or life cycle. Three kinds of traps, host-seeking traps, light traps, and gravid/oviposition traps, are used as described below:

- Host-seeking traps use dry ice (carbon dioxide) to attract female mosquitoes behaviorally cued to seek a host to blood feed. The trap's components include a dry ice container, battery power source, a low ampere motor/fan combination, an LED light source, and a collection container for holding captured adults. Host seeking traps are also called encephalitis virus survey (EVS) traps or carbon dioxide-based traps.
- Light traps (commonly called New Jersey Light traps) use a source of photo-attraction such as an incandescent lamp (25 watt) or compact fluorescent lamp (7 watt) where mosquitoes are pulled in by the suction provided by an electric (110 v AC) appliance motor/fan combination. Mosquitoes picked up by the suction are directed downward (via screened cone) inside the trap body to a plastic collection jar containing a 1-inch strip of Vapona, Hot Shot® , or No-Pest® strip (dichlorvos).
- Oviposition traps are used to collect gravid *Culex* spp. mosquitoes and/or to measure their egg-laying activity. As an example, they may use 5-day-old hay-infused water contained in a small plastic dish pan that has a 6-volt battery-operated fan directly above to draw the gravid female mosquitoes into the small collection net. Little black jar traps or ovitraps have been employed in surveys for exotic container breeding species such as the Asian tiger mosquito (*Aedes albopictus*) or yellow fever mosquito (*Aedes aegypti*)

Mosquito development stages include eggs, four larval stages, and a transitional pupal stage. Mosquito control agencies routinely target the larval and pupal stages to preclude an emergence of adults. Operation evaluation of the presence and abundance of immature mosquitoes is limited to the larval and pupal stages, although the District may sample eggs for research reasons. Sampling and collection of the immature stages (egg, four larval stages, and a transitional pupal stage) involves the use of a 1-pint dipper (a standardized small plastic pot or cup-like container on the end of a 36-inch handle), which scoops up a small amount of water from the mosquito-breeding site. Operationally, the abundance of immature mosquitos in any identifiable "breeding" source is measured through direct sampling, which provides relative local abundance as the number of immature mosquitos per unit volume or area of the source. This method requires access by field personnel to within about 3 feet of larval sites at least every 2 weeks in warm weather. The spatial patchiness of larvae requires access to multiple locations within each source, rather than to single "bell-weather" stations.

> **"Arbovirus"[2] surveillance to determine the likelihood and occurrence of mosquito-borne illness** is accomplished by two methods commonly used in California: (1) capturing and testing female vector mosquitoes for the presence of mosquito-borne encephalitis viruses as explained above and (2) periodic testing for the presence of encephalitis virus-specific antibodies in the blood serum of either sentinel chickens or wild birds. The first method involves the use of host-seeking traps to capture female vector mosquitoes. Captured females are sorted into groups of up to 50 (called pools) and submitted to UC Davis or a laboratory local to that District to test for the presence of mosquito-borne viruses. The District uses the second method through the placement of caged chickens as "sentinel birds." Since the viruses of major concern (WNV, WEE, and SLE) are diseases actively transmitted by mosquitoes to both birds and to humans through bites, caged chickens' routine blood samples will reveal whether one or more of the virus-specific antibodies are present. The chickens are placed generally 10 to a caged area (at least 6 by 12 feet or larger), are humanely handled, and are provided ample shelter with nest boxes, water, and feed. Chickens are used as the early detection system for virus transmission, as they are unaffected by the presence of these viruses in their systems. At the end of the mosquito season, the chickens are adopted out. In addition, dead birds reported by the public to the statewide WNV Hotline are mapped to determine high-risk areas, and those meeting testing criteria are brought to the District or sent to UC Davis to be tested for WNV.

> **Field inspection of known or suspected habitats** where mosquitoes live and breed. Sites where water can collect, be stored, or remain standing for more than a few days are potential habitats for mosquito breeding that require continuous inspection and surveillance. Likely sources are water runoff into catch basins and stormwater detention systems from land uses including, but not limited to, residential communities, parks and recreation areas, and industrial sites, as well as ornamental ponds, unmaintained swimming pools, seeps/seepages, seasonal wetlands, tidal and diked marshes, freshwater marshes, wastewater ponds, sewer plants, winery waste/agricultural ponds, managed waterfowl ponds, canals, creeks, streams, tree holes, tires, man-made containers, flooded basements/crawl spaces, and other standing waters.

> **Maintenance of paths and clearings** to facilitate sampling and to provide access to vector habitat. It is District policy that staff manages vegetation periodically for accessibility to water bodies and use preexisting roads, trails, walkways, and open areas to conduct routine and essential surveillance activities with the least harm to the environment. Surveillance is conducted using ATVs, but offroad access is minimized and used only when roads and trails are not available. Some access for inspection is conducted on foot.

> **Analysis of public service requests and surveys** and other methods of data collection. The District's mosquito surveillance activities are conducted in compliance with accepted federal and state guidelines, in particular the *California Mosquito-borne Virus Surveillance and Response Plan* (CDPH 2010a) and *Best Management Practices for Mosquito Control in California* (CDPH 2010b).These guidelines recognize that local conditions will necessarily vary and, thus, call for flexibility in selection and specific application of control methods.

[2] Arthropod-borne viruses. The primary reservoir for the pathogens that cause these diseases is wild birds, and humans only become exposed as a consequence of an accidental exposure to the bite of infective mosquito vectors.

2.3.1.2 Tick Surveillance

The District performs surveillance of ticks (e.g., *Ixodes pacificus* and *Dermacentor* spp.) to determine incidence of Lyme disease (*Borrelia burgdorferi*), ehlichia, bartonella, tularemia, and Rocky Mountain spotted fever by way of the following practices:

> **Collection** of ticks in public contact areas to (a) determine the location of ticks infected with Lyme disease or other disease/pathogen and (b) to determine the seasonal and geographical distribution of the ticks according to species. Ticks are collected by "flagging" vegetation along trails. Stiff fabric is dragged for specified distances along the trails to stimulate ticks to attach to the material. Then they are manually removed and placed in vials for transport back to the laboratory for testing.

> **Identification** of ticks brought in by the public, which are usually found biting persons or their domestic animals.

> **Submission** of ticks that have been attached to persons to determine if they are infected with the Lyme disease, tularemia, and/or Rocky Mountain spotted fever organism. The District refers individuals to the appropriate lab for tick testing.

> **Dissemination** of educational information to the public concerning Lyme disease, ticks, and other tick-borne diseases.

2.3.1.3 Rodent Surveillance

The District responds to requests regarding "rodents" (rats and field mice) to assist residents in addressing rodent control issues and disease transmission risk. The monitoring and control focuses on both domestic rats, including Norway rats (*Rattus norvegicus*) and roof rats (*Rattus rattus*), and house mouse. Norway rats are known to invade homes and businesses from sanitary sewers. Property inspections in response to public service requests involve perimeter inspections, looking for rodent entry points, burrows, and signs of infestation.

Testing for the presence of HPS is occasionally conducted by sampling wild rodents. For hantavirus surveillance, small traps are placed in suspect areas including peridomestic habitats along the urban fringe or rural areas. The traps are checked the following day to remove any rodents for sampling. Wild rodent collection for disease surveillance requires a Scientific Collecting Permit from CDFW and is conducted in compliance with CDPH and CDC guidelines. Blood samples are submitted to CDPH for testing.

2.3.1.4 Yellowjackets and Wasps

Venomous biting insect encounters often require District staff's response. It is important to educate the residents that while these insect stings may potentially induce life-threatening allergic reactions and pain, overall, these insects serve beneficial roles as pollinators and biological control agents.

The District responds to public service requests and provides recommendations and control of yellowjackets, wasps and bees that are not within structures (e.g., ground-nesting burrows walkways, sidewalks, trails, parks, etc.). Control measures are provided in cases where the public is in imminent danger from stings, and the location of the hive is accessible and known.

2.3.1.5 Other Vector Surveillance

Ground squirrel (*Spermophilus beecheyi*) and other sylvatic rodent surveillance for the plague consists of sampling by trapping with blood samples sent to CDPH, Vector-Borne Disease Section for testing. These animals may also be tested for tularemia. Testing for the presence of plague and murine typhus might be conducted by collecting ground squirrels, opossums, and fleas in addition to wild rodents described in Section 2.3.1.3 above. Small animals will be trapped using live traps baited with food. The traps will be set in late afternoon and will be collected within 24 hours. The animals will be anesthetized and blood, tissue and

flea samples will be obtained. Threatened and endangered species and other legally protected animals that may become trapped will be immediately released and will not be used in these tests.

The two primary reservoir vectors of rabies in California are bats and skunks. Both live in close proximity to humans and their pets because of their ability to adapt to the urban/suburban environment. Residential landscapes provide them with an abundance of food and shelter options that have increased their numbers and the potential for direct contact with the human population. This scenario is true for all wildlife and because of it, a potential rabies health threat exists. The District works with home and property owners to discourage wildlife such as skunks and bats from taking up residence on their property. Service requests and other sources of information prompt the District's Wildlife Technician to survey the property and provide guidance and recommendations on exclusion methods to minimize vector harm to the property.

The District responds to public service requests for bedbugs. The CDC and USEPA have jointly said that bedbugs are a public health nuisance pest. Their biting can cause welts (however, not everyone will react to bedbug bites). Under heavy infestations, asthma or allergy can be problematic for children and senior citizens. The District's bedbug protocol includes the following activities:

> Assist the public in Identification of bedbugs.

> Point out likely bedbug infestation signs (e.g., skin cast, blood stains).

> Provide information on ways to reduce clutter, improve sanitation, make repairs, and use pillow and mattress encasements.

> Advise using passive monitoring devices (e.g., Climb Up or Night Watch bedbug detection devices).

> Advise on hiring a reputable and experienced pest control operator to control the bedbugs.

> Remain neutral on landlord/tenant bedbug disputes.

> Assist the county Consumer Protection Division response to bedbugs

2.3.2 Physical Control Component

Managing vector habitat to reduce vector production or migration, either directly or through public education is often the most cost-effective and environmentally benign element of an IVMP. This approach to the control of vectors and other pests is often called "physical control" to distinguish it from those vector management activities that directly rely on application of chemical pesticides (chemical control) or the introduction or relocation of living agents (biological control). Other terms that have been used for vector habitat management include "source reduction," which emphasizes the significance of reducing the habitat value of an area for vectors, or "permanent control," to contrast with the temporary effectiveness of pesticide applications. Vector habitat management is important because its use can virtually eliminate the need for pesticide use in and adjacent to the affected habitat and, in some situations, can virtually eliminate vector production from specific areas for long periods of time, reducing the potential disturbances associated with frequent biological or chemical control activities. The intent is to reduce the abundance of vectors produced or sheltered by an area while protecting or enhancing the habitat values of the area for desirable species. In many cases, physical control activities involve restoration and enhancement of natural ecological functioning, including production and dispersal of special-status species and/or predators of vectors.

2.3.2.1 Mosquitoes

Physical control for mosquitoes consists of the management of mosquito-producing habitat (including freshwater marshes and lakes, saltwater marshes, temporary standing water present for one week or more, and wastewater treatment facilities) especially through water control and maintenance or improvement of channels, tide gates, levees, and other water control facilities. Physical control is usually the most effective mosquito control technique because it provides a long-term solution by reducing or eliminating mosquito developmental sites and ultimately reduces and potentially eliminates the need for chemical applications. The physical control practices may be categorized into three groups: maintenance, new construction, and cultural practices.

Maintenance activities are conducted within tidal, managed tidal, and nontidal marshes, seasonal wetlands, diked, historic baylands, and in some creeks adjacent to these wetlands. They include connection of backwaters or isolated pools on floodplains to the main channels of streams and rivers and increased drainage rates and areas in managed wetlands. The following activities are classified as maintenance:

> Removal of sediments from existing water circulation ditches

> Repair of existing water control structures

> Removal of debris, weeds, and emergent vegetation in natural channels

> Clearance, trimming, and removal of brush for access to streams tributary to wetland areas

> Filling of existing, nonfunctional water circulation ditches to achieve required water circulation dynamics and restore ditched wetlands

New construction typically involves the creation of new ditches to enhance tidal flow preventing stagnant water.

Cultural practices include vegetation and water management, placing culverts or other engineering works, and making other physical changes to the land. They reduce mosquito production directly by improving water circulation and indirectly by improving habitat values for predators of larval mosquitoes (fish and invertebrates), or by otherwise reducing a site's habitat value to mosquito larvae.

The District performs these physical control activities in accordance with all appropriate environmental regulations (e.g., wetland fill and dredge permits, endangered species review, water quality review, streambed alteration permits, see Section 2.7), and in a manner that generally maintains or improves habitat values for desirable species. Major physical control activities or projects (beyond the scope of the District's 5-year regional wetlands permits with the United States Army Corps of Engineers (USACE), San Francisco Bay Regional Water Quality Control Board (SFBRWQCB) and San Francisco Bay Conservation and Development Commission (BCDC) are addressed where known and identified. Minor physical control activities (covered by the regional wetlands permits) are also addressed. Under an active regional permit, the District's work plans are reviewed annually by trustee and other responsible agencies prior to initiation of the planned work. USACE, USFWS, CDFW, and other responsible agencies may inspect completed work.

The District may request/require landowners and stewards to maintain and clear debris from drainage channels and waterways; excavate built-up spoil material; remove water from tires and other urban containers; cut, trim, mow, and harvest aquatic and riparian plants (but not including any mature trees, threatened or endangered plant species, or sensitive habitat areas); and install minor trenching and ditching.

The remainder of this subsection describes physical control or "source reduction" practices by type of potential mosquito habitat.

2.3.2.1.1 Freshwater Habitats

The District Service Area includes a number of areas, generally man-made, that are permanently ponded with fresh water. Examples include the margins of reservoirs with shallow water and emergent vegetation, artificial ponds for holding drinking water for livestock, and retention ponds created for holding of rainwater. Some retention ponds have been constructed within freeway interchanges and others have been built in cities and towns to provide wildlife habitat and flood protection. Natural lakes are usually not a mosquito problem because most of the water is deep, and little emergent vegetation may exist.

Source reduction activities to control mosquito populations in freshwater habitats, i.e., marshes and ponds, generally consist of consultation with landowners or land stewards to implement measures, including constructing and maintaining channels to reduce mosquito production in floodplains and marshes. The primary principle governing source reduction is to manipulate water levels in low-lying areas to eliminate or reduce the need for chemical control applications. Physical control of mosquitoes in nontidal habitats typically involves improving the habitat value or dispersal potential of the site for mosquito predators; reducing the habitat value for mosquitoes through vegetation management, increased circulation, steepening banks, or changes in water quality; or by reducing the duration of standing water in areas that produce mosquitoes by filling small areas or improving drainage. Filling or draining artificially ponded areas (low spots in flood-irrigated fields, etc.) can be cost-effective and environmentally acceptable, but is not an appropriate strategy in natural areas (however small), large permanent water bodies, or in areas set aside for stormwater or wastewater retention. In such situations, the other options are more appropriate. At this time, the District is rarely involved in new drainage projects. However, the District does maintain or assist with the maintenance of some existing drainage systems. This maintenance can include upkeep of gates and other water control structures, excavating accumulated spoil materials, and advising property managers to conduct vegetation management such as cutting, mowing, clearing debris, and/or herbiciding overgrown vegetation (see Section 2.3.3 for vegetation management including the use of herbicides).

Ditches are a traditional technique for mosquito control, and they function in a number of ways. In addition to providing drainage if they lead from high to low ground, ditches can serve as a reservoir for larvivorous fish (i.e., fish that eat mosquito larvae). As rainfall increases, larvivorous fish move outward to adjacent areas to prey on immature mosquitoes, and as water levels decrease, larvivorous fish retreat to water in the ditches. Also, sills or weirs constructed in ditches can intentionally decrease water flow, decrease emergent aquatic weeds, prevent depletion of the water table, and allow larvivorous fish year-round refuge. Over the past several decades, urban development has occurred in areas where mosquito control drainage ditches have existed as the primary drainage systems. In many cases, maintenance responsibility for mosquito control projects has been taken over by city and county public works departments and integrated into their comprehensive stormwater management programs.

The District considers two mosquito control strategies when advising on freshwater source reduction for mosquito habitat. One strategy involves reducing the amount of standing water or reducing the length of time that water can stand in low areas following significant rainfall or artificial flooding events. In light of this strategy, District staff will advise or require landowners to construct channels or ditches with control elevations low enough to allow for a certain amount of water to leave an area before immature mosquitoes can complete their life cycle. However, the District does not encourage land managers and/or owners to alter vernal pool and seasonal wetland habitats, especially those managed for waterfowl.

The second strategy relies on vegetation management (see Section 2.3.3). District staff will advise or require landowners to remove or thin vegetation to improve surveillance or reduce mosquito habitats.

As environmental laws, including Clean Water Act Section 404, greatly restrict mosquito habitat manipulations in freshwater habitats, the District is generally precluded from undertaking permanent physical control of these areas. Consequently, the District does not usually undertake physical control projects in freshwater bodies, including marshes and ponds.

2.3.2.1.2 Seasonal Wetlands and Vernal Pools

The Service Area's Mediterranean climate results in large numbers of seasonally flooded areas, which may produce large numbers of mosquitoes during part of the year (i.e., Winter and Spring). Vernal pools are a specific type of seasonally flooded wetland, distinguished by a subsurface hardpan and often an assemblage of protected plants and invertebrates. Peripheral areas of tidal and historically tidal marshes can produce mosquitoes in response to seasonal rains, as well as following unusually high tides. Physical control methods include those described above for nontidal habitats.

2.3.2.1.3 Freshwater Marshes and Duck Clubs

Within federal and state property, a number of marshes have been created and operated to provide aquatic habitats for wildlife, especially waterfowl. Some of these marshes are drained and refilled periodically to enhance the primary productivity of the habitat, and under certain circumstances, can result in large populations of mosquitoes. The major waterfowl management areas in the District Service Area include sections of Don Edwards National Wildlife Refuge. In addition, other "mitigation marshes" have been created by the Santa Clara Valley Water District or other agencies to support waterfowl and other native species . Physical control methods include those described above for nontidal habitats.

2.3.2.1.4 Saline and Brackish Habitats

Saline and brackish marsh habitats of concern are along the edge of San Francisco Bay that are subject to tidal action, but they can include reclaimed or other brackish/salt marshes that are not subject to natural tidal action. These brackish areas are usually contained by levees, rotary ditches, or other water control structures. Physical control measures are those used for freshwater marshes (nontidal) and increasing tidal circulation such as:

> Circulation ditches to enhance drainage or to allow larvivorous fish access to mosquito breeding locations (with enhancement through the creation of permanent water bodies that act as predatory fish reservoirs

> Small ditches formed by a speed scavel that are up to 18 inches wide and 18 inches deep to enhance water circulation

> Rotary ditching, which involves the construction of shallow ditches usually 4 feet wide and 2 to 3 feet deep, using high-speed rotary equipment with the spoil material evenly distributed in a very thin layer over the marsh surface, with limitations on its use based on the size of ditch needed, soil types, access, adjacent terrain, and vegetation present

> Impoundments that involve keeping a sheet of water across a salt-marsh substrate

> Rotational impoundment management (RIM), which is a formal strategy of impoundment management that achieves multipurpose management by allowing the impoundment to (1) control salt-marsh mosquito production from the marsh through means other than insecticides, (2) promote survival and revegetation by maintaining open periods and sufficiently low water levels during the summer flooding period, and (3) allow marine life to use the previously unavailable impounded high marsh.

> Excavation using a low ground pressure excavator

These ecologically sensitive areas require careful implementation of any physical modifications to avoid damage to the habitat and sensitive species that may be present. Physical control measures can reduce salt-marsh mosquito production through enhancement of the frequency and duration of tidal inundation or through other water management strategies.

2.3.2.1.5 Temporary Standing Water and Artificial Ponds

Temporary standing water can occur from a variety of conditions including irrigation of parks, golf courses, and agricultural fields in addition to ponding from rainfall events in natural areas. As environmental laws generally prevent/restrict permanent draining or filling of small artificial ponds, the District advises property owners to employ other options that are effective in controlling mosquitoes, which include periodic draining, providing deepwater sanctuary for larvivorous fish, minimizing emergent and standing vegetation, and maintaining steep banks. Improved drainage is one effective tool for source reduction in such habitats. The second is advising for the use of irrigation practices for those agricultural areas that require artificial watering. Proper water management, land preparation, and adequate drainage are the most effective means of physically controlling mosquitoes in these types of sources. The District provides technical assistance to landowners who are interested in reducing mosquitoes by developing effective water management systems on any lands within the service district.

Pond management options that are effective in controlling mosquitoes include periodic draining, providing deepwater sanctuary for larvivorous fish, working with landowners to identify leaky pipes, and advising management to minimize emergent and standing vegetation and maintain steep banks. The District routinely advises landowners on the BMPs for ponds to reduce mosquito development.

2.3.2.1.6 Riparian Areas

Control measures will vary depending on the density of the human population, proximity of sensitive species, the vector potential of the mosquito causing the complaint, and access to the larval breeding or adult resting habitat. Minor physical control activities with minimal environmental effects can be accomplished using hand tools to connect small ponded areas to the channel along the edge of streams with highly variable flows. Generally, thick brush and complex microtopography preclude extensive physical control in these areas, or chemical control is generally more effective.

2.3.2.1.7 Tree Holes

Control measures are very limited here due to the large numbers of tree holes in most impacted areas, difficulties in access, concerns for staff safety, and in some cases the age and size of the tree (heritage trees). The control methods used are also dependent on the location and numbers of people and pets affected by the mosquitoes produced from this habitat. Current control measures include public education, filling of some holes with sand or other inert materials (absorbent gel) to displace larval habitat, or chemical control (larvicides, adulticides, or aerosols).

2.3.2.1.8 Wastewater Treatment Facilities/Septic Systems

Wastewater recycling and reuse help to conserve and replenish freshwater supplies. Concern for water quality conditions in lakes, rivers, and marine areas has resulted in the enactment of new state laws that will greatly limit future disposal of wastewater into these aquatic systems. To adjust to these changing conditions, many communities must implement wastewater reuse and recycling programs. Mosquito problems are frequently associated with some of the conventional wastewater treatment operations, and the expanded use of wastewater recycling and reuse by both municipal and commercial/industrial operations may inadvertently create even more mosquito habitats.

The San Jose Pollution and Control Plant currently utilizes numerous settling ponds and other above and below ground water processes that frequently produce mosquitoes. Seasonal District staff are assigned to survey and control mosquitoes within the plant facility and recommend physical control or source reduction whenever feasible. Other treatment plants are located in Palo Alto, Sunnyvale and Gilroy.

Onsite treatment systems, such as septic tanks and associated drain fields, can flow laterally into nearby swales and ditches, especially in rural areas. Physical control requires maintenance and repair of these systems by the property owner and ditch maintenance where lateral flow occurs.

2.3.2.1.9 Artificial Container Habitats

Artificial containers, such as flowerpots, cans, barrels, and tires, provide opportunities for mosquitoes to breed in urban areas. A container-breeding mosquito problem can be solved by properly disposing of such materials, covering them, or tipping them over to ensure that they do not collect water. The District has both house-to-house surveillance and education programs to address urban container-breeding mosquito problems.

2.3.2.2 Other Vectors

Physical control for other vectors such as rats, mice, raccoons, skunks, and opossum is based on site inspections by the District to determine conditions promoting harborage and signs of infestation. Property owners are provided educational materials on control measures that include removal of food sources (such as pet food, bird/squirrel feeders, and fruit from trees) and blockage of access points into the structure (i.e., exclusion). If the vector shows signs of disease, has been involved in serious human or pet contact incident, or is otherwise infesting a home or other structure or posing an immediate health or safety risk, then the District employs removal by trapping.

Three elements are necessary for a successful wildlife management program: sanitation, exclusion, and rodent proofing.

> *Sanitation*: Correcting sanitation deficiencies is basic in rodent control. Eliminating food sources through good sanitation practices will prevent an increase in their populations. Sanitation involves good housekeeping, including proper storage and handling of food materials and pet food. For example, store pet food in metal, rodent-proof containers, clean up bird seed spillage, and pick up tree fruit that is on the ground. For roof rats, thinning dense vegetation will make the habitat less desirable. Algerian or English ivy, star jasmine, and honeysuckle on fences or buildings are very conducive to roof rat infestations and should be thinned or removed if possible.

> *Exclusion of rodents*: Sealing cracks and openings in building foundations, and any openings for water pipes, electric wires, sewer pipes, drain spouts, and vents is recommended. No hole larger than ¼ inch should be left unsealed to exclude both rats and house mice. Doors, windows, and screens should fit tightly. Their edges can be covered with sheet metal if gnawing is a problem. Coarse steel wool, wire screen, and lightweight sheet metal are excellent materials for plugging gaps and holes.

> *Rodent proofing* against roof rats requires more time to find entry points than for Norway rats because of their greater climbing ability. Roof rats often enter buildings at the roofline area so the District advises that all access points in the roof are sealed. If roof rats are traveling on overhead utility wires, the District recommends/encourages the property owner to contact a pest control professional or the utility company for information and assistance with measures that can be taken to prevent this access.

While activities designed to reduce vector populations through changes in the physical environment are considered Physical Control, they must be distinguished from activities related to rearing or relocating predators of vectors, which are discussed below as “Biological Control,” as well as those tools that harm vector habitat through manipulation of vegetation, which are described below as “Vegetation Management” practices.

2.3.3 Vegetation Management Component

The species composition and density of vegetation are basic elements of the habitat value of any area for mosquitoes and other vectors, for predators of these vectors, and for protected flora and fauna. District staff periodically undertake vegetation management activities, or encourage and teach others how to do so on their property, as a tool to reduce the habitat value of sites for mosquitoes and other vectors or to aid production or dispersal of vector predators, as well as to allow District staff's access to vector habitat for surveillance and other control activities. District staff's direct vegetation management generally consists of activities to reduce the mosquito habitat value of sites by improving water circulation or access by fish and other predators, or to allow District staff 's access to standing water for inspections and treatment.

For vegetation management, the District uses hand tools or other mechanical means (i.e., heavy equipment) for vegetation removal or thinning to improve surveillance or reduce vector habitats. Vegetation removal or thinning primarily occurs in aquatic habitats to assist with the control of mosquitoes and in terrestrial habitats to help with the control of other vectors. To reduce the potential for mosquito breeding associated with water retention and infiltration structures, District staff may systematically clear weeds or algae and other obstructing vegetation in wetlands and retention basins (or request the structures' owners to perform this task). In particular, thinning and removal of cattail overgrowth would be done to provide a maximum surface coverage of 30 percent or less. In some sensitive habitats and/or where sensitive species concerns exist, vegetation removal and maintenance actions would be restricted to those months or times of the year that minimize disturbance. Vegetation management is also performed to assist other agencies and landowners with the management of invasive/nonnative weeds (e.g., *Spartina*, *Lepidium*, *Arundo*, *Tamarix*, and *Ailanthus*). These actions are typically performed under the direction of the concerned agency, which also maintains any required permits.

Tools ranging from shovels and pruners to chain saws and "weed-whackers" up to heavy equipment can all be used at times to clear plant matter that either prevent access to mosquito breeding sites or that prevent good water management practices that would minimize mosquito populations. Generally, however, District "brushing" activities rely almost entirely on hand tools. Trimmed vegetation is either removed and disposed of properly from the site or broadcast in such a way as to minimize visual degradation of the habitat. Trimming is also kept to a minimum to reduce the possibility of the invasion of exotic species of plants and animals. Surveys for special-status plants using the California Natural Diversity Database and other online sources of information including relevant HCPs, coordination with the landowner, and acquisition of necessary permits are completed before any work is undertaken. Follow-up surveys are also conducted to verify that the work undertaken was effective and that the physical manipulation of the vegetation did not result in any unintended overall habitat degradation.

In addition, the use of water management to control vegetation is in some ways an extension of physical control, in that water control structures created as part of a physical control project may be used to directly manipulate hydroperiod (flood frequency, duration, and depth) as a tool for vegetation management. Where potential evapotranspiration rates are high, water management can also become a mechanism for salinity management and, indirectly, vegetation management through another path.

2.3.4 Biological Control Component

Biological control of mosquitoes and other vectors involves the intentional use of vector pathogens (diseases), parasites, and/or predators to reduce the population size of target vectors. It is one of the principal components of a rational and integrated vector control management program. Biological control is used as a method of protecting the public from mosquitoes and the diseases they transmit without the use of pesticides and potential problem of pesticide resistance; however, the use of pathogens involves USEPA-registered materials regulated and labeled as chemical insecticides. The different types of biological controls are described in the following paragraphs.

2.3.4.1 Mosquito Pathogens

Mosquito pathogens include an assortment of viruses and bacteria. Pathogens are highly host-specific and usually infect mosquito larvae when they are ingested. Upon entering the host, these pathogens multiply rapidly, destroying internal organs and consuming nutrients. The pathogen can be spread to other mosquito larvae in some cases when larval tissue disintegrates and the pathogens are released into the water to be ingested by uninfected larvae. Examples of viruses that can infect mosquitoes are mosquito iridoviruses, densonucleosis viruses, nuclear polyhedrosis viruses, cytoplasmic polyhedrosis viruses, and entomopoxviruses. The District does not use viruses as part of the Biological Control component of its program because they have not become commercially available for mosquito control (see Appendix E).

Examples of bacteria pathogenic to mosquitoes are Bs, the several strains of Bti, and *Saacharopolyspora spinosa*. Two bacteria, Bs and Bti, produce proteins that are toxic to most mosquito larvae, while *Saacharopolyspora spinosa* produces compounds known as spinosysns, which effectively control all larval mosquitoes. Bs can reproduce in natural settings for some time following release. Bti materials the District applies do not contain live organisms, but only spores made up of specific protein molecules.

All three bacteria are naturally occurring soil organisms that are commercially produced as mosquito larvicides. Because the potential environmental effects of Bs or Bti application are generally similar to those of chemical pesticide applications, these materials and Spinosad are discussed below under the Chemical Control Component in Section 2.3.5.

2.3.4.2 Mosquito Parasites

The life cycles of mosquito parasites are biologically more complex than those of mosquito pathogens and involve intermediate hosts, organisms other than mosquitoes. Mosquito parasites are ingested by the feeding larva or actively penetrate the larval cuticle to gain access to the host interior. Once inside the host, parasites consume the internal organs and food reserves until the parasite's developmental process is complete. The host is killed when the parasite reaches maturity and leaves the host (*Romanomermis culicivorax*) or reproduces (*Lagenidium giganteum*). Once free of the host, the parasite can remain dormant in the environment until it can begin its developmental cycle in another host. Examples of mosquito parasites are the fungi *Coelomomyces* spp., *Lagenidium giganteum, Culicinomyces clavosporus*, and *Metarhizium anisopliae*; the protozoa *Nosema algerae, Hazardia milleh, Vavraia culicis, Helicosporidium* spp*., Amblyospora californica, Lambornella clarki*, and *Tetrahymena* spp.; and the nematode *Romanomermis culicivorax*. These parasites are not generally available commercially for mosquito control at present.

2.3.4.3 Mosquito Predators

Mosquito predators are represented by highly complex organisms, such as insects, fish, birds, and bats that consume larval or adult mosquitoes as prey. Predators are opportunistic in their feeding habits and typically forage on a variety of prey types, which allows them to build and maintain populations at levels

sufficient to control mosquitoes, even when mosquitoes are scarce. Examples of mosquito predators include representatives from a wide variety of taxa: coelenterates, *Hydra* spp.; platyhelminths, *Dugesia dorotocephala, Mesostoma lingua, and Planaria* spp.; insects, *Anisoptera, Zygoptera, Belostomidae, Gerridae, Notonectidae, Veliidae, Dytiscidae, and Hydrophilidae*; arachnids, *Pardosa* spp.; mosquitofish, *Gambusia affinis*, *Gasterosteus aculeatus*; bats; and birds, *anseriformes, apodiformes, charadriiformes, and passeriformes*. Only mosquitofish are commercially available to use at present, or able to be reproduced/reared, while the District supports the presence of the other species as practical (also see Section 15.2).

The District's rearing and stocking of mosquitofish in mosquito habitat is the most commonly used biological control agent for mosquitoes in the world. These fish are ideal control agents for several reasons. They feed primarily at the water's surface, where larvae can be found. They can tolerate a significant range in water temperature and water quality. They are also easy to handle, transport, stock, and monitor. Correct use of this fish can provide safe, effective, and persistent suppression of a variety of mosquito species in many types of mosquito sources. As with all safe and effective control agents, the use of mosquitofish requires a good knowledge of operational techniques and ecological implications, careful evaluation of stocking sites, use of appropriate stocking methods, and regular monitoring of stocked fish. Mosquitofish reproduce in natural settings, for at least some time after release. Due to concerns that mosquitofish may potentially harm red-legged frog and tiger salamander populations, District policy is to limit the use of mosquitofish to ornamental fish ponds, water troughs, water gardens, fountains, and unused swimming pools. Limiting the introduction of the mosquitofish to these sources should prevent their migration into habitats used by threatened, endangered, or rare species.

On average, the District produces and releases about 120 pounds of mosquitofish annually. The District's stocking tanks are kept at the District facility and produces minimal discharge that averages about 10 to 15 gallons per week. This wastewater is dispensed into the sanitary sewer system.

2.3.4.4 Other Vectors

No effective predators exist to control high rodent populations in urban areas. Although they sometimes inhabit residential neighborhoods, raptors, raccoon, coyote and bobcat do not provide adequate rodent control in urban environments.

Currently, no commercial biological control agents or products are available for wasp and yellowjacket control.

2.3.5 Chemical Control Component

Chemical control is a Program tool that consists of the application of nonpersistent selective insecticides to directly reduce populations of larval or adult mosquitoes and other invertebrate threats to public health (e.g., midges and blackflies) and the use of rodenticides to control rats and mice. If and when inspections reveal that mosquitoes or other vector populations are present at levels that trigger the District's criteria for chemical control – based on the vector's abundance, density, species composition, proximity to human settlements, water temperature, presence of predators and other factors – District staff will apply pesticides to the site in strict accordance with the pesticide label instructions. The total number of applications and weight or volumes of specific pesticides the District applied in Summer 2011 through Spring 2012 are presented in Appendix B, Attachment A of this Environmental Evaluation.

2.3.5.1 Mosquito Abatement

The vast majority of chemical control tools are used for mosquito abatement. The primary pesticides used can be divided between "larvicides," which are specifically toxic to mosquito larvae, and "adulticides", which are used to control adult mosquito populations. These pesticides and their applications are described in the following paragraphs.

2.3.5.1.1 Mosquito Larvicides

Larvicides are applied when the chemical control criteria for mosquito larvae are present and application rates vary according to time of year, water temperature, the level of organic content in the water, the type of mosquito species present, larval density, and other variables. Larvicide applications may be repeated at any site at recurrence intervals ranging from annually to weekly.

Larvicides the District may routinely use include Bti, Bs, Methoprene (Altosid or Metalarv), CoCoBear Oil, BVA-2, Masterline Mosquito Larvicide, *Saacharopolyspora spinosa* (Spinosad) (Natular), and Agnique.

> **Bti** is a biological larvicide. Bti is a bacterium that is ingested by mosquito larvae and that disrupts their gut lining, leading to death before pupation. The District applies Bti as a liquid or bonded to an inert substrate (sand or corncob granules) to assist penetration of vegetation. Persistence is low in the environment, and efficacy depends on careful timing of application to coincide with periods in the life cycle when larvae are actively feeding. Pupae and late 4th stage larvae do not feed and, therefore, will not be controlled by Bti. Low water temperature inhibits larval feeding behavior, reducing the effectiveness of Bti during very cold periods. High organic conditions also reduce the effectiveness of Bti. Therefore, use of Bti requires frequent inspections of larval sources during periods of larval production, and may require frequent applications of material. Application can be by hand, from an ATV, from watercraft, or from aircraft (helicopter).

> **Bs** is a biological larvicide. Bs is a bacterium that when ingested by mosquito larvae produces microbial gut toxins that destroy the insect gut wall, leading to paralysis and death. Bs is a biological larvicide the District applies as a liquid or bonded to an inert substrate (corncob granule) to assist penetration of vegetation. The mode of action is similar to that of Bti, but Bs may be used more than Bti in some sites because of its higher effectiveness in water with higher organic content and residual properties that allow longer larvicidal action. Persistence is low in the environment, and efficacy depends on careful timing of application to coincide with periods in the life cycle when larvae are actively feeding. Pupae and late 4th stage larvae do not feed and, therefore, will not be controlled by Bs. Low water temperature inhibits larval feeding behavior, reducing the effectiveness of Bs during very cold periods. Bs is also ineffective against certain mosquito species such as those in the genus *Aedes*. Knowing the stage and species present can increase the effectiveness of this material, restricting it to sources containing susceptible species. Therefore, use of Bs requires frequent inspections of larval sources during periods of larval production and may require frequent applications of material. Application can be by hand, from an ATV, from watercraft, or from aircraft (helicopter).

> **Spinosad** is an Omri Listed Dow AgroSciences active ingredient that is a fermentation product of bacteria first discovered in an old rum distillery. Spinosad is a fermentation product of the naturally occurring soil bacterium *Saacharopolyspora spinosa*. It causes excitation of the mosquito's nervous system, ultimately leading to paralysis and death. This mode of action makes this pesticide a good option for rotational use in the prevention of resistance. Its action on the target organism is either by contact or by ingestion, and as with other bacterial larvicides, activity can be reduced in highly organic water. The District applies Spinosad as a liquid or as a sustained-release product that can persist for up to 30 or 180 days. It is applied either in response to high observed populations of mosquito larvae at a site or as a sustained-release product that can persist for up to about 4 months. This product has very low potential for accumulation in soil or groundwater contamination. Application can be performed by hand, from an ATV, from watercraft, or from aircraft.

> **Methoprene**, formerly Altosid, now Metalarv, is a synthetic juvenile hormone that is designed to disrupt the transformation of a juvenile mosquito into an adult. Methoprene products must be applied (or present, if using a slow release formula) to the late instar (e.g., third and fourth) and/or pupal stages of mosquitoes. It is not effective against other life stages. Methoprene can be applied in granular, liquid, pellet, or briquet formulation. Sustained-release products can persist for up to 30 or 150 days. Application can be performed by hand, from an ATV, from watercraft, or from aircraft.

> **BVA-2** and Masterline Mosquito Larvicide are highly refined petroleum distillates (mineral oil). These new larvicides demonstrate a low level of toxicity to plant growth (phytotoxicity) and rapid environmental breakdown. BVA-2 larvicide oil has a water-white clear color and is also practically odorless. It forms a thin film on water and kills larvae through suffocation and/or direct toxicity. It is typically applied at application rates of 3 to 5 gallons per acre and can be applied by hand, from an ATV, from watercraft, or from a truck.

> **Agnique** is the trade name for a surface film larvicide, comprised of ethoxylated alcohol that kills mosquito larvae and pupae. Agnique forms an invisible monomolecular film that is odorless and visually undetectable. This film interrupts the critical air/water interface (surface tension) in the mosquito's larval and pupal development cycle causing them to drown. Because the layer is thin, larvae can still temporarily penetrate the film to get air allowing for them to survive for up to 5 days. Mortality rate is somewhat dependent on life-cycle stage. Larvae are typically killed within 48 to 72 hours; however, with some species and under certain environmental conditions (such as cool temperatures when development is slow) larval control may take upwards of 120 hours. Water temperature will affect oxygen demands and rate of maturation, thus slowing control. Pupae are typically controlled within 24 to 72 hours, and any pupae that attempt to emerge will be controlled due to the presence of the film. The District may use Agnique as an alternative to BVA-2 although costs, limits of application, and effective duration are issues of concern. Because the application rate of Agnique is much lower than that of BVA-2, 0.35 to 1 gallon per acre, this potential shift would not include an increase in volume of materials applied.

> **CoCoBear Oil** is a food grade, highly refined petroleum distillate but mostly plant-derived oil (mineral oil) that has replaced the discontinued Golden Bear Oil 1111. This new larvicide has similar characteristics and properties to Golden Bear Oil 1111 in that it also demonstrates low-level toxicity to plant growth (phytotoxicity) and rapid environmental breakdown. It forms a thin film on water and kills larvae through suffocation and/or direct toxicity. It is typically applied at application rates of 3 to 5 gallons per acre and can be applied by hand, from an ATV, from watercraft, or from a truck.

Mosquito pathogens and other larvicides most likely to be used are listed in Table 2-1 (Bacterial Pesticides and Other Larvicides the District Uses for Mosquito Abatement).

Larviciding Techniques

Because of the wide range of mosquito sources in the Service Area, and the variety of pesticide formulations described above, the District uses a variety of techniques and equipment to apply larvicides, including handheld sprayers, backpack sprayers and blowers, truck-or-ATV-mounted spray rigs, watercraft, and helicopters or other aircraft. See Section 2.6 for more detailed information on equipment the District uses.

Ground Larviciding Techniques

The District uses conventional pickup trucks, Argo utility task vehicles and various all-terrain vehicles (ATVs) to dispense larvicides. A chemical container tank, high-pressure, low-volume electric or gas pump, and spray nozzle are mounted in the back of the truck bed, with a switch and extension hose allowing the driver to operate the equipment and apply the larvicide. The ATVs have a chemical container mounted on the vehicle, a 12-volt electric pump supplying high-pressure, low-volume flow, and booms and/or hose and spray tips allowing for application while steering the vehicle. ATVs are ideal for treating areas such as agricultural fields, pastures, and other offroad sites. Additional training in minimizing habitat effects, recognizing sensitive flora and fauna, and ATV safety and handling is provided to employees before operating these machines.

Additional equipment used in ground applications of liquid formulations includes handheld sprayers (handcans or spray bottles), and backpack sprayers and blowers. Handheld sprayers (handcans) are standard 1- or 2- or 3-gallon garden style pump-up sprayers used to treat very small isolated areas.

Backpack sprayers are either hand pump-up for liquid applications and have a 3 to 5-gallon tank or are gas powered with a chemical tank and calibrated proportioning slot. Generally, a pellet or small granular material is applied by hand or with a gas-powered backpack sprayer, blower, ATV-mounted Herd Seeder, or hand crank "belly grinder" machine designed to evenly distribute the pellets or granules.

Table 2-1 Bacterial Pesticides and Other Larvicides Santa Clara County Vector Control District Uses for Mosquito Abatement

Pesticide Product Name	Common Name / Active Ingredients	Chemical Type	CAS or EPA Number	Mode of Action	Timing of Application	Method of Application	Sites
Bacterial Control Agents							
FourStar 45 Bti	*Bti*, 7% 45 day briquet	Bacterial derivative	EPA 83362-3	Larvicide; when ingested, produce microbial gut toxins that destroy insect gut wall leading to paralysis and death. Mosquito midgut disruptor	All year	Hand	Creeks, curbs and sewer ponds
FourStar SBG	*Bti* / *Bs*	Bacterial derivative	EPA 85685-1	Mosquito midgut disruptor	All year	Hand	Creeks, curbs and ponds.
FourStar 90 briquet	*Bti* / *Bs*	Bacterial derivative	EPA 83362-3	Mosquito midgut disruptor	All year	Hand	Creeks, neglected swimming pools, sewer ponds
FourStar 180 Bs	*Bs* 6% *Bti* 1% 180 day briquet	Bacterial derivative	EPA 83362-3	Larvicide; when ingested, produce microbial gut toxins that destroy insect gut wall leading to paralysis and death. Mosquito midgut disruptor	All year	Hand	Creeks, neglected swimming pools, sewer ponds
Spheratax SPH WSP 50	*Bs*	Bacterial derivative	EPA 84268-2	Mosquito midgut disruptor	All year		Creeks, neglected swimming pools and curbs
Summit B.T.I. Briquet	*Bti*	Bacterial derivative	EPA 6218-47	Mosquito midgut disruptor	All year	Hand	Creeks, neglected swimming pools and curbs
Teknar HP-D	*Bti*	Bacterial derivative	EPA 73049-404	Mosquito midgut disruptor	All year	Handcan/Quart Sprayer	Salt marsh and ponds
VectoBac 12AS	*Bti* (1.2% liquid)	Bacterial derivative	EPA 73049-38	Larvicide; when ingested, produce microbial gut toxins that destroy insect gut wall leading to paralysis and death. Mosquito midgut disruptor	All year	Handcan/Quart Sprayer	Creeks, curbs and sewer ponds

Table 2-1 Bacterial Pesticides and Other Larvicides Santa Clara County Vector Control District Uses for Mosquito Abatement

Pesticide Product Name	Common Name / Active Ingredients	Chemical Type	CAS or EPA Number	Mode of Action	Timing of Application	Method of Application	Sites
VectoBac G	Bti 0.2% granule	Bacterial derivative	EPA 73049-10	Larvicide; when ingested, produce microbial gut toxins that destroy insect gut wall leading to paralysis and death. Mosquito midgut disruptor	All year	Hand/spreader	Creek, salt marsh and sewer pond
VectoLex CG Biologic	*Bs*, 7.5% granule	Bacterial derivative	EPA 73049-20	Larvicide; when ingested, produce microbial gut toxins that destroy insect gut wall leading to paralysis and death. Mosquito midgut disruptor	All year	Hand/spreader	Creeks, sewer ponds and salt marsh
VectoLex WDG	*Bs*	Bacterial derivative	EPA 73049-57	Larvicide; when ingested, produce microbial gut toxins that destroy insect gut wall leading to paralysis and death. Mosquito midgut disruptor	All year	Hand/spreader	Neglected swimming pools and ponds
VectoLex WSP	*Bs*, 7.5% granule in water soluble packets	Bacterial derivative	73049-20	Larvicide; when ingested, produce microbial gut toxins that destroy insect gut wall leading to paralysis and death.	All year	Hand	Creeks, sewer ponds and curbs
VectoMax CG	*Bs* 2.7% *Bti* 4.5% granules	Bacterial derivative	EPA 73049-429	Larvicide; when ingested, produce microbial gut toxins that destroy insect gut wall leading to paralysis and death. Mosquito midgut disruptor	All year	Hand/spreader	Creeks and sewer ponds
VectoMax WSP	*Bti* / *Bs*	Bacterial derivative	EPA 73049-429	Mosquito midgut disruptor	All year	Hand	Creeks and sewer ponds

Table 2-1 Bacterial Pesticides and Other Larvicides Santa Clara County Vector Control District Uses for Mosquito Abatement

Pesticide Product Name	Common Name / Active Ingredients	Chemical Type	CAS or EPA Number	Mode of Action	Timing of Application	Method of Application	Sites
Other Larvicides							
Agnique MMF	Ethoxylated alcohol	Organic	EPA 53263-28	surfactant	All year	Handcan/quart sprayer	Neglected swimming pools, curbs and creeks
Agnique MMF G	Ethoxylated alcohol	Organic	EPA 53263-30	surfactant	All year	Hand/spreader	
Altosid Briquets 30	Methoprene	Insect Hormone mimic	EPA 2724-375-50809	Insect growth regulator	All year	Hand	Creeks, curbs and sewer ponds
Altosid Liquid SR20	Methoprene	Insect Hormone mimic	EPA 2724-446	Insect growth regulator	All year	Handcan/quart sprayer	Diked marsh and salt marsh
Altosid Liquid SR5	Methoprene	Insect Hormone mimic	EPA 2724-392	Insect growth regulator	All year	Handcan/quart sprayer	Diked marsh and salt marsh
Altosid Pellets	Methoprene	Insect Hormone mimic	EPA 2724-448	Insect growth regulator	All year	Hand	Sewer ponds, creeks and curbs
Altosid WSP	Methoprene	Insect Hormone mimic	EPA 2724-489	Insect growth regulator	All year	Hand	Creeks, curbs and sewer ponds
Altosid XR Briquets	Methoprene	Insect Hormone mimic	EPA 2724-375-64833	Insect growth regulator	All year	Hand	Creek, sewer ponds and curbs
Altosid XR-G	Methoprene	Insect Hormone mimic	EPA 37254-451	Insect growth regulator	All year	Hand/spreader	Creeks, sewer ponds, curbs
BVA 2	Petroleum distillate	Organic	EPA 70589-1	Surfactant	All year	Handcan/quart sprayer	Curbs, creeks and sewer ponds.

Table 2-1 Bacterial Pesticides and Other Larvicides Santa Clara County Vector Control District Uses for Mosquito Abatement

Pesticide Product Name	Common Name / Active Ingredients	Chemical Type	CAS or EPA Number	Mode of Action	Timing of Application	Method of Application	Sites
Golden Bear 1111 (Discontinued)	Aliphatic petroleum hydrocarbon s	Organic	EPA 8329-72	Larvicide; oil spreads over surface and suffocates larvae (prevents adult emergence)	All year	Handcan/quart sprayer	Containers, curbs, flooded areas, swimming pools

CAS Number = Chemical Abstracts Service Registry Number

EPA Number = Registered with the US Environmental Protection Agency

Using ground application equipment, both when on foot and when conveyed by vehicles, has several advantages. Ground larviciding allows applications while in close proximity to the actual treatment area and, consequently, treatments occur to only those microhabitats where larvae are actually present. This method also reduces both the unnecessary pesticide load on the environment and the financial cost of the amount of material used and its application. Both the initial and the maintenance costs of ground equipment are generally less than for aerial equipment. Furthermore, ground larviciding applications are less affected by weather conditions than are aerial applications.

However, ground larviciding is impractical for large or densely wooded/vegetated areas. Also, risk of chemical exposure for the applicators (workers) is greater than during aerial larviciding operations. Damage may occur from the use of a ground vehicle in some natural areas. Ruts and vegetation damage may occur, although both these conditions are reversible and generally short-lived. Technicians are trained to recognize sensitive habitat areas and to use good judgment to avoid harming these areas.

Aerial Larviciding Techniques

When large areas or areas difficult to reach are simultaneously producing mosquito larvae at densities exceeding District treatment thresholds, then the District may use helicopters or other aircraft to apply any of the larvicides discussed above or listed in Table 2-1. The District contracts with independent flying services to perform aerial applications, with guidance to the target site that District staff provides. Aerial application of larvicides is a relatively infrequent activity for the District, typically occurring only once to several times per year, with each application covering around 400 to 1,000 acres. However, larval production can vary substantially, and the District is capable of undertaking more frequent or extensive operations if necessary.

The larvicides, excluding granular and pellet formulations, are typically combined with water and applied as a low-volume wet spray mix at 2 gallons per acre. Depending on weather conditions, the volume of final mix can be increased to 5 gallons per acre without changing the actual amount of larvicidal active ingredient that is applied per acre. Adjusting the final mix volume per acre to 5 gallons has the advantage of increasing the droplet size to help minimize potential drift and the disadvantage of substantially increasing the flying time, which may also increase costs. Aerial application of liquid larvicides typically occurs during daylight hours and at an altitude above the treatment site of less than 40 feet.

Granular and pellet formulations of larvicides are applied using a large mechanical spreader with a bucket (or hopper) that can hold several hundred pounds of granules/material beneath the aircraft. Granular and pellet formulations are generally much more expensive than liquid formulations of larvicides and are used to penetrate dense vegetation. Application rates can range between 3 and 10 pounds per acre for pellets/granules impregnated with methoprene. Applications of methoprene pellets above 5 pounds per acre are highly unlikely due to the high cost. Applications are around 10 pounds per acre for corncob granules impregnated with Bti or Bs. Rates depend on the density of vegetative cover and the organic content of the mosquito breeding water being treated. It is also significant to note that granular applications occur during daylight hours and are at an altitude that is less than 50 feet.

Using aerial application equipment has are three advantages compared to ground application. First, it can be more economical for large target areas with extensive mosquito production. Second, by covering large areas more quickly, it can free District staff to conduct other needed surveillance or control. Third, it can be more practical for remote or inaccessible areas, such as islands, large marshes, and densely vegetated tule areas, than ground larviciding. However, risk of drift is greater with aerial applications, especially with liquid or ultralow volume (ULV) aerial larviciding and, consequently, more potential risk of nontarget exposure exists. In addition, accuracy in hitting the target area temporarily requires additional manpower for flagging or electronic guidance systems, which can increase costs. Finally, in addition to the timing constraints inherent in most larvicide use, the potential application window can be very narrow for aerial activities due to weather conditions.

2.3.5.1.2 Mosquito Adulticides

In addition to chemical control of mosquito larvae, the District may use pesticides for control of adult mosquitoes when no other tools are available and if specific criteria are met, including species composition, population density (as measured by landing count or other quantitative method), proximity to human populations, and/or human disease risk. As with larvicides, adulticides are applied in strict conformance with label requirements (Appendix B). Adulticides the District potentially uses include Pyrethrins (Pyrocide®, Pyrenone 25-5®); Pyrenone Crop Spray®, and the synthetic pyrethroids etofenprox (Zenivex), resmethrin (Scourge®) and permethrin (Kontrol 4-4). Table 2-2 lists the adulticides the District uses for mosquito abatement for 2013 and beyond. Adulticide materials are used infrequently and only when necessary to control mosquito populations.

Ground Adulticiding Techniques

The most common form of adulticide application is via insecticide aerosols at very low dosages. This method is commonly referred to as the ultra-low volume (ULV) method. This method employs specially designed ULV equipment mounted on trucks, ATVs, golf carts, and boats or handheld for ground applications. Barrier or residual treatments for adult mosquitoes consist of an application using a material generally applied with a compressed air sprayer to the preferred foliage, buildings, or resting areas of the mosquito species.

Cold aerosol generators, cold foggers, and ULV aerosol machines were developed to eliminate the need for great quantities of petroleum oil diluents necessary for earlier fogging techniques. These units are constructed by mounting a vortex nozzle on the forced air blower of a thermal fogger. Insecticide is applied as technical material or at moderately high concentrations (as is common with the short-lived pyrethroids), which translates to very small quantities per acre and is, therefore, referred to as ULV. In agriculture, this rate is classified as “low” at 36 ounces per acre, but mosquito control ground adulticiding operations rarely exceed 1 ounce per acre. The optimum sized droplet for mosquito control with cold aerosols applied at ground level has been determined to be in the range of 5 to 20 microns. District uses ULV materials with short half-lives, for example Zenivex is reported at 1.5 days.

Adulticiding is the only known effective measure of reducing an adult mosquito population in a timely manner. All mosquito adulticiding activities follow reasonable guidelines to avoid affecting nontarget species including bees. Timing of applications (when mosquitoes are most active), avoiding sensitive habitat areas, working and coordinating efforts with CDFW or USFWS when appropriate, and following label instructions all result in environmentally sound mosquito control practices.

Aerial Adulticiding Techniques

Aerial applications may be the only reliable means of obtaining effective control in areas bordered by extensive mosquito production sites or with a small, narrow, or inaccessible network of roads. Aerial adulticiding is often the only means available to cover a very large area quickly in case of severe mosquito outbreaks or vector-borne disease epidemics.

Two aerial adulticiding techniques are used in California: low-volume spraying and ULV aerosols. Low-volume (<2-gallon-per-acre) sprays are applied with the pesticide diluted in light petroleum oils or water and applied as a rather wet spray. The size of the droplets reduces drift, thus limiting swath widths, and may not be ideal under certain circumstances for impinging on mosquitoes. The technique is compatible with equipment commonly used for aerial liquid larviciding.

A common aerial adulticiding technique applies the insecticide in a technical concentrate or in a very high concentration formulation as a ULV cold aerosol. Lighter aircraft, including helicopters, can be used because the insecticide load is a fraction of the other techniques. If the aircraft are capable of >120 knots, fine droplets can be created by the high-speed air stream affecting the flow from hydraulic nozzles. Slower aircraft and most helicopters typically use some variety of rotary atomizers to create the required

droplet spectrum. ULV applications can be difficult to accurately place with any regularity. Without the visual cues, drift and settling characteristics can be difficult to assess.

Table 2-2 Adulticides Santa Clara County Vector Control District Uses for Mosquito Abatement

Pesticide Product Name	Common Name / Active Ingredients	CAS or EPA Number	Mode of Action	Timing of Application	Method of Application	Sites
Pyrenone 25-5	5% Pyrethrins and 25% PBO	432-1050	Adulticide interferes with sodium channel function in the nervous system. Mosquito midgut disruptor	Summer and Fall	Truck-mounted ULV	Urban Areas
EcoExempt IC2	Rosemary / Peppermint Oil	Not Registered	Insect nervous system affected	Summer	Handcan	
Scourge 18%*	18% Resmethrin and 54% piperonyl butoxide	432-667	Adulticide; interferes with sodium channel function in the nervous system.	Summer and Fall	Truck-mounted ULV	Urban Areas
Scourge 4%*	4.14% Resmethrin and 12.42% piperonyl butoxide	432-716	Adulticide; interferes with sodium channel function in the nervous system.	Summer and Fall	Truck-mounted ULV	Urban Areas
Suspend SC	Deltamethrin	432-763	Insect nervous system affected	Summer and Fall	Low-volume sprayer	Urban Areas
Zenivex E20	Etofenprox	EPA 2724-791	Sodium channel blocker	Summer and Fall	Truck-mounted ULV	Urban Areas
Zenivex E4	Etofenprox	EPA 2724-807	Sodium channel blocker	Summer and Fall	Truck-mounted ULV	Urban Areas

*Scourge pesticides replaced with Pyrenone 25-5 Public Health Insecticide, EPA Number 432-1050, in 2012.

CAS Number = Chemical Abstracts Service Registry Number

EPA Number = Registered with the US Environmental Protection Agency

The flight parameters differ by program and technique. Some operations fly during hours of daylight so their applications begin either at morning's first light or before sunset and work into twilight. At these times, the pilots should be able to see towers and other obstructions as well as keep track of the spray plume. The aircraft can be flown at less than a 200-foot altitude, which may make it easier to hit the target area.

Other operations may be conducted in the dark of the night, typically after twilight or early in the morning before dawn. The aircraft typically are flown at an altitude of between 200 and 300 foot. Swath widths vary from operation to operation but are normally set somewhere between 400 and 1,200 feet. Most mosquito flight activity is crepuscular, so these flights catch the adults at their peak activity.

Swaths are flown as close to perpendicular with the wind as is possible, working into the wind and commonly forming a long, tight S pattern. A number of factors affect the spray-drift offset and settling such as wind speed, droplet size, aircraft wake turbulence, altitude, and even characteristics of the individual aircraft. Pilots rely somewhat on experience for determining this offset, and some use telltale smoke or paper markers for swath alignment.

Aerial applications may be conducted over, but are not limited to, the following land uses within the Program Area: salt marsh, diked marsh, and seasonal wetlands; evaporation ponds and wastewater ponds; and agricultural, residential, commercial, industrial, and recreational areas.

2.3.5.2 Yellowjacket and Other Insects Abatement

Besides using insecticides for mosquito populations, the District selectively applies them to control ground-nesting yellowjackets, as well as other insect pests (e.g., fleas, mites, ticks) that pose an imminent threat to people or to pets. This activity is generally triggered by public requests for District assistance or action rather than as a result of regular surveillance of their populations. The District excludes from its yellowjacket control program populations of this vector that are located in or on a structure. Yellowjacket nests that are off the ground would be treated under special circumstances to protect public health and safety of the District's residents. Whenever a District technician learns that a hive is situated inside or on a structure or is above ground, the resident(s) are encouraged to contact a private pest control company that is licensed to perform this work. When a technician encounters a honeybee swarm or unwanted hive, residents are provided a list of beekeepers that can safely remove the bees. If a beekeeper is not readily available, swarms posing an imminent threat to public safety may be treated with MPede (insecticidal soap). If a District technician deems it appropriate to treat yellowjackets, they will apply the insecticide directly within the nest in accordance with the District's policies to avoid drift of the insecticide or harm to other organisms. Alternatively, they will place tamper-resistant traps or bait stations, selective for the target insect, in the immediate environment of the vector (which is equivalent to "other vertebrate vector control").

Pyrethroid-based chemicals are typically used against ground-nesting yellow jackets and ticks. The potential environmental effects of these materials is minimal due to two factors: (1) their active ingredients consist largely of pyrethrin (a photosensitive natural insecticide manufactured from a *Chrysanthemum* species), or allethrin and phenothrin (first generation synthetic pyrethroids with similar photosensitive, nonpersistent characteristics as pyrethrin), and (2) the mode of their application for yellowjacket population control (i.e., directly into the underground nest) prevents drift and further reduces the potential for inadvertent exposure to these materials. The pesticides the District uses to control yellowjacket and tick populations are shown in Table 2-3 (Pesticides the District Uses for Yellowjacket Wasp Abatement**).**

The District has developed a rodent program to assist residents in the Service Area. The District's limited use of rodenticides is only during extreme rodent issues targeting sewer rats. Table 2-4 (Pesticides the District Uses for Rat Abatement) lists the pesticides the District uses for control of rats. The District may use two different groups of anticoagulant rodenticides, known as first generation and second generation rodenticides. First generation rodenticides require consecutive multiple doses or feedings over a number of days to be effective. Concentrations of active ingredient in the bait typically range from 0.005 to 0.1 percent. Second generation rodenticides are lethal after one dose and are effective against rodents that

have become resistant to first generation rodenticides. Concentrations of active ingredient in the bait typically range from 0.001 to 0.005 percent, as these anticoagulant baits are far more toxic than first generation baits.

The District may conduct rodent baiting at underground sites such as sewers, storm drains, or catch basins. Secure and tamper-resistant bait stations or other accepted methods of rodent baiting are conducted in areas with severe rodent infestations. In sewer baiting, bait blocks containing bromadiolone (a second generation, single-feeding anticoagulant rodenticide) are often used. The block is suspended by wire above the water line to encourage rodent feeding. For rodent burrows when the rodent population poses a public health risk, chlorophacinone (a first generation, multiple feeding anticoagulant dust) is blown into the burrows.

2.3.6 Other Nonchemical Control/Trapping Component

This tool includes the trapping of rodents and/or yellowjackets that pose a threat to public health and welfare. For both vector species, tamper-resistant or baited traps are used. District staff place the trap(s) in secure locations primarily at the request of the property owner or manager. When requests for rat and yellowjacket pest removal in or on structures occurs, citizens are referred to a directory of local private pest control companies, because the District is not licensed for these types of structural control activities.

Trapping is also used for the removal of nuisance wildlife such as bats, raccoons, skunks, and opossums when these animals pose a threat to public health and safety. The two primary reservoir vectors of rabies in California are bats and skunks. Both live in close proximity to humans and their pets because of their ability to adapt to the urban/suburban environment. Residential landscapes provide them with an abundance of food and shelter options that have increased their numbers and the potential for direct contact with the human population. This scenario is true for all wildlife and because of it a potential rabies health threat exists. The District works with home and property owners to discourage wildlife such as skunks and bats from taking up residence on their property. Following a request for service, the District's Vector Control Officer will survey the property and provide guidance and recommendations on exclusion methods to minimize harm to the property. If all efforts are tried and the problem remains or a threat of physical injury or disease transmission is imminent, the District may trap the animal(s) once property owner/manager have signed the trapping agreement. Since wildlife cannot be relocated without permits, it is often necessary to release the animal on-site or perform humane euthanasia. Current protocol is to have a District Wildlife trapper trap the animal then have Animal Care and Control Services pick up the animal and perform humane euthanasia. All animals trapped are tested for rabies, particularly those that have injured a human or their pet, or appear to be sick, are submitted to the Santa Clara County Public Health Lab for rabies testing.

2.4 Public Education

Public education is a key component that is used to encourage and assist reduction and prevention of vector habitats on private and public property. While this component is a critical element of the District's Program, these activities don't generally affect the physical environment and are therefore not further addressed in this document.

A solid mosquito/vector prevention program includes good public education. The District's education program teaches the public how to recognize, prevent, and suppress mosquito/vector breeding on their property. This part of the project is accomplished through the distribution of brochures, fact sheets, newsletters, billboards, participation in local events and fairs, presentations to community organizations, newspaper and radio advertising, public service announcements, and contact with District staff in response to service requests. Public education also includes a school program that teaches future adults to be responsible by preventing and/or eliminating vector breeding sources and educates their parents or guardians about District services and how they can reduce vector-human interaction.

Educational activities also include making recommendations on specific property development and land and water management practices or proposals, in response to ongoing or proposed developments or management practices that may create sources of mosquitoes/vectors. To ensure that the District does not indirectly encourage environmental impacts without CEQA review, the District informs landowners and others who might modify the physical environment in response to our educational programs that they have specific environmental obligations, including compliance with CEQA and permit requirements. The District is not a permitting agency and it is not responsible for implementing or approving the recommendations; therefore, property owners or developers are required to prepare and submit their own documents for projects to permitting agencies, which may involve site-specific CEQA review.

2.5 Emergency Activities

In the event of emergency conditions, comprising an actual or imminent disease outbreak declared by the CDPH, the District's Program activities will temporarily vary from its routine operational tools through increases in scope or intensity of methods, and potentially through use of legal pesticides, in strict conformance with label requirements, that the District does not routinely use. Because of their temporary nature and their similarity to routine activities, emergency activities are not addressed in this Environmental Evaluation.

2.6 Vehicles and Equipment Used to implement the Program

Equipment listed and described herein is those mechanized items with engines or applicators that have the potential to affect air quality, greenhouse gas emissions, noise, or hazard evaluations for the environmental evaluation. The specific types of District vehicles and equipment, and aerial equipment used by other pesticide applicators under contract, used in its Program are listed in Table 2-5 (District Vehicle and Equipment List). The list includes vehicles, vehicle-borne pesticide applicators, personnel-borne applicators, and power tools. Nonmechanized equipment, such as trailers and hand rakes, is not included.

Table 2-3 Pesticides Santa Clara County Vector Control District Uses for Yellowjacket Wasp and Bee Swarm Control Abatement

Pesticide Product Name	Common Name / Active Ingredients	CAS or EPA Number	Mode of Action	Timing of Application	Method of Application	Sites
Drione Insecticide	Pyrethrin / silica gel dust	EPA 432-992	Insect nervous system affected / dehydration	All year	Bellow Duster	Urban, suburban areas, tree holes, ground nests
M-Pede	Potassium salts	EPA 53219-6	Fills tracheae or asphyxiation	Spring and Summer	Handcan	Urban, suburban areas,
Wasp Freeze	Phenothrin/trans allethrin	EPA 49-362	Insect nervous system affected	All year	Aerosol can	Urban, suburban areas,

CAS Number = Chemical Abstracts Service Registry Number

EPA Number = Registered with the US Environmental Protection Agency

Table 2-4 Pesticides Santa Clara County Vector Control District Uses for Rat Abatement

Pesticide Product Name	Common Name / Active Ingredients	CAS or EPA Number	Mode of Action	Timing of Application	Method of Application	Sites
Contrac 8 oz. blk	01% Bromadiolone	EPA 12455-82	Vitamin K antagonist	All year	Bait Station	Urban, domestic
FirstStrike Soft Bait	Difethialone	EPA 7173-258	Anticoagulant	All year	Bait Station	Urban, domestic
Giant Destroyers Gop	Sulfur	EPA 10551-1	Fumigant	Summer and Fall	Buried in a burrow and lit	Urban, suburban areas
Large Gas Cartridge	Sodium nitrate	EPA 56228-21	Fumigant	All year	Buried in a burrow and lit	Urban, suburban areas
Sewer Blocks	Diphacinone	EPA 56-20	Anticoagulant	All year	Suspended on a wire	Sewer

CAS Number = Chemical Abstracts Service Registry Number

EPA Number = Registered with the US Environmental Protection Agency

Table 2-5 Santa Clara County Vector Control District Vehicles and Equipment

Type of Vehicle/Equipment	Engine	Fuel Type
Ground Surveillance and Applications/Management		
Ford Personnel Van(1)	2.4 L 4cyl	Gas
Dodge Dakota Pickup truck(1)	3.7L V6	Gas
Ford F150 (14)	4.6 L V8	Gas
Dodge ¾ ton (1)	5.9 L V8	Gas
GMC ½ ton (5)	5.3 L V8	Gas
Fork Lift (1)	Battery	Electric
Ford Escape (1)	2.4 L Hybrid	Gas/Electric
Ford F250 (10)	5.4 L V8	Gas
Ford Ranger (5)	4.0 L V6	Gas
Ford Expedition	4.6L	Gas
International flatbed truck	345 cu in V8 (5.4L)	Gas
Water Surveillance and Applications/Management		
Argo Avenger ATV(2)	26 HP Kohler engine	Gas
Kabota	3 cyl 21HP	Diesel
Boat	Battery	Electric
Yamaha Quads (2)	400cc 4 stroke	Gas
Argo Conquest	20 HP Kawasaki	Gas
Maruyama Spreader	25 cc	2 stroke
Aerial Applications		
Alpine Helicopter Services	Alison C20 Gas Turbine	Jet-A

2.6.1 Vehicles and Equipment for Ground Surveillance and Chemical Application

The District uses open bed 4-wheel drive pickup trucks that have been modified for the particular Program activity. Generally, a chemical container tank, high-pressure, low-volume electric or gas pump, and spray nozzle are mounted in the back of the bed, with a switch and extension hose allowing the driver to operate the equipment and apply larvicides. When treatment sites cannot be accessed by roads, access is by way of ATVs or by foot (if vehicle access is prohibited), and treatments are made using handheld sprayers or belly grinders (for granular or pellet formulations). Some situations where flooding and wetlands preclude access by 4-wheel drive vehicles or reasonable walking distance in waders/boots do require the use of an approved ATV. District staff do not use ATVs where environmental conditions (e.g., impenetrable vegetation/terrain, endangered/threatened plants, sensitive habitat) can result in causing an accident, personal injury, or significant environmental damage. When used, ATVs are fitted with a chemical container mounted on the vehicle, a 12-volt electric- or gasoline-engine-powered pump supplying high-pressure, low-volume flow, and a hose and spray tip allowing for application while steering the vehicle. ATVs are ideal for treating areas like agricultural fields, pastures, salt marshes, and other offroad sites.

Additional equipment used in ground applications includes handheld sprayers, seeders, and backpack sprayers/blowers. Handheld sprayers (handcans) are standard 1- or 2- or 2- or 3-gallon garden style pump-up sprayers used to treat small isolated areas with precision. Backpack sprayers are either gas or hand powered and are fitted with chemical tanks that can hold granular or pellet formulations in addition to liquid. Generally, for smaller areas, pellet or small granular material is applied with a mechanical hand-crank spreader, seeder, or backpack blower.

2.6.2 Boats for Water Surveillance and Application

District personnel use a 15-foot aluminum outboard-equipped boat to inspect and treat large deepwater bodies and islands. They are commonly used for accessing saltmarsh island areas in the south San Francisco Bay such as in Alviso (San Jose) and Palo Alto Floodbasin. The boat is the best access to inspect aquatic plant mats, algae mats, and islands for mosquitoes. Boat use minimizes vehicle travel in offroad areas of the creek beds and hazardous terrain along shorelines for carrying treatment equipment on foot. Further, boat operations do not have lasting environmental effects, such as ground disturbance.

2.6.3 Aerial Application

The District uses a contract agricultural application service to provide helicopter and optionally fixed-wing treatments to large or problematic/difficult access source areas (around 400 acres, up to 1,200 acres). Helicopter and fixed-wing operations are done at very low altitude in areas away from people. An advantage of using a helicopter is the high rate of application to large areas without contact with the ground surface (no disturbance of vegetation) at a reasonable per acre cost. A helicopter can treat up to 200 acres per hour. Helicopter treatments occur during daylight hours, typically before noontime when little or no wind occurs, and at an altitude that is less than 40 feet above the surface of the site being treated. A 120-gallon tank is used with a typical application rate of 2 gallons of final mix per acre. Although very cost prohibitive, the application rate can exceed 5 gallons per acre in “special” circumstances when a larger droplet size is desired to further minimize potential drift issues or penetrate vegetation. Typically, aerial larvicide treatments are done using granular Bs and Bti formulations at a target rate of 10 to 20 pounds per acre depending on the density of vegetation. If dense vegetation is present, application rates may increase to up to 20 pounds per acre.

2.7 Other Required Permits and Agency Coordination

2.7.1 Required Permits

2.7.1.1 California Department of Public Health

The District’s Program as a whole, including the registration and continuing education of state-certified field personnel, is reviewed and approved by the CDPH, through a formal Cooperative Agreement that is renewed annually. The CDPH also performs onsite annual inspection of the District’s equipment, operations, safety training, and records.

2.7.1.2 Statewide General NPDES Permit for Vector Control

The application of pesticides at, near, or over waters of the US that results in discharges of pollutants requires coverage under a National Pollutant Discharge Elimination System (NPDES) permit. In response to the Sixth Circuit Court’s decisions and previous decisions by other courts on pesticide regulation, the State Water Resources Control Board (SWRCB) has adopted four Pesticide Permits. Water Quality Order No. 2011-0002-DWQ (General Permit No. CAG 990004) is the Permit for Biological and Residual Pesticide Discharges to waters of the US from vector control applications. The District completed application requirements, including preparation of a Pesticide Application Plan (PAP) and public notice requirements, and received permit approval on March 1, 2011.

This General Permit covers the point source discharge of biological and residual pesticides resulting from direct to water and spray applications for vector control using (1) larvicides containing monomolecular films, methoprene, Bti, Bs, temephos, petroleum distillates, or Spinosad; and (2) adulticides containing, naled, pyrethrin, permethrin, resmethrin, sumithrin, prallethrin, PBO (an inert ingredient), etofenprox, or N-octyl bicycloheptene dicarboximide (or MGK-264). Users of products containing these active ingredients (and the inert PBO) are required to obtain coverage under this General Permit prior to application to waters of the US. This General Permit only covers the discharge of larvicides and adulticides that are currently registered in California.

Pursuant to California Water Code Section 13389, SWRCB and Regional Water Resources Control Boards (RWQCBs) are exempt from the requirement to comply with CEQA (Public Resources Code, Chapter 3, Division 13) when adopting NPDES permits (SWRCB 2011a).

2.7.1.3 United States Army Corps of Engineers

For minor physical control activities, the District may obtain a 5-year regional permit from the USACE (with review by the SFBRWQCB and/or the USFWS, as needed), and from the BCDC (as needed).

2.7.1.4 United States Fish and Wildlife Service

The District is required to submit an annual Pesticide Use Proposal (PUP) and apply for a Supplemental Use Permit (SUP) whenever performing vector control activities on USFWS lands. Depending on the location and nature of the work, the District may also be required to consult with the USFWS under Section 7 of the federal Endangered Species Act to address potential impacts to sensitive species and habitats. In addition to SUPs and PUPs, the USFWS reviews, and may also comment on, the District's proposed annual minor physical control projects (see Section 2.8.1.4 above on the USACE permit).

2.7.1.5 Santa Clara County Agricultural Commissioner

County Agricultural Commissioners also regulate sale and use of pesticides in California. In addition, County Agricultural Commissioners issue Use Permits for applications of pesticides that are deemed as restricted materials by CDPR. For chemical control activities, the District reports to and is periodically reviewed by the Santa Clara County Agricultural Commissioner.

During the permitting process, County Agricultural Commissioners determine if the pesticide use will result in substantial adverse environmental impact, whether appropriate alternatives were considered, and if any potential adverse effects are mitigated. The Use Permit conditions contain minimum measures necessary to protect people and the environment.

2.7.2 Agency Coordination

For work on State of California lands and riparian zones, wetlands, or other sensitive habitats, the District coordinates and reviews activities with the CDFW and the California State Lands Commission as Trustee Agencies.

2.8 Best Management Practices

The District has implemented a number of procedures and practices designed to avoid or minimize potential adverse effects on the human, biological, and physical environments. These Best Management Practices (BMPs) are organized under the following categories:

> Pesticide Applications to Product Label Requirements

> Other BMPs for Mosquito and/or Vector Control

> Hazardous Materials Spill Management

> Worker Illness and Injury Prevention Program and Emergency Response.

The District will observe all state and federal regulations. The District will follow all appropriate laws and regulations pertaining to the use of pesticides and safety standards for employees and the public, as governed by the USEPA, CDPR, and local jurisdictions (with some exceptions). Although the products the District uses are all tested, registered, and approved for use by the USEPA and/or CDPR, Districts provide additional margins of safety with the adherence to additional internal guidance based on BMPs and the principles embodied in District IVM policies, where applicable.

> Ensure all District and contracted applicators are appropriately licensed by the state.

> District staff or contractors will coordinate with the County Agricultural Commissioners, and obtain and verify all required licenses and permits as current prior to pesticide application.

All applicators and handlers will use proper personal protective equipment.

2.8.1 Pesticide Applications to Product Label Requirements

2.8.1.1 California Pesticide Regulatory Program

CDPR regulates the sale and use of pesticides in California. CDPR is responsible for reviewing the toxic effects of pesticide formulations and determining whether a pesticide is suitable for use in California through a registration process. Although CDPR cannot require manufacturers to make changes in labels, it can refuse to register products in California unless manufacturers address unmitigated hazards by amending the pesticide label. Consequently, many pesticide labels that are already approved by USEPA also contain California-specific requirements. Pesticide labels defining the registered applications and uses of a chemical are mandated by USEPA as a condition of registration. The label includes instructions telling users how to make sure the product is applied only to intended target pests and includes precautions the applicator should take to protect human health and the environment. For example, product labels may contain such measures as restrictions for applications in certain land uses and weather (i.e., wind speed) parameters.

> District staff conducts applications with strict adherence to product label directions that include approved application rates and methods, storage, transportation, mixing, and container disposal.

> District selects option to use ULV applications rather than application sprays at the suggested label guidance.

> In some cases, the material is applied at concentrations and in amounts less than the label application rate allows.

2.8.2 Other BMPs for Mosquito and/or Vector Control

Many BMPs the District directly practices can be found in the *Best Management Practices for Mosquito Control in California* (CDPH 2010b). A summary of the BMPs is included below:

BMPs for Applications of Pesticides, and Surfactants

> Avoid use of surfactants in sites with aquatic nontargets or natural enemies of mosquitoes present such as nymphal damselflies and dragonflies, dytiscids, hydrophilids, corixids, notonectids, ephydrids, etc. Use a microbial treatment (Bti, Bs) or methoprene instead.

> Postpone or cease application when predetermined weather parameters exceed product label specifications or when wind speeds exceed a predetermined velocity (e.g., 7 miles per hour) and when a high chance of rain is predicted (e.g., a greater than 40 percent chance of precipitation is forecasted for a 24-hour period).

> Applicators to remain aware of wind conditions prior to and during spray events to minimize any possible drift to unwanted water bodies, and other areas adjacent to the application areas.

> Adjust spray nozzles to produce larger droplet size rather than smaller droplet size. Use low nozzle pressures where possible (e.g., 30 to 70 pounds per square inch). Keep spray nozzles within a predetermined maximum distance of target pests (e.g., within 24 inches of vegetation during spraying). Adjusting droplet size would only apply to larvicides and non-ULV applications. Use ULV sprays that are calibrated to be effective and environmentally safe at the proper droplet size (about 15 microns).

> Clean containers at an approved site and dispose of at a legal dumpsite or recycle in accordance with manufacturer's instructions if available.

> Special-Status Aquatic Wildlife Species:

- A qualified person (e.g., a District biologist) will review available CNDDB records to alert designated staff to the potential existence of special status species and the need to modify treatment materials and methods appropriate to that species and habitat.. Use only pesticides, and adjuvants approved for aquatic areas or manual treatments within a predetermined distance from aquatic features (e.g., within 15 feet of aquatic features). Aquatic features are defined as any natural or man-made lake, pond, river, creek, drainage way, ditch, spring, saturated soils, or similar feature that holds water at the time of treatment or typically becomes inundated during winter rains.
- If it is found that aquatic features are present within the boundary of the proposed treatment area, the District will not implement treatment actions in those areas or if the District wishes to continue treatment actions in these areas, it will further investigate the work area (e.g., using aerial photos and biological data developed for other permits) prior to treatment to determine presence of suitable habitat or critical habitat for special-status species.
- If suitable habitat necessary for special-status species is found, including vernal pools, and if aquatic-approved pesticides and adjuvants treatment methods have the potential for affecting the potential species, then the District will coordinate with the CDFW, USFWS, and/or National Marine Fisheries Service (NMFS) before conducting treatment activities within this boundary or cancel activities in this area. If the District determines no suitable habitat is present, treatment activities may occur without further agency consultations.

> Conduct worker environmental awareness training for all treatment field crews and contractors for special-status species and sensitive natural communities a qualified person (e.g., District biologist) determines to have the potential to occur on the treatment site. Conduct the education training prior to starting work at the treatment site and upon the arrival of any new worker onto sites with the potential for special-status species or sensitive natural communities.

> Survey all predetermined treatment sites every year prior to work to determine the potential presence of special-status plants and terrestrial wildlife using the CNDDB, relevant Habitat Conservation Plans (HCPs), NOAA Fisheries and USFWW websites, CAlfish.org, and other biological information developed for other permits. Establish a predetermined buffer of reasonable distance from known special-status species locations and do not allow application of pesticides/rodenticides (including fumigants) within this buffer without further agency consultations.

> District staff will monitor sites post-treatment to determine if the target pests were effectively controlled with minimum effect to the environment and nontarget organisms. Design future treatment methods in the same season or future years to respond to changes in site conditions.

> For rodenticides – deploy bait blocks by suspension to reduce potential dietary exposure to nontarget animals. Apply bait block attachments to the underside of manhole covers so that rodents are more likely to perish while still in the sewer and away from predators to reduce secondary exposure.

> For rodenticides – use tamper-proof bait stations firmly attached to embedded stakes so that bait cannot be dragged away by nontarget animals.

> Whenever possible, do not apply pesticides that could affect insect pollinators during the day when honeybees are active or at dawn/dusk when other pollinators are active. Applications of these specific pesticides are to occur after dark.

> The District will perform public education and outreach activities.

> District will notify the public when applying pesticides for large scale treatments or for those on parklands (e.g., 48 hours prior to treatment and 24 hours after treatment). BMPs for Surveillance and Nonchemical Physical Control and Vegetation Management

> If suitable habitat necessary for special-status species is found, including vernal pools, and if nonchemical physical and vegetation management control methods have the potential for affecting the potential species, then the District will coordinate with the CDFW, USFWS, and/or NMFS before conducting control activities within this boundary or cancel activities in this area. If the District determines no suitable habitat is present, control activities may occur without further agency consultations.

> Survey all predetermined treatment sites every year prior to work to determine the potential presence of special-status plants and terrestrial wildlife using the CNDDB, relevant HCPs, and other biological information developed for other permits . Establish a predetermined buffer of reasonable distance from special-status species locations. Nonchemical methods are acceptable within the buffer zone without further agency consultations but only if designed to avoid damage to any identified and documented rare plants (e.g., hand pulling).

> District personnel and equipment will implement site access selection criteria to minimize equipment use in sensitive habitats including active nesting areas and to use the proper vehicles for road and offroad conditions. The District's Control Program contains information on these access criteria indicating acceptable, acceptable with care, and not acceptable methods of access or the equivalents.

> When using heavy equipment for vegetation management, District staff (and contractors) will not operate such equipment in the water and will provide appropriate containment and cleanup systems to avoid, contain, and clean up any leakage of toxic chemicals into the aquatic environment, controlling turbidity and minimizing the area that is affected by the vegetation management activity.

> Properly train all staff, contractors, and volunteer crew leaders to prevent spreading weeds and pests to other sites.

> Operation of noise-generating equipment (e.g., chainsaws, wood chippers, brush-cutters, pickup trucks) will abide by the time-of-day restrictions established by the applicable local jurisdiction (i.e., City and/or County) if such noise activities would be audible to receptors (e.g., residential land uses, schools, hospitals, places of worship) located in the applicable local jurisdiction. Shut down all motorized equipment when not in use.

> The District will perform public education and outreach activities.

2.8.3 BMPs for Permethrin

Permethrin is a Type I synthetic pyrethroid that is usually combined with synergists such as PBO to control adult mosquitoes using ULV techniques and for yellowjacket control. It is hydrophobic and tends to partition to soil and sediment. Its primary degradation pathways include photolysis and aerobic metabolism and it may be persistent in environments free of light. Permethrin is slightly toxic to humans and has been included in the final list of chemicals for screening under USEPA's Endocrine Disruptor Screening Program. It has low toxicity to mammals and is practically nontoxic to birds, but is very highly toxic to fish, aquatic invertebrates, and honeybees. Because of its high toxicity and potential persistence, the application of permethrin is subject to the following Best Management Practices:

- Application of permethrin is applied only when other IPM options have been exhausted. Alternative mosquito adulticides shall be applied whenever possible.
- These chemicals are not be applied in locations where receiving waters are 303(d) listed for pyrethroids or sediment toxicity. Consistent with the District's current IPM plan, application of chemicals occur only when other IPM options have been exhausted. Because permethrin has relatively high toxicity and persistence in comparison to other pyrethroids, the District's current IPM plan is updated to give lower priority to the use of permethrin than other pyrethroids in instances requiring chemical control. Permethrin use is reserved for specific cases where alternative pesticides would not be as effective. Prior to chemical applications, the location of the application area is reviewed with respect to proximity to impaired water bodies. Application of permethrin is not conducted in locations where receiving waters are 303(d) listed for pyrethroids or sediment toxicity.

2.8.4 BMPs for Resmethrin

Resmethrin is a Type I synthetic pyrethroid that is usually combined with synergists such as PBO to control adult mosquitoes in tree holes and using ULV techniques. Resmethrin has a high affinity to bind to soils, sediments, and organic carbon and it degrades rapidly when exposed to light. When not subject to photolysis, it may be environmentally persistent. Resmethrin has low toxicity to mammals but has been included in the final list of chemicals for screening under USEPA's Endocrine Disruptor Screening Program. It is moderately toxic to birds and highly toxic to fish and aquatic invertebrates. Due to its high toxicity and potential persistence, the following Best Management Practices are applied:

- Resmethrin is applied only when other IPM options have been exhausted. Alternative mosquito adulticides are applied whenever possible.
- These chemicals are not be applied in locations where receiving waters are 303(d) listed for pyrethroids or sediment toxicity. Consistent with the District's current IPM plan, application of chemicals occurs only when other IPM options have been exhausted. Because resmethrin has relatively high toxicity and persistence in comparison to other pyrethroids, the District's current IPM plan has been updated to give lower priority to the use of resmethrin than other pyrethroids in areas requiring chemical control. Resmethrin use is reserved for specific cases where alternative pesticides are not as effective. Prior to chemical applications, the location of the application area is reviewed with respect to proximity to impaired water bodies. Resmethrin is not applied in locations where receiving waters are 303(d) listed for pyrethroids or sediment toxicity.

2.8.5 Habitat Treatments

The District coordinates with appropriate resource agency personnel, whenever a habitat treatment is under consideration in an area potentially supporting sensitive species, as indicated by the California Natural Diversity Database, Calfish.org, NOAA Fisheries, and USFWS websites. If shallow freshwater habitats associated with natural waterways where sensitive species could be present need to be drained, the District shall schedule such activity at a time of year when these species are absent from the treatment site. In the event that such activity cannot be postponed, or must be performed in habitat that has the potential for continuous occupancy, the District shall have a qualified biologist conduct surveys to determine if sensitive fish species are present. This treatment would be avoided where sensitive species are present.

2.8.6 Hazardous Materials Spill Management

Concerning the use of pesticides, all small spills will be handled according to the District's procedures for cleanup of small spills of 5 gallons or less as follows:

> Exercise adequate caution to prevent spillage of pesticides during storage, transportation, mixing or application of pesticides. Report all pesticide spills and cleanups (excepting cases where dry materials may be returned to the container or application equipment) using the Vector Control Management System (VCMS) database application.

> Maintain a pesticide spill cleanup kit and proper protective equipment at the Vector Control Service Yard and in each vehicle used for pesticide application or transport.

> Manage the spill site to prevent entry by unauthorized personnel. Contain and control the spill by stopping it from leaking or spreading to surrounding areas, cover dry spills with polyethylene or plastic tarpaulin, and absorb liquid spills with appropriate absorbent materials.

> Properly secure the spilled material, label the bags with service container labels identifying the pesticide, and deliver them to the Field Operations Support Specialist for disposal.

> Maintain list of hazardous materials sites pursuant to Government Code Section 65962.5 (CalEPA 2013).

2.8.7 Worker Illness and Injury Prevention Program and Emergency Response

The District's Illness and Injury Prevention Program and the Emergency Response Plan provide safety training for all employees who may be affected by any substance, process, procedure, or equipment that represents a potential hazard. Training programs are conducted for the safe use of equipment, machinery, or tools and the safe use and disposal of pesticides. After completing the training, employees are required to take a comprehensive examination and are enrolled in a continuing education program.

> Equip all vehicles used in wildland areas with a shovel and a fire extinguisher during the dry season.

Train employees on the safe use of equipment and machinery, including vehicle operation.

2.8.8 BMPs for Odorous Compounds

To minimize the possibility that VOCs, sulfur compounds, and chlorine compounds found in some pesticides such as OPs, fumigants, and organochlorines will not create objectionable odors in treatment areas, the District employs the following BMPs as applicable to the specific application situation to reduce drift towards human populations/residences from the ground and aerial applications of odorous treatment compounds:

- Maintain appropriate buffer zones between spray areas and sensitive receptor locations whenever possible and practicable for the application of the treatment compounds, especially true for aerial applications.
- Whenever possible and practicable, defer application of treatment compounds until favorable wind conditions would reduce or avoid the risk of drift into populated areas.
- Use global positioning system (GPS) dataloggers that document site-specific compliance with all label requirements for drift mitigation.
- Use precision application technology to reduce drift and the total amount of material applied. This measure can include (1) Precision guidance systems that minimize ground or aerial spray overlap (e.g., GPS and Real Time Kinetics – GPS/RTK) and (2) Computer-guided application systems that integrate real-time meteorological data and computer model guidance to reduce drift from aerial application (e.g., trade names "AIMMS," "Wingman™ GX," and "NextStar™ Flow Control").

2.8.9 Noise BMPs

The District implements the following BMPs for operations that generate noise that could be expected to be of concern to the public or potentially exceed regulatory standards:

- Provide Advance Notices. A variety of measures are implemented depending on the nature/magnitude of the activities and the District involved, including press releases, social media, District websites, hand-delivered flyers, posted signs, emails, and phone alerts. Public agencies and elected officials also may be notified of the nature and duration of the activities, including the local Board of Supervisors or City Council, environmental health and agricultural agencies, emergency service providers, and airports.
- Provide Mechanism to Address Complaints. The District staff is available during regular business hours to respond to service calls and may staff phone lines to address concerns during nighttime operations.
- Follow Established Procedures for Airboat Operations. Airboat operators are limited to certain areas and follow the guidelines established for those areas.

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3 Urban and Rural Land Uses

The focus of this chapter is on the consistency of the Program with local and regional land use plans and policies in effect in the Program Area. Because the exact location and timing of potential vector control activities are unknown, this analysis has been conducted at a programmatic level.

3.1 Environmental Background

This section presents an overview of the types of land uses found in the Program Area, including a description of public lands in the Program Area where vector control measures could be implemented. It also presents federal, state, and local ordinances and regulations that are related to pesticide use in the Program Area. Section 3.2 assesses the ongoing Program in terms of issues related to urban and rural land uses.

3.1.1 Overview of Urban and Rural Land Use

Generally, implementation of vector control activities could occur on a wide range of land uses within the Program Area of Santa Clara county. In addition, actions can also be taken in adjacent counties as needed, including Alameda, San Mateo, Santa Cruz, Stanislaus, Merced, and San Benito counties. This 7-county region representing the Program Area is characterized by both urban and rural settings. Urban areas include residential, commercial, and industrial uses that tend to be located in incorporated areas. In fact, portions of the Program Area cover the San Francisco Bay Area region, which is densely populated. Other parts of the Program Area are rural in character, including agricultural land, rural residential, open space, and other public lands that are generally undeveloped.

Control measures specific to mosquitoes are focused on aquatic habitats, including natural areas, such as marshes, lakes and ponds, rivers and streams, vernal pools and other seasonal wetlands. These types of habitats typically are found in rural areas. Mosquito control measures can also occur at developed facilities found in urban areas or other areas that retain water, such as stormwater detention basins, flood control channels, spreading grounds, street drains and gutters, wash drains, , artificial containers, tire piles, fountains, ornamental fishponds, and swimming pools. Similar environments serve as habitat for other vectors (Note: also infers that similar control measures can be applied.

3.1.2 Public Lands

Although vector control measures can be implemented on lands irrespective of land ownership, large expanses of aquatic and terrestrial habitat are commonly found on public lands, such as National Wildlife Refuges administered at the federal level by the USFWS. Table 3-1 presents the extent of federal land in the Program Area. The Program Area also has extensive areas of public land managed by state agencies, namely California State Parks, as well as community and regional parks managed by local parks and recreation departments of affected municipalities and special districts.

Table 3-1 Federal Lands in the Program Area, FY-2012 (acres)

County	Agency							Program Area?
	BLM	USFS	USBR	NPS	USACE	USFWS*	Total	
Alameda	217	0	542	0	111	0	870	Yes
Merced	4,175	0	31,353	0	0	8	35,536	Yes
San Benito	87,147	0	573	15,175	0	0	102,895	Yes
San Mateo	0	0	0	2,349	0	0	2,349	Yes

Table 3-1 Federal Lands in the Program Area, FY-2012 (acres)

County	Agency							Program Area?
	BLM	USFS	USBR	NPS	USACE	USFWS*	Total	
Santa Clara	1,636	0	175	0	0	0	1,811	Yes
Santa Cruz	12	0	0	0	0	0	12	Yes
Stanislaus	471	0	1,765	0	1,048	0	3,284	Yes
Total	**93,658**	**0**	**34,408**	**17,524**	**1,159**	**8**	**146,757**	**--**

Source: US Department of Interior (2013)

Notes:

*Many lands within the National Wildlife Refuge system administered by USFWS are not eligible for payments in lieu of taxes and are not included in the table.

BLM = Bureau of Land Management
NPS = National Park Service
USACE = US Army Corps of Engineers
USBR = US Bureau of Reclamation
USFS = USDA Forest Service
USFWS = US Fish and Wildlife Service

3.1.3 Regulatory Setting

3.1.3.1 Federal

No federal regulations and/or policies govern land use in the Program Area, except for management plans related to federal land holdings. However, the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)[12] regulates, at the federal level, pesticide distribution, sale, and use. For more information on FIFRA, refer to Section 7.1.5.1 (Human Health).

3.1.3.2 State

Similar to the federal level, the State of California has no direct authority on local land use on private lands with the exception of requirements related to general plan development and zoning consistency. Specifically, California Government Code Section 65300 et seq. establishes the obligation of cities and counties to adopt and implement general plans. A general plan is a comprehensive, long-term strategy document that sets forth the expected location and general type of physical development expected in the city or county developing the document. In addition, State Zoning Law (California Government Code Section 65800 et seq.) establishes that zoning ordinances, which are laws that define allowable land uses in a specific district, are required to be consistent with the general plan and any applicable specific plans. Land use on state-managed public lands is regulated pursuant to any applicable land use plans and policies administered by each state agency.

From a land use perspective, the key regulatory consideration at the state level is related to the concept of preemption. Preemption refers to laws at one level of government taking precedence over laws of a lower level. As such, no entity at the lower level can pass a law inconsistent with the law at the higher level. The California Constitution also allows the state to preempt local jurisdictions. California Food and Agricultural Code Section 11501.1 states that no ordinance or regulation of local government “may prohibit or in any way attempt to regulate any matter relating to the registration, sale, transportation, or use of pesticides, and any of these ordinances, laws or regulations are void and of no force or effect.”

[12] 7 United States Code Section 136 et seq. (1996)

3.1.3.3 Local

Each of the municipalities (i.e., counties and incorporated cities) in the Program Area maintains its own general plan and/or zoning ordinance that regulates allowable land use within its jurisdiction. Typically, policies and programs related directly to pesticide use are outside the purview of local planning and zoning regulation. However, some cities and counties have enacted regulations on pesticide use as part of their municipal code. Local governing bodies may pass ordinances that regulate or restrict pesticide use in their own operations. However, these restrictions do not apply to state operations and would not be applicable to treatments proposed by the District under the Program because California state law preempts local regulation and restriction of pesticide use. The District is a regulatory agency formed pursuant to California Health and Safety Code Section 2000 et seq. State law charges the District with the authority and responsibility to take all necessary or proper steps for the control of mosquitoes and other vectors in the District (see Section 1.1.3).

All municipalities within the Program Area have adopted specific regulations regarding the use of pesticides and/or have developed IPM plans or programs. In the Program Area, these municipalities include:

> Member Agencies of the Santa Clara Valley Urban Runoff Pollution Prevention Program have each adopted IPM policies as part of a regional NPDES coalition consisting of: Campbell, Cupertino, Los Altos, Los Altos Hills, Los Gatos, Milpitas, Monte Sereno, Mountain View, Palo Alto, San Jose, Santa Clara, Saratoga, Sunnyvale, Santa Clara County, and Santa Clara Valley Water District.

>

> City of Berkeley. Created an IPM program, and attempts to minimize or eliminate the use of pesticides.

> City and County of San Francisco. Passed an ordinance in 1996 that created a mandatory IPM program for public property with the primary goal of reducing pesticide use, as well as to provide for the use of pesticide alternatives in hospitals, jails, office buildings, the San Francisco Port and International Airport, golf courses, parks, and watershed areas.

> City of Santa Cruz. Passed an ordinance to limit pesticide use on city property, and created an IPM plan.

> City of Sunnyvale. Developed and implemented a pesticide toxicity control plan to address urban stream impairment.

> Town of Woodside. Adopted San Mateo Countywide Pollution Prevention Program Model Integrated Pest Management Policy.

3.2 Environmental Evaluation

The evaluation of the Program in terms of urban and rural land uses is presented below.

3.2.1 Evaluation Methods and Assumptions

The methodology for the evaluation consists of (1) reviewing existing recreational opportunities in the Program Area and analyzing how proposed vector control measures would affect recreational land uses and (2) reviewing the Program components in the context of state and local laws and regulations pertaining to pesticide use.

3.2.2 Surveillance Component

Recreational Land Uses

The Surveillance component involves utilization of various methods to monitor targeted vectors in terms of their location and distribution. District staff may implement surveillance techniques in recreational

settings, but they would not likely interfere with existing recreational uses. Recreationists continue to utilize recreation areas and degradation of the quality of the recreational experience, such as from noise, would be minor.

Conflict with Applicable Land Use Regulations and Policies

This component does not involve the use of chemical pesticides to control vectors and, therefore, would not conflict with local ordinances restricting pesticide use.

3.2.3 Physical Control Component

Recreational Land Uses

The Physical Control component entails changes to the extent or composition of vector habitats as a means of vector control or "source reduction." Recreational areas that affected by physical control activities include aquatic habitats that are used either directly or indirectly for recreational purposes, e.g., water bodies used by anglers or waterfowl that are targeted by hunters. The District undertakes a variety of physical control projects, such as removal of sediments from channels and repair of water control structures, in freshwater bodies and saline habitats, including marshes and ponds, consistent with regulatory requirements (see Section 2.7) in a manner that generally maintains or improves habitat values for desirable species to control mosquitoes. These types of maintenance activities do not generally interfere with public use of these habitats for fishing or hunting. Moreover, the control of mosquitoes in aquatic habitats prevents them from annoying/biting recreationists, which enhances the recreational experience. In addition, physical control measures target other types of vector habitats that generally do not support recreational uses. As a result, this component does not likely interfere with existing recreational uses except on a limited basis, and recreationists continue to utilize recreation areas in a similar fashion to the present.

Conflict with Applicable Land Use Regulations and Policies

This component does not involve the use of chemical pesticides to control vectors and, therefore, would not conflict with local ordinances restricting pesticide use.

3.2.4 Vegetation Management Component

Recreational Land Uses

The Vegetation Management component involves control or removal of vegetation in an effort to control vectors. Vegetation management tends to be targeted at areas where it can improve surveillance and reduce vector habitats, and may take place at different times of year. It usually involves thinning rather than total removal of a given species (e.g., cat tails). Because these activities are intermittent, temporary in nature, and limited in extent, they would not prevent recreationists from using these areas.

Conflict with Applicable Land Use Regulations and Policies

This component does not involve the use of chemical pesticides to control vectors and, therefore, would not conflict with local ordinances restricting pesticide use.

3.2.5 Biological Control Component

Recreational Land Uses

This component entails the use of pathogens and predators to control target vectors. Mosquito pathogens are covered under Chemical Control. The predator technique requires placement of mosquitofish in controlled water bodies such as ornamental ponds and water gardens. Such methods are not noticeable in recreational settings and do not likely interfere with existing recreational uses. Recreationists continue to have access areas, and effects on the quality of the recreational experience are negligible.

Conflict with Applicable Land Use Regulations and Policies

This component does not involve the use of chemical pesticides to control vectors and, therefore, does not conflict with local ordinances restricting pesticide use.

3.2.6 Chemical Control Component

Recreational Land Uses

The Chemical Control component entails the periodic use of insecticides, and rodenticides to control target vectors, which are implemented based on a number of factors, including but not limited to the vector's abundance, density, species composition, proximity to human settlements, water temperature, and presence of predators. Chemical applications may occur in public recreation areas, such as parks and refuges, thereby potentially affecting recreational uses.[13] Chemical applications in recreation areas can improve the quality of recreational opportunities due to the elimination of nuisance effects from vectors. However, some factors may result in adverse effects on recreation. First, chemical application techniques may involve the use of heavy equipment, including aircraft for aerial applications, which would diminish the quality of the recreational experience realized by recreationists. Such equipment generates noise, particularly aircraft, and alters the visual landscape, which is inconsistent with the overall character of many recreation areas. Second, the potential exists that chemical applications deter people from recreating in certain areas in an effort to avoid direct exposure, thereby limiting recreational access for local residents and visitors. Helicopter applications require the District to close walking trails and restrict access into flight areas for public safety. The District checks with the Don Edwards Refuge Education Center for scheduled events such as school field trips to avoid concurrent spraying. The public education component calls for public notification in advance of chemical application in public areas (as necessary), which allows recreationists to adjust their recreational patterns, e.g., visiting alternative recreation sites in the region. Overall, chemical applications in recreation areas are isolated events implemented on an as-needed basis that do not affect most recreational usage.

Conflict with Applicable Land Use Regulations and Policies

The Chemical Control component could conflict with local land use regulations that restrict pesticide use in some jurisdictions, such as those outlined in Section 3.1.3.3. However, because state law preempts local restrictions on the use of pesticides, local ordinances prohibiting their use are not applicable to the Program.

3.2.7 Other Nonchemical Control/Trapping Component

Recreational Land Uses

The Other Nonchemical Control/Trapping component involves the use of traps to control vectors. Although such traps may be placed in recreational settings, they are not directly placed in high-use areas during the day and, therefore, do not likely interfere with existing recreational uses. Recreationists continue to maintain access to recreation areas, and the effect on the quality of the recreational experience is negligible.

Conflict with Applicable Land Use Regulations and Policies

This component does not involve the use of chemical pesticides to control vectors and, therefore, does not conflict with local ordinances restricting pesticide use.

[13] Table 3-1 shows the extent of federal land holdings in the Program Area, which include areas used for recreational purposes.

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4 Biological Resources – Aquatic

This chapter evaluates Program components in relation to aquatic resources. Section 4.1, Environmental Background, presents an overview of the aquatic resources in the Program Area and vicinity. Section 4.2assesses the ongoing Program in terms of issues related to aquatic resources. Monitoring of recommended mitigation measures

This chapter depends heavily on the information provided in Appendix A, Biological Resources Technical Report, Appendix B, Human and Ecological Health Assessment Report, and Chapter 6, Ecological Health. Terrestrial resources are addressed in Chapter 5.

4.1 Environmental Background

Section 4.1.1 identifies the zoogeographic provinces in the District's Program Area, Section 4.1.2 describes the special-status aquatic species that have the potential to occur within the Program Area, and Section 4.1.3 provides an overview of federal, state, and local ordinances and regulations pertinent to these resources that are applicable to the Program. Section 4.1.4 identifies the Habitat Conservation Plans (HCCPs) and Natural Community Conservation Plans (NCCPs) in the Program Area.

4.1.1 Aquatic Resources within the Program Area

The Program will be implemented within the District, located in Santa Clara County. This area encompasses a range of aquatic habitats and a diverse array of fish and other aquatic species. The zoogeographic provinces and species assemblages presented in Moyle (2002) have been used to describe the areas where the Program activities and treatments would be implemented and are shown on Figure 4-1. The zoogeographic provinces are described in Appendix A.

4.1.2 Special-Status Species

A number of special-status species are found in the Program Area and vicinity. Special-status species are those that are listed as endangered, threatened or candidate species under the federal Endangered Species Act, endangered or threatened under the California Endangered Species Act, or listed as species of special concern by the State of California. Brief life-history descriptions for special-status species represented in Appendix A, Attachment A, Table A-3. According to the California Natural Diversity Database (CNDDB), Special-Status fish species that have been reported within the District include Green sturgeon (*Acipenser medirostris*) and Rainbow trout / Steelhead (*Oncorhynchus mykiss*). The Green sturgeon and Rainbow trout / Steelhead (Northern CA ESU, Central CA Coast ESU, South-Central CA Coast ESU, Central Valley ESU) are Federally listed as Threatened. In the Program Area (adjacent counties), species of concern include Kern brook lamprey (*Lampetra hubbsi*), Green sturgeon (*Acipenser medirostris*), California roach (*Lavinia symmetricus*), Sacramento splittail (*Pogonichthys macrolepidotus*), Coho salmon (*Oncorhynchus kisutch*), Chinook salmon (*Oncorhynchus tshawytscha*), Rainbow trout / Steelhead (*Oncorhynchus mykiss*), and Tidewater goby (*Eucyclogobius newberryi*).

4.1.3 Regulatory Setting

The regulatory setting includes the federal, state, and local laws, statues, and regulations pertinent to the Program Area and vicinity and the aquatic resources residing therein. These laws include the following:

Federal

> Endangered Species Act of 1973

> Magnusson-Stevenson Fishery Conservation and Management Act of 1996

> Clean Water Act of 1977

> Executive Order 11990

State

> Porter-Cologne Water Quality Control Act of 1970

> California Fish and Game Code Section 1600 et seq.

> California Endangered Species Act of 1984

> California Fish and Game Code Section 5650

> Natural Community Conservation Planning Act

> California Food and Agricultural Code, Section(s) 12976 and 12981

Local

> Local governing bodies may pass ordinances that regulate or restrict pesticide use within their jurisdictional areas.

A description of these laws and regulations is provided in Appendix A, Section 2.5.

4.1.4 Habitat Conservation Plans and Natural Community Conservation Plans

HCPs are planning documents required as part of an application by a nonfederal entity for incidental take of a species listed under the federal Endangered Species Act as part of their proposed activities. An HCP describes the proposed action(s), and its anticipated effects on the individuals and populations of listed species. It also will describe how impacts will be minimized and mitigated. An HCP also can include protections for species that are candidates for listing or are proposed for listing. The HCP is reviewed by USFWS or National Oceanic and Atmospheric Administration (NOAA) Fisheries, when reviewing a project. If a project is approved by the USFWS or NOAA Fisheries, they will issue an incidental take permit for the project actions, which provides for take of these species based on the actions provided for in the HCP, as well as additional measures that the USFWS or NOAA Fisheries might include.

The California Natural Community Conservation Planning Act was first passed by the state legislature in 1991, and was updated and superseded in 2003. The primary objective of the NCCP program is to conserve natural communities at the ecosystem level, while accommodating compatible land use. It focuses on the long-term stability of wildlife and habitat, and seeks to avoid controversy and delays associated with species listings.

The Santa Clara Valley Habitat Plan provides a framework for promoting the protection and recovery of natural resources, including endangered species, while streamlining the permitting process for planned development, infrastructure, and maintenance activities. The Habitat Plan allows the County of Santa Clara (County), the Santa Clara Valley Water District, the Santa Clara Valley Transportation Authority (VTA) and the cities of Gilroy, Morgan Hill, and San José (collectively, the Local Partners or Permittees) to receive endangered-species permits for activities and projects they conduct and those under their jurisdiction. The Santa Clara Valley Open Space Authority also contributed to Habitat Plan preparation. The Habitat Plan will protect, enhance, and restore natural resources in specific areas of Santa Clara County and contribute to the recovery of endangered species. Rather than separately permitting and mitigating individual projects, the Habitat Plan evaluates natural-resource impacts and mitigation requirements comprehensively in a way that is more efficient and effective for at-risk species and their essential habitats.

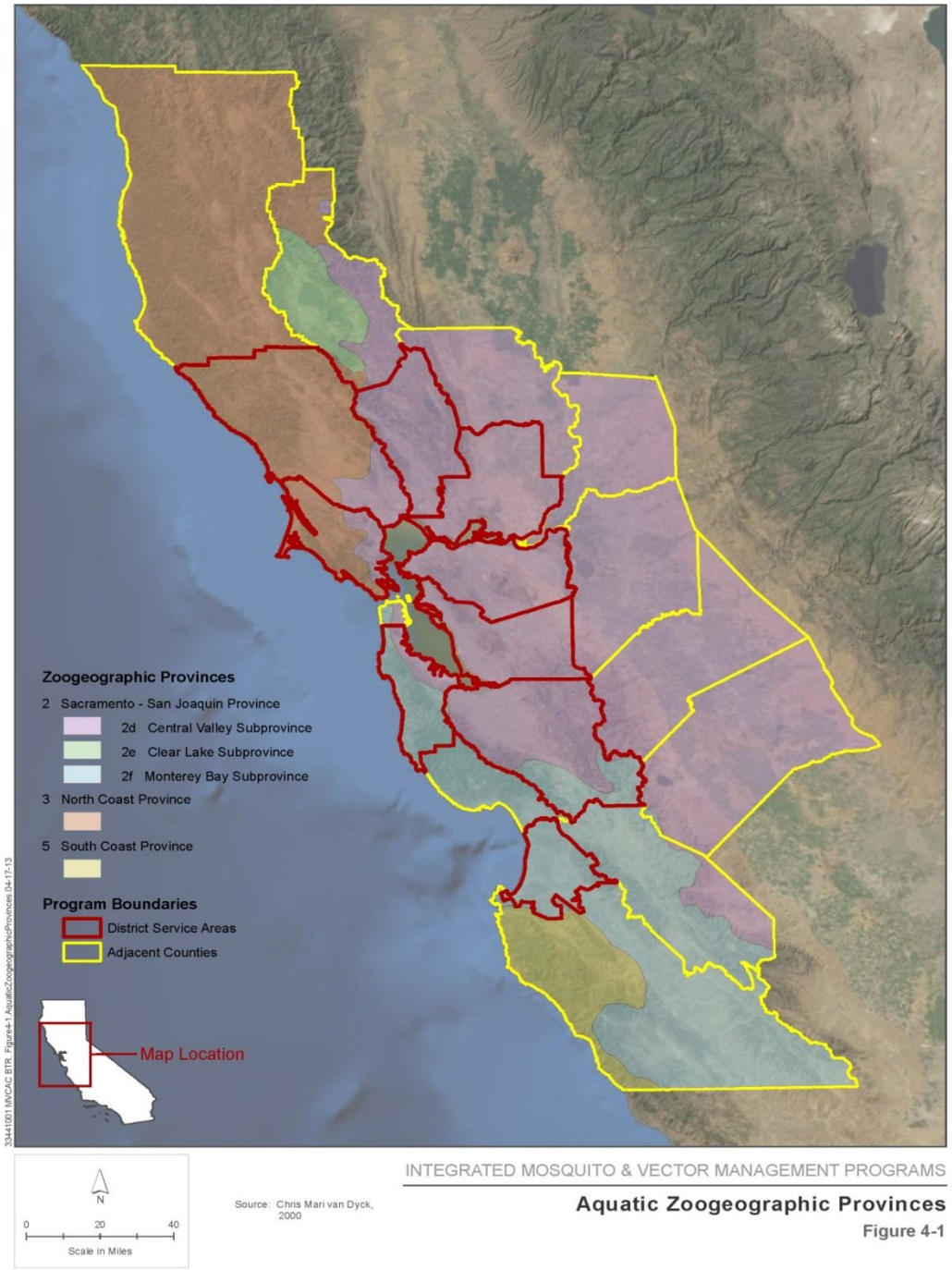
The Habitat Plan was developed in association with the U.S. Fish and Wildlife Service (USFWS), and the California Department of Fish and Wildlife (CDFW), and in consultation with stakeholder groups and the general public. The USFWS will issue the Permittees a 50-year permit that authorizes incidental take of

listed species under the federal Endangered Species Act (ESA), while CDFW will issue a 50-year permit that authorizes take of all covered species under the Natural Community Conservation Planning Act (NCCP Act). This approach allows the Permittees to streamline future mitigation requirements into one comprehensive program. In addition to obtaining take authorization for each participating agency's respective activities, the cities and County will be able to extend take authorization to project applicants under their jurisdiction.

USFWS and CDFW will also provide assurances to the Permittees that no further commitments of funds, land, or water will be required to address impacts on covered species beyond that described in the Plan to address changed circumstances. In addition to strengthening local control over land use and species protection, the Plan provides a more efficient process for protecting natural resources by creating new habitat reserves that will be larger in scale, more ecologically valuable, and easier to manage than the individual mitigation sites created under the current approach.

The Habitat Plan and associated documents are approved and adopted by the six Local Partners (Cities of Gilroy, Morgan Hill and San Jose, County of Santa Clara, Santa Clara Valley Transportation Authority, and Santa Clara Valley Water District).

Figure 4-1 Aquatic Zoogeographic Provinces



4.2 Environmental Evaluation

4.2.1 Evaluation Concerns and Criteria

The Program components are described in Section 2.3. The Program uses alternative nonchemical and chemical treatments in sequential manner to minimize potential harm to the environment; evaluating each treatment site and situation and implementing the least harmful technique that is applicable for that situation. Treatments with higher potential risk to the environment are only implemented when treatments with lower potential risk are ineffective or cannot be applied to that site. This approach minimizes the overall Program risk, but environmental concerns relating to different components remain.

4.2.1.1 Environmental Concerns

Some Program components have the potential to affect aquatic habitat through direct toxicity to nontarget organisms. The Program components may also affect aquatic resources indirectly through effects on nontarget organisms that may affect food webs, making food less available to other organisms.

Direct effects would include habitat modifications, such as draining or changing the hydrology of waterways through removal of or placement of sediment and fill, removal of debris and weeds, and trimming or removal of emergent and riparian vegetation. The District may also request or require other landowners to perform similar activities. These activities may be undertaken in a variety of habitats including freshwater habitats (streams, rivers, ponds, and lakes), seasonal wetlands and vernal pools, marshes, and saline or brackish water habitats.

Introduction of mosquito predators, specifically mosquitofish, into natural, and some artificial, environments could adversely affect nontarget organisms including insects, amphibians, and fish. These organisms may prey upon these nontarget species directly or may compete with them for food resources.

Chemical control components, including larvicides, adulticides and the biological agents Bs, Bti, and Saacropolyspora spinosa have the potential to affect nontarget organisms, either through direct toxicity or through effects on nontarget organisms, which could affect the food web. Similar types of effects could occur through the use of surfactants.

Concerns identified during public scoping include the following which are addressed as elements of the broader issues explained above:

> Employ techniques associated with the physical control of vectors and their habitat that conform to Habitat Conservation Plan (HCP) avoidance, minimization, and mitigation measures.

> Ensure mosquito abatement staff minimize impacts on tidal marsh habitats (especially during bird breeding season). Restrict operation of vehicles to levees and existing roads.

> Consider direct/indirect effects of using mosquitofish as control. Do not stock mosquitofish (*Gambusia affinis*) in ponds, creeks, or reservoirs. As the mosquitofish used (*Gambusia affinis)* are nonnative predatory fish, . Mosquitofish are opportunistic feeders that may compete for food with native fish species or feed on their fry and eggs.

> Include a detailed description and complete assessment of the biological control impacts (current and future, direct and indirect) on habitats (including endangered, threatened, and locally unique species and sensitive habitats) and on species (sensitive fish, wildlife, or plants).

> Include a detailed description and complete assessment of the chemical control impacts (current and future, direct and indirect) on habitats (including endangered, threatened, and locally unique species and sensitive habitats) and on species (sensitive fish, wildlife, or plants).

> Include appropriate measures to ensure complete take avoidance of protected species while coordinating with United States Fish and Wildlife Service (USFWS), United States Department of Agriculture, Forest Service (USFS), and California Department of Fish and Wildlife (CDFW).

4.2.2 Evaluation Methods and Assumptions

The evaluation covered desired fish species (e.g., native and listed species), macroinvertebrate communities, and effects on food supply for fish, using the criteria described above. The assessment used available information on the types of control and treatment and the toxicity of the various chemicals used, the treatment descriptions, and assuming that all applicable BMPs as described in Chapter 2, Program Description, CDPH's Best Management Practices for Mosquito Control in California, the Statewide General NPDES Permit for Biological and Residual Pesticide Discharges to Waters of the US from Spray Applications (SWRCB Water Quality Order No. 2011-0004-DWQ; NPDES No. CAG 990007; Spray Applications Permit) and District-specific BMPs, as indicated in the PAPs are implemented. This assessment also considers the physical and biological connections between treatment areas and aquatic ecosystems. This information was evaluated in the context of the treatment components as described in Section 4.1.1.

The potential effects of the treatment components will vary depending on the specific treatment applied, the size and location of the treated area, the type of habitat treated, and the timing and frequency of treatment. Small treatment areas or less frequent applications of a treatment would generally be expected to result in lesser effects than the same treatment applied over a larger area or more frequently.

The potential effects of the nonchemical components are based on the type and location of habitats treated and the magnitude and frequency of treatment. The potential effects were evaluated based on the magnitude and duration of the treatments and the toxicity and application information presented in Chapter 6, Ecological Health, and Appendix B, Human and Ecological Health Assessment Report. The evaluation of all components considered the life histories of the different listed fish species and ecological interactions including effects to the aquatic food chain.

This evaluation does not incorporate any assumptions about which alternative treatment strategy or strategies would be applied in any given area. Therefore, each treatment alternative is considered as a stand-alone option, although the Program may include multiple alternative treatments within a given area, i.e., physical controls followed by larvicide application. This evaluation assumes that all chemical treatments would be made in accordance with label instructions and guidance provided by the USEPA and CDPR.

Assumptions related to the analysis of hazards, toxicity, and exposure for chemical treatment methods are explained below, including the definition of key terms. The ecological food web concept is explained as well, and it is addressed primarily in Section 6.1.1.1, *Toxicity and Exposure*.

4.2.2.1 Hazardous Material

A "hazardous material" is defined in California Health and Safety Code Section 25501 (p): as "any material that, because of its quantity, concentration, or physical or chemical characteristics, poses a significant present or potential hazard to human health and safety or to the environment if released into the workplace or the environment. "Hazardous materials" include, but are not limited to, "hazardous substances, hazardous waste, and any material that a handler or the administering agency has a reasonable basis for believing that it would be injurious to the health and safety of persons or harmful to the environment if released into the workplace or the environment." Any liquid, solid, gas, sludge, synthetic product, or commodity that exhibits characteristics of toxicity, ignitability, corrosiveness, or reactivity has the potential to be considered a "hazardous material."

4.2.2.2 Toxicity and Exposure

Toxicology is the study of a compound's potential to elicit an adverse effect in an organism. The toxicity of a compound is dependent upon exposure, including the specific amount of the compound that reaches an organism's tissues (i.e., the dose), the duration of time over which a dose is received, the potency of the chemical for eliciting a toxic effect (i.e., the response), and the sensitivity of the organism receiving the dose of the chemical. Toxicity effects are measured in controlled laboratory tests on a dose/response

scale, whereby the probability of a toxic response increases as dose increases. Exposure to a compound is necessary for potential toxic effects to occur. However, exposure does not, in itself, imply that toxicity will occur. Thus, toxic hazards can be mitigated by limiting potential exposure to ensure that doses are less than the amount that may result in adverse health effects.

The toxicity data included in the numerous tables and charts in this document are generally derived from rigidly controlled laboratory animal studies designed to determine the potential adverse effects of the chemical under several possible routes of exposure. In these studies, the species of interest is exposed to 100 percent chemical at several doses to determine useful information such as the lowest concentration resulting in a predetermined adverse effect (LOAEL) on numerous selected physiological and behavioral systems. The second component of these tests is to determine the highest concentration of chemical that results in no measurable adverse effect (NOAEL).

However, these, and other, coordinated and focused laboratory tests are designed to document the effects of the chemical when a continuous, controlled, exposure exists and do not realistically reflect the likely exposures or toxicity in the District field application scenarios. As such, the toxicity information is intended as an overview of potential issues and guidance for understanding the completely “safe” maximum exposure levels of applications that would not adversely affect humans or nontarget plant and animal species.

Although the regulatory community uses this basic information to provide a relative comparison of the potential for a chemical to result in unwanted adverse effects and this information is reflected in the approved usage labels and MSDSs, in actual practice, the amounts applied in the District’s Program Area are often substantially less than the amounts used in the laboratory toxicity studies. Because of the large safety factors used to develop recommended product label application rates, the amount of chemical resulting in demonstrated toxicity in the laboratory is much higher than the low exposure levels associated with an actual application. The application concentrations consistent with the labels or MSDSs are designed to be protective of the health of humans and other nontarget species (i.e., low enough to not kill them, weaken them, or cause them to fail to reproduce). However, adverse effects may still occur to some non-target organisms.

The toxicity of a chemical is also affected by various biological, chemical, and physical parameters that affect the behavior of a compound in the environment and its potential toxicity. The chemistry, fate, and transport of a compound must be analyzed to fully estimate potential exposure to a given receptor. The fate and transport of a compound is determined by the physical and chemical properties of the compound itself and the environment in which it is released. Thus, the following characteristics of a compound must be evaluated: its half-life in various environmental media (e.g., sediment, water, air); photolytic half-life; lipid and water solubility; adsorption to sediments and plants; and volatilization. Environmental factors that affect fate and transport processes include temperature, rainfall, wind, sunlight, water turbidity, dissolved oxygen concentrations, and water and soil pH. Information pertaining to these parameters allows evaluation of how compounds may be transported between environmental media (e.g., from sediments to biota), how a compound may be degraded into various breakdown products, and how long a compound or its breakdown products may persist in different environmental media. Appendix B provides a discussion of the environmental fate of the pesticide active ingredients and other chemicals associated with specific pesticide formulations used in the Program components.

4.2.2.3 Ecological Food Web

While it is important to evaluate the potential adverse impacts of a pesticide application to potentially affected nontarget species, it is not practical to evaluate those potential effects to all of the food webs present in the various ecosystems under consideration. An ecological food web is represented in the illustration representing some of the multitude of possible biotic and food uptake interactions in an ecosystem. Figure 4-2 depicts a highly simplified food web. In an ecological system each level in the food web is occupied by dozens or hundreds of species, with consumers using those resources (in this case species from a lower trophic level) in different ways depending on availability and competition for those resources. Their utilization of these resources shifts by time of day and season, and multiple resources being used simultaneously or alternatively. If the availability of one resource deceases, the consumer can generally replace that with another resource. Each of the possible connections between species is also associated with other interactions, such as competitive release, where the abundance of a species increases in response to the decline in a competitor's abundance, or competitive interactions between consumers where one consumer can use a particular resource better than its competitor.

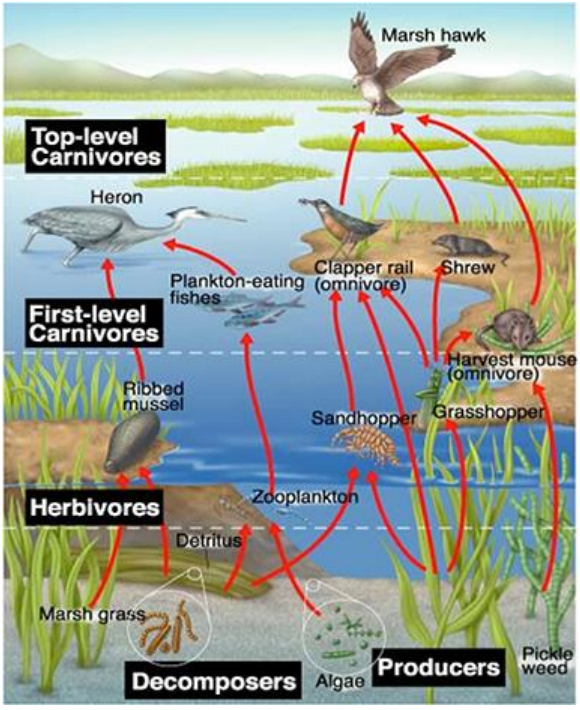


Figure 4-2 Ecological Food Web Concept

Although ecological food webs could be used to describe the complex system interactions that might be associated with District application scenarios, it is neither feasible nor practical to evaluate those potential effects using a food-web approach. The numerous, interactions in typical food webs are highly complex and would be subject to substantial uncertainty. This would make it exceedingly difficult to confidently assess relevant effects. Because of these constraints and complexity, it is neither practical nor productive to attempt to predict food-web interactions for each of the numerous application scenarios the District uses. It is appropriate, however, to use a food-web analysis to identify and consider the first level of potentially adverse effects to nontarget species that might result from a pesticide application. This information is used to assure a minimal effect to nontarget species and is typically a part of the MSDS and Toxicology profiles, providing the basis for the more reasonable, technically feasible approach to evaluate the safety of the pesticides the District commonly uses.

4.2.3 <u>Surveillance Component</u>

The Surveillance component affects small areas with the intent of monitoring vector populations to determine where control options are required. Small numbers of vector and nontarget organisms are trapped through this Program strategy at sites with the potential to support substantial vector populations. These sites are dispersed throughout the District. Chemicals may be used within adult mosquito traps (some adult mosquito traps use a Vapona strip infused with dichlorvos), but these chemicals are confined to the traps and do not enter the environment.

Small effects to upland and riparian habitats in the vicinity of aquatic ecosystems may occur when the District is required to maintain paths and clearings to access surveillance sites and facilitate sampling. However, because of their small size and location on preexisting roads, trails, and walkways, these activities are not anticipated to directly affect aquatic habitats.

4.2.4 Physical Control Component

4.2.4.1 Mosquitoes

This component modifies habitats that support mosquito larva to make these habitats less suitable for mosquitoes and/or more suitable for their predators. This component includes maintenance of ditches and water control structures, removal of debris and weeds, clearance of brush for access to areas to be treated, and filling of nonfunctional water circulation ditches. It may also include reconnecting backwaters or isolated pools on the floodplains of streams and rivers, and increased drainage rates and areas in managed wetlands. These activities are conducted in accordance with all appropriate environmental regulations. The District's annual work plans are submitted for review by other responsible agencies prior to implementation. Completed work is available for inspection by the USACE, USFWS, and CDFW upon request. The evaluation is based on the types and locations of habitats where such activities would be performed. The District is rarely involved in new drainage projects, and when they are, they consult with the appropriate agencies and acquire all required permits for implementing that work, which provides protection for native and special-status fish species.

4.2.4.1.1 Freshwater Habitats and Riparian Areas

The freshwater habitats that could be treated include the margin of reservoirs, artificial ponds for drinking water or stock water, runoff retention ponds, and freshwater marshes. With the exception of freshwater marsh, these areas are generally man-made habitats and if they support fish, these fish will largely consist of introduced species. Some reservoirs and ponds are also stocked with rainbow trout. While rainbow trout are native to the region, these stocked fish are not considered to be natural populations, and are treated as introduced fish.

Mosquitoes typically breed in shallow areas, with emergent vegetation, and little to no current, and where fish are excluded. Treatment of these areas by increasing circulation (water flow) to areas that are problem areas for mosquitoes increases the accessibility of these areas to young fish, which then eat the mosquito larvae. This access provides these fish with a previously inaccessible food source. Additionally, these areas can be important for young fish, as they provide protection from predation by larger fish and tend to be warmer, with higher primary productivity, providing good conditions for the growth of young fish. Most young fish eat insect larvae during at least the first few months of their lives, and some species eat insect larvae throughout their lives. Special-status fish species are not affected because they do not occur in reservoirs and ponds, and ditches.

Draining areas of shallow freshwater habitat to reduce the amount of standing water or reduce the amount of time such water remains standing can result in adverse effects to young fish using those habitats, leaving fish that cannot vacate the area without water, requiring fish that can leave the area to move to new locations, and reducing the amount of larval rearing habitat present. Where native or special-status fish species are not present, these effects would be negligible. Where native or special-status species are present, these areas could be important nursery areas for young fish, depending on location, season, fish species present, accessibility for adult fish to enter these areas to deposit eggs, and amount of other habitat available to the species.

Because their rapid currents do not provide suitable habitat for mosquitoes, streams and rivers generally do not support substantial numbers of mosquitoes, although, some mosquitoes can be found in slow eddies and back channels, or in pools isolated on the banks as flows recede. Streams and rivers may support sensitive fish species including steelhead, Chinook salmon, Coho salmon, Sacramento perch, hardhead, tule perch, California roach, and hitch. Isolated ponds and back channels may provide habitat for mosquito larva, but these areas may also provide excellent rearing habitat for young fish and amphibians, as they provide warmer water temperatures, higher primary productivity and protection from predaceous fish. The District coordinates with appropriate resource agency personnel, whenever a habitat treatment is under consideration in an area potentially supporting sensitive species, as indicated

by the California Natural Diversity Database, Calfish.org, NOAA Fisheries, and USFWS websites. If shallow freshwater habitats associated with natural waterways where sensitive species could be present need to be drained, the District shall schedule such activity at a time of year when these species are absent from the treatment site. In the event that such activity cannot be postponed, or must be performed in habitat that has the potential for continuous occupancy, the District shall have a qualified biologist conduct surveys to determine if sensitive fish species are present. This treatment would be avoided where sensitive species are present.

4.2.4.1.2 Seasonal Wetlands and Vernal Pools

The USACE defines wetlands as "*those areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. (33 [Code of Federal Regulations] CFR 328.3(b); 40 CFR 230.3(t)).*" For the purposes of this document, seasonal wetlands are areas that are flooded for 1 week or more during the year, generally during the rainy season. Effects to vernal pools, a subclass of seasonal wetlands underlain by impermeable substrates, are discussed in Chapter 5, Biological Resources – Terrestrial. Seasonal wetlands may be flooded by increased runoff, rainfall, or unusually high tides. Fish may use these areas for spawning and rearing. Splittail, for instance, use floodplain habitats to spawn and rear (Moyle 2002). Their young may live in these seasonally flooded habitats for several weeks, until these habitats dry out. Chinook salmon can use flooded wetlands and floodplains for rearing habitat during their outward migration toward the ocean. Young salmonids using these seasonally flooded wetlands have higher growth rates than the fish that remain in the mainstem rivers (Sommer et al. 2003; Swenson et al. 2003; Moyle et al. 2007). Coho salmon also may use backwater channels and ponds during the winter months to shelter from the higher currents in the main channel of river or stream habitats (Moyle 2002). The availability of such habitats has been substantially reduced by human land use practices and flood control measures. Reducing the frequency or duration with which such habitats are flooded would adversely affect habitat and aquatic resources. As discussed above and in section 2.8.3, the District coordinates with appropriate resource agency personnel to minimize the effects of habitat treatments.

Vernal pools do not support fish but do support a number of sensitive invertebrates, plants, and amphibians. As such, physical control measures should not be applied to vernal pool habitats. effects to other plants and animals using vernal pools are provided in Chapter 5.

4.2.4.1.3 Freshwater Marshes and Duck Clubs

The San Francisco Bay-Delta once supported vast tracts of freshwater, brackish, and saline marsh habitat. The vast majority of these marsh habitats have been converted to human uses such as farming, industrial uses, and urbanization. Some of the remaining marsh lands are maintained and operated to provide habitat for wildlife or as private or public duck clubs. These areas are primarily located in Suisun Bay and the Delta. These wetlands can be important sources of mosquitoes seasonally. These marshes take water from the Delta to facilitate their operation and are seasonally flooded and drained to optimize habitat for ducks, geese, and other wildlife. Because of this procedure, a variety of special-status fish species including all races of Central Valley Chinook salmon, steelhead, green sturgeon, delta smelt, longfin smelt, Sacramento splittail, and Sacramento perch could use these marshes. These marshes, however, do not provide primary habitat for these species.

The same physical control measures previously described can be employed in these areas to reduce mosquito populations. The District may perform these actions on an as needed basis. Increasing circulation of water in these areas would not substantially affect fish populations. Improving drainage of low-lying areas within these managed areas, which would be drained with or without mosquito control activities, could decrease the likelihood that fish become trapped or stranded. Construction of channels could result in temporary increases in turbidity, which could adversely affect fish. BMPs would be

implemented to control and localize this turbidity. They may include constructing new channels during periods when the marsh is dry or isolating areas where new channels are being constructed from the surrounding environment. These turbidity increases would be short term and temporary and, thus, would not substantially affect aquatic species.

4.2.4.1.4 Saline and Brackish Habitats

These habitats occur along the margins of San Francisco Bay and are subject to tidal action. A variety of special-status fish species including all races of Central Valley Chinook salmon, steelhead, green sturgeon, delta smelt, longfin smelt, Sacramento splittail, and Sacramento perch could use these marshes. They are typically bounded by levees and water control structures. Physical measures to control mosquitoes in these areas include maintenance of ditches and water control structures, removal of debris and weeds, clearance of brush for access to areas to be treated, and filling of nonfunctional water circulation ditches, as described previously. Other measures include retaining water on the surface of the area, and rotational impoundment monitoring, which reduces mosquito populations by increasing the frequency with which suitable habitats are inundated and drained. These actions would have similar effects to those described in Section 4.2.4.1.3, Freshwater Marshes and Duck Clubs.

4.2.4.1.5 Temporary Standing Waters and Artificial Ponds

Temporary standing waters refers to water ponding on an upland habitat because of rainfall or irrigation. Artificial ponds include stock ponds, golf course water hazards, or ornamental ponds. These habitats do not provide habitat for special-status fish species. While native fish species may occur in some artificial ponds, these ponds are not primary habitats for these species and do not contribute to the survival of the species.

4.2.4.1.6 Tree Holes

Tree holes do not provide habitat for fish or support fish populations nor do they support special-status invertebrates or substantive populations of other invertebrates.

4.2.4.1.7 Wastewater Treatment Facilities/Septic Systems

Wastewater treatment facilities do not provide habitat for native or special-status fish species, although such facilities may lie close to suitable habitats in streams or the San Francisco Bay Delta system and connectivity may exist between the system and the natural environment that could allow aquatic resources to enter the system. The extent to which these species may enter these facilities is unknown. Because of the limited number of such facilities and the very limited use of such facilities by fish species, physical control measures are not anticipated to substantially affect these fish species.

4.2.4.1.8 Artificial Container Habitat

Artificial containers do not provide habitat for fish or support populations of native or special-status fish or invertebrates.

4.2.4.2 Other Vectors

Physical control measures for other vectors would not affect aquatic habitats and, thus, have no effect on fish.

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4.2.4.3 Habitat Conservation Plans and Natural Community Conservation Plans

HCP/NCCPs generally incorporate measures to protect sensitive habitats. Protective measures or restoration goals for wetland, riverine, and lacustrine habitats are often included in these documents and their accompanying permits. The Physical Control component specifically seeks to alter habitats to make them less suitable to mosquito larvae. However, these types of habitats are not covered by the Santa

Clara County Habitat Conservation Plan, nor does the plan cover maintenance activities that are part of the Physical Control component. Therefore, this component, when applied within the boundaries of an HCP/NCCP, would not conflict with the provisions of that HCP/NCCP.

4.2.5 Vegetation Management Component

The vegetation within and surrounding aquatic habitats is an important component of the aquatic ecosystem. This vegetation provides shade, helping to keep the water cool; increases structure and habitat complexity; and contributes organic material and insect drop, subsidizing the food web. It provides fish and other aquatic organisms with cover from aquatic and terrestrial predators and provides visual separation that increases the density of territorial species. Vegetation also helps slow runoff from the surrounding land surface, protecting the aquatic environment from sediments and toxins that may wash in from upland areas.

The removal of vegetation does not have a substantial effect on aquatic ecosystems if the amount of vegetation removed from within and around a water body is limited to less than 20 percent. This level of removal will continue to provide the ecosystem services described in the preceding paragraph. The manual removal of vegetation, which is the primary method of vegetation removal, would be expected to have minimal effects on aquatic resources, because it would not be anticipated to affect substantial patches of vegetation. The use of unspecified heavy equipment could have substantial effects if used in waterways supporting native or special-status fish species. Appropriate BMPs are employed when using heavy equipment for vegetation management, including: not operating such equipment in the water, providing appropriate containment and cleanup systems to avoid, contain, and clean up any leakage of toxic chemicals into the aquatic environment, controlling turbidity, and minimizing the area that is affected by the vegetation management activity.

4.2.5.1 Habitat Conservation Plans and Natural Community Conservation Plans

HCP/NCCPs generally incorporate measures to protect sensitive habitats and sensitive species, including plants. Protective measures or restoration goals for wetland, riverine, and lacustrine habitats are often included in these documents and their accompanying permits. However, these types of habitats are not covered by the Santa Clara County Habitat Conservation Plan, nor does the plan cover maintenance activities that are part of the Vegetation Management component.

4.2.6 Biological Control Component

This component consists of the introduction of mosquito predators, specifically mosquitofish (*Gambusia affinus*), into habitats occupied by mosquito larvae. These fish are ideal candidates for this use because they are highly tolerant of a wide range of temperature and water quality conditions, they can reproduce rapidly, and they are highly effective at locating and consuming mosquito larvae. Mosquitofish are also opportunistic omnivores, eating other invertebrates when they are more abundant and feeding on algae during times when insects are not abundant. This species can affect aquatic food webs. They are known to feed on fish and amphibian eggs and larvae (Moyle 2002; Nico et al. 2013). Mosquitofish can compete with other small fish for food and can also prey on other fish and insect mosquito predators when those species are present. Therefore, the use of mosquitofish in a given situation is given careful consideration with regard to the potential ecological consequences of such introductions. District policy is to limit the use of mosquitofish to artificial water bodies (ornamental fish ponds, water troughs, water gardens, fountains, and unused swimming pools), where they do not pose a threat to natural environments or native fish and amphibians. These artificial habitats are not included in HCP/NCCPs

Mosquito pathogens such as Bs, Bti, and *Saacharopolyspora spinosa* may be considered biological control agents, but are regulated by USEPA. Therefore, they are addressed in the Chemical Control component.

4.2.7 Chemical Control Component

A wide variety of chemicals and formulations are available for use to control mosquitoes. These chemicals can be used as mosquito larvicides or adulticides. Chemical control is also used to control nuisance populations of yellowjackets, ticks, and rodents.

These chemicals are used in accordance with all applicable BMPs as described in Section 2.9.1, CDPH's *Best Management Practices for Mosquito Control in California*, the Statewide General NPDES Permit for Biological and Residual Pesticide Discharges to Waters of the US from Spray Applications (SWRCB Water Quality Order No. 2011-0004-DWQ; NPDES No. CAG 990007; Spray Applications Permit) and District-specific BMPs as indicated in the PAPs and APAPs. All of these measures are designed to minimize effects to nontarget organisms.

The toxicity data included in the tables in this section are generally derived from rigidly controlled laboratory animal studies designed to determine the potential adverse effects of the chemical under several possible routes of exposure. In these studies, the species of interest is exposed to 100 percent chemical at several doses to determine useful information such as the lowest concentration resulting in a predetermined adverse effect (lowest observed adverse effect level [LOAEL]) on numerous selected physiological and behavioral systems. The second component of these tests is to determine the highest concentration of chemical that results in no measurable adverse effect (no observed adverse effect level [NOAEL]).

However, these, and other, coordinated and focused laboratory tests are designed to document the effects of the chemical when a continuous, controlled, exposure exists and do not realistically reflect the likely exposures or toxicity in the District field application scenarios. As such, the toxicity information is intended as an overview of potential issues and guidance for understanding the completely "safe" maximum exposure levels of applications that would not adversely affect humans or nontarget plant and animal species.

Although the regulatory community uses this basic information to provide a relative comparison of the potential for a chemical to result in unwanted adverse effects and this information is reflected in the approved usage labels and MSDSs, in actual practice, the amounts applied in the District's Program Area are often substantially less than the amounts used in the laboratory toxicity studies. Because of the large safety factors used to develop recommended product label application rates, the amount of chemical resulting in demonstrated toxicity in the laboratory is much higher than the low exposure levels associated with an actual application. The application concentrations consistent with the labels or MSDSs are designed to be protective of the health of humans and other nontarget species (i.e., low enough to not kill them, weaken them, or cause them to fail to reproduce). However, adverse effects may still occur to some non-target organisms.

This assessment also considers the physical and biological connections between treatment areas and aquatic ecosystems. These chemicals are assessed by the vectors they are primarily used to control, and are grouped within these vectors into classes based on their composition, mechanism of action, and relative effect on aquatic resources (Table 4-1). These chemicals are discussed in greater detail in Chapter 6, Ecological Health, and Appendix B.

Table 4-1 Chemical Classes and their Toxicity[1] to Fish and Nontarget Aquatic Invertebrates

Class	Chemical	Mechanism of Action	Toxicity to	
			Fish	Nontarget Invertebrates
Mosquito Larvicides				
Bacterial Larvicides	Bs, Bti, spinosad	Paralyzes gut or disrupts central nervous system	Low	Low
Hydrocarbon esters	Methoprene and s-methoprene	Interferes with maturation process of insects	Moderate	High
Surfactants	Alcohol ethoxylated surfactant, aliphatic solvents	Drowns larvae	Very low	Affects Only Surface Breathing Insects
Organo-phosphates	Temephos	Cholinesterase inhibitor	Slight to Moderate	High
Mosquito Adulticides				
Pyrethroids	Pyrethrins, allethrins, phenothrin, prallethrin, deltamethrin, esfenvalerate, resmethrin, tetramethrin, permethrin, etofenprox	Interferes with operation of sodium channels in insect neurons	High	High
Piperonyl butoxide		Synergist. Enhances operation of other active ingredients by inhibiting their breakdown	Moderate to High	High
Yellowjackets and Ticks				
Pyrethroids	lambda-cyhalothrin, pyrethrins, allethrins, phenothrin, prallethrin, deltamethrin, tetramethrin, permethrin,	Interferes with operation of sodium channels in insect neurons	High	High
Piperonyl butoxide		Synergist. Enhances operation of other active ingredients by inhibiting their breakdown	Moderate to High	High
Potassium salts		Disrupts cell membranes	Low	High
Rodenticides				
Anticoagulants	Chlorophacinone, diphacinone, brodifacoum, bromadiolone, difethialone	Blocks vitamin K cycle, causing death by hypovolemic shock or severe anemia	Low to High	Moderate to High
	Cholecalciferol	Causes calcification of soft tissues	Low	Moderate
Fumigants	Sulphur, sodium nitrate	Cause asphyxiation	Nontoxic	Nontoxic

[1] Toxicity information is summarized for each group from the information provided in Appendix B (Table 4-1).

[2] The toxicity data are derived from rigidly controlled laboratory animal studies designed to determine the potential adverse effects of the chemical under several possible routes of exposure (see Appendix B for further information). In these studies, the species of interest is continuously exposed to 100 percent chemical at several doses. In actual practice, the amounts applied in the District's Program Area are substantially less than the amounts used in the toxicity studies and organisms are not continuously exposed to the chemical. Furthermore, actual application rates by the District may be less than label requirements. Thus, the laboratory test results do not provide a realistic assessment of field exposure.

4.2.7.1 Mosquito Larvicides

4.2.7.1.1 Bacterial Larvicides

These larvicides are developed from bacteria that have natural insecticidal properties. Concentrates are prepared that include fermentation solids, bacterial spores, and insecticidal toxins. These larvicides act by disrupting the larval mosquito gut wall when ingested, causing the larvae to die. Bs may persist in the environment for 2 to 4 weeks; Bti generally persists for 1 to 4 days.

Neither Bs nor Bti are acutely toxic to nontarget species including fish and invertebrates, nor are they toxic to predators of mosquito larvae (Appendix B). Bti may affect some dipterans (chironomids, simullids, ceratopogonids, and dixids), but only at concentrations 10 to 1,000 times higher than used for mosquito control.

Spinosad is a biologically derived insecticide produced from the fermentation of *Saacharopolyspora spinosa*, a naturally occurring soil organism. Spinosad activates the central nervous system of insects through interaction with neuroreceptors and causes continuous stimulation of the insect nervous system. In water, spinosad is degraded primarily through photolysis, which has a half-life of less than 1 day. It is slightly-to-moderately toxic to fish and most aquatic invertebrates. It may have slight effects on some aquatic invertebrates with chronic exposure, but application for mosquitoes tends to be episodic, and given the rapid breakdown of spinosad in the environment, chronic exposure is unlikely.

4.2.7.1.2 Hydrocarbon Esters

Methoprene is an insect growth regulator and selective larvicide. Methoprene is used primarily against mosquitoes, but can also be used for flies, moths and butterflies, and beetles. Methoprene interferes with the development of larval insects, preventing them from becoming adults. Within the aquatic environment, methoprene has a half-life of a few hours to a couple of days, but is sometimes applied in an extended release format, which may persist for many days or even months in the environment. Methoprene is effective for mosquito control at concentrations of 0.5 to 3 microgram per liter (µg/L), with the District generally applying it at a maximum concentration of 5 µg/L[At these application rates, some effects may occur to some nontarget midges (*Chrionomidae*) and blackflies (*Simuliidaes*), but these populations recover quickly after treatment (Appendix B; Maffei, pers. comm., 2013). No other invertebrates have shown signs of toxicity at these concentrations. Methoprene can be toxic to fish, but the lowest 50 percent lethal dose[14] (LD50 4.62 milligrams per kilogram [mg/L]) is several orders of magnitude greater than the dose used by the District to control mosquitoes.

4.2.7.1.3 Surfactants

Surfactants (alcohol ethoxylated surfactants and aliphatic solvents) work by making it difficult for mosquito larvae to attach to the water's surface, causing them to drown. Surfactants affect only the uppermost layer of the water. They are nontoxic to most organisms at label application rates, but may affect other surface-breathing aquatic insects. The numbers of these nontarget surface-breathing insects were temporarily reduced following treatment, but recovered within a few days at Don Edwards Wildlife Area (Miles et al. 2002). These short-term effects to a small portion of the food chain are unlikely to harm nontarget species in the aquatic environment.

4.2.7.1.4 Organophosphate Insecticides

Organophosphates (OPs) are a class of chemicals that kill insects by interfering with their production of the acetylcholinestarase enzyme, resulting in nervous and respiratory system damage. Temephos is used as a larvicide to help prevent mosquitoes from developing resistance to the bacterial larvicides

[14] LD50 refers to the lethal single dose of a chemical (amount of chemical regardless of the volume of liquid in which it is delivered) that that would kill 50 percent of a group of test animals treated with that dose.

(Section 4.2.7.4). It is persistent in the environment, with a half-life in excess of 15 days via most degradation pathways. While applied widely in some areas of the country, the District uses this chemical infrequently to treat man-made mosquito sources, such as tire piles, that are resistant to other treatments. Temephos is effective in highly polluted water. Temephos can be used to control dipteran midges and blackflies, but it is applied at higher concentrations for this application than for mosquito control.

Temephos is not toxic to fish at the concentrations the Districts use for mosquito control and is not applied in natural water bodies where fish or sensitive invertebrates would be present. It has been observed to be toxic to some planktonic crustaceans (copepods and cladocerans), as well as stoneflies (Plecopterans) and mayflies (Ephemerellids). Because of this toxicity, its use is restricted to isolated, man-made habitats, where sensitive species are absent.

4.2.7.2 Mosquito Adulticides

4.2.7.2.1 Pyrethrins and Pyrethroids

Pyrethrins are naturally occurring products distilled from the flowers of the *Chrysanthemum* species. Pyrethroid insecticides are synthetic compounds that are chemically similar to the pyrethrins that have been modified to increase stability and activity against insects. They are highly potent insecticides, but are highly toxic to fish and aquatic invertebrates as well, sometimes at environmental concentrations of less than 1 µg/L. The presence of these pesticides in aquatic environments can result in lethal and sublethal effects on fish and aquatic invertebrates. Where substantial numbers of such organisms are affected, food supplies can be diminished, resulting in indirect effects to secondary and tertiary consumers dependent on the aquatic food web, including aquatic invertebrates, fish, amphibians, and birds. Both sets of compounds tend to break down relatively quickly in the environment, often within hours, and usually within a few days. Of the pyrethroids that are applied adjacent to aquatic environments, phenothrin and permethrin are more persistent than the other chemicals in this group, with half lives of days to months in water under aerobic conditions.

Pyrethrins and pyrethroids are applied in ULV applications by aircraft, truck, ATV, or handheld foggers include pyrethrins, phenothrin, and permethrin. Numerous studies have found that these ULV applications result in concentrations in the aquatic environment of 0.23 to 3.77 µg/L and had little to no effect on fish or nontarget aquatic invertebrates (see Appendix B).

On rare occasions, pyrethrins are applied directly in aquatic environments as mosquito larvicides in accordance with label specifications, and guidance from the USEPA and CDPR. These areas are preferentially treated with Bs, Bti, or methoprene (discussed above).

4.2.7.2.2 Piperonyl Butoxide

PBO is a synergist, a chemical applied with a pesticide to enhance the effectiveness of the pesticide (Appendix B). PBO works by interfering with an insect’s ability to detoxify pyrethrins and pyrethroids. PBO is moderately toxic to fish (LD50=1.9 to 3.94 mg/L) and moderately to highly toxic (0.51 to 12.0 mg/L) to aquatic invertebrates. However, its toxicity is much lower than that of the pesticides it is used with. PBO can break down relatively rapidly by photolysis (half-life of 8.4 hours), but has a half-life exceeding 30 days based on aerobic metabolism in water. Although it degrades rapidly, release of PBO to the environment may “activate” persistent pyrethroids that are already present in the sediment. Field tests indicate that PBO concentrations were very low (~2 µg/L) immediately after 3 consecutive nights of treatment, declined rapidly thereafter, and was undetectable 8 days after application (see Appendix B). A number of studies indicate that PBO, when applied at the levels used for mosquito control, did not have any detectable effect on sentinel species (Appendix B). These studies also indicate that PBO does not persist in the environment very long after application. This information indicates that the use of PBO does not substantially affect aquatic organisms.

4.2.7.3 Rodent Abatement

Rodent abatement methods are employed following verification of a serious rodent infestation of typically Norway rats or in conjunction to other agency projects. These methods focus primarily on the use of first and second generation rodenticides. These rodenticides are toxic to fish and aquatic invertebrates. However, they are applied in bait blocks in sewers, storm drains and catch basins, which would not support sensitive fish species. They may also be placed seasonally along creek banks within 100 feet of a structure. They are never placed at water level and are removed in early fall to prevent them from becoming submerged in storm events. Tamper-proof stations are used to eliminate effects to nontarget organisms. The USEPA has determined that many of these rodenticides pose little risk to the aquatic environment (see Appendix B). The rodenticide is incorporated into a water-resistant, nonleaching bait block suspended or placed out of the water, which prevents the direct entry of the rodenticide into the water. The rodenticide could also enter an aquatic environment if a rodent ingests the chemical and then dies in the water. The rodenticide could then be released into the water as the corpse decomposes. This potential mechanism for introduction of rodenticides is limited. Rats and mice are not aquatic organisms and do not forage or nest in aquatic environments. Thus, it is unlikely that a rodent would die in the water. If a rodent's corpse did enter the aquatic environment, the rodenticide contained in that animal would be released over a period of days, as the corpse decomposed, and would be subject to dilution over that period of time. The chemical would also be deteriorating over this period of time, due to both the processes within the corpse (contact with digestive fluids and metabolites in the body of the animal) as well as in the environment once released. This mechanism is highly unlikely to introduce rodenticides into the aquatic environment in sufficient quantity to affect aquatic organisms.

4.2.7.4 Yellowjacket and Other Arthropod Abatement

The District may use pesticides (typically pyrethroids) to control yellowjackets and other arthropods, such as fleas, ticks, and mites that pose an imminent threat to people or pets, generally following public requests for assistance or assisting in vector control in recreational areas. These pesticides are highly toxic to fish and aquatic invertebrates, as described in Section 4.2.7.2. For control of yellowjackets and ticks, these pesticides are applied in highly localized, upland areas.

A number of these pyrethroids are used primarily to control insects in residential or upland *environments: prallethrin, deltamethrin, esfenvalerate, lambda-cyhalothrin, resmethrin,* and tetramethrin. These compounds would only be expected to enter the aquatic environment through runoff. All degrade rapidly and bind readily to soil, so they are not anticipated to enter aquatic environments in sufficient quantities to result in adverse effects.

A few of the pyrethroids are bioaccumulative in fish, meaning that they can occur in organisms at higher concentrations than what occurs in the environment. These bioaccumulative pyrethroids include deltamethrin, esfenvalerate, and lambda-cyhalothrin. However, the District does not regularly use these pyrethroids and never near water. When these pyrethroids are used, they are generally deployed in bait stations, which are readily isolated from aquatic environments. Therefore, these compounds are not expected to affect fish or other aquatic organisms.

4.2.7.4.1 Potassium Salts

The District may also use potassium salts to control yellowjackets. Potassium salts of fatty acids are used as insecticides, acaricides, herbicides, and algaecides. They penetrate an insect's body covering and disrupt the cell membranes, causing the insect to die of dehydration. They are slightly toxic to fish and highly toxic to aquatic invertebrates. They are applied directly to the yellowjacket nest, are not applied to aquatic environments, are highly unlikely to enter the aquatic environment, and degrade quickly after application. Thus, the use of potassium salts would not affect fish and aquatic invertebrates.

4.2.7.4.2 Habitat Conservation Plans and Natural Community Conservation Plans

HCP/NCCPs generally incorporate measures to protect sensitive habitats and sensitive species, including plants. Protective measures or restoration goals for wetland, riverine, and lacustrine habitats are often included in these documents and their accompanying permits. However, these types of habitats are not covered by the Santa Clara County Habitat Conservation Plan, nor does the plan cover maintenance activities that are part of the Chemical Control component.

4.2.8 Other Nonchemical Control/Trapping Component

The Other Nonchemical Control/Trapping component is focused on rodents, yellowjackets, and other organisms not associated with aquatic environments. This activity does not affect aquatic environments or the species that occupy these environments.

4.2.8.1 Habitat Conservation Plans and Natural Community Conservation Plans

HCP/NCCPs generally incorporate measures to protect sensitive habitats and sensitive species, including plants. Protective measures or restoration goals for wetland, riverine, and lacustrine habitats are often included in these documents and their accompanying permits. However, these types of habitats are not covered by the Santa Clara County Habitat Conservation Plan, nor does the plan cover maintenance activities that are part of the Other Nonchemical Control/Trapping component.

5 Biological Resources – Terrestrial

Chapter 5 evaluates the Program components in relation to terrestrial resources. Results of the evaluation are provided at the programmatic level. Section 5.1, Environmental Background, presents an overview of the affected environment settings and contains federal regulations, state regulations, and local ordinances and regulations that are applicable to the Program. Section 5.2 presents the environmental assessment. Aquatic resources are addressed in Chapter 4.

5.1 Environmental Background

The Program Area is defined as Santa Clara County and adjacent counties (Alameda, San Mateo, San Benito, Santa Cruz, Merced, and Stanislaus) impacted by pests that must be controlled to assure the health and quality of life for residents and recreationists.

Section 5.1.1 identifies the ecoregion provinces in the District's Program Area, Section 5.1.2 describes the special-status terrestrial species that have the potential to occur within the Program Area, Section 5.1.3 provides an overview of federal, state, and local ordinances and regulations pertinent to these resources that are applicable to the Program. Section 5.1.4 identifies the Habitat Conservation Plans (HCPs) and Natural Community Conservation Plans (NCCPs) in the Program Area.

Background information on hazards, toxicity, and exposure is provided in Section 5.2.2.2.

5.1.1 Terrestrial Resources within the Program Area

The immediate District Service Area is located in Santa Clara County, while the Program Area also includes adjacent counties: Alameda, San Mateo, San Benito, Santa Cruz, Stanislaus, and Merced. This area encompasses a range of terrestrial habitats and a diverse array of wildlife and plants. The ecoregion provinces (McNab and Avers 1996) have been used to describe the areas where the Program activities and treatments would be implemented and are shown on Figure 5-1. The ecoregion provinces are described in Appendix A, Biological Resources Technical Report.

Control activities may also be provided in areas adjacent to the Districts' Service Areas upon request of the adjacent jurisdictions to protect the health and safety of residents in adjacent jurisdictions. Actions that would be taken outside of the Districts' Service Areas are the same types of actions undertaken within the Districts' Service Areas and in similar types of habitats or sites.

5.1.2 Special-Status Species

A number of special-status species are found in the Program Area and vicinity. Special-status species are those that are listed as endangered, threatened, or candidate species under the federal Endangered Species Act, endangered or threatened under the California Endangered Species Act, or listed as species of special concern by the state. Brief life-history descriptions for special-status species as well as their presence or absence within Program Areas are presented in Appendix A, Attachments A-1 (plants) and A-2 (wildlife). The special-status plants located within the District's Program Area are listed below:

Plants

Species Name	***Scientific Name***
adobe sanicle	*Sanicula maritime*
Arburua Ranch jewel flower	*Streptanthus insignis lyonii*
California seablite	*Suaeda californica*
caper-fruited tropidocarpum	*Tropidcarpum capparideum*
chaparral ragwort	*Senecio aphanactis*

Greene's tuctoria	*Tuctoria greenei*
Hartweg's golden sunburst	*Pseudobahia bahiifolia*
Hickman's cinquefoil	*Potentilla hickmanii*
Keck's checkerbloom	*Sidalcea keckii*
marsh skullcap	*Scutellaria galericulata*
Metcalf Canyon jewel-flower	*Streptanthus albidus albidus*
most beautiful jewel flower	*Streptanthus albidus peramoenus*
Mt. Hamilton jewel-flower	*Streptanthus callistus*
Oregon polemonium	*Polemonium carneum*
pine rose	*Rosa pinetorum*
prairie wedge grass	*Sphenopholis obtusata*
rock sanicle	*Sanicula saxatilis*
saline clover	*Trifolium hydrophilum*
San Francisco campion	*Silene verecunda verecunda*
Santa Cruz clover	*Trifolium buckwestiorum*
Santa Cruz microseris	*Stebbinsoseris decipiens*
Scotts Valley polygonum	*Polygonum hickmanii*
showy rancheria clover	*Trifolium amoenum*
slender-leaved pondweed	*Stuckenia filiformis*
Wright's trichocoronis	*Trichocoronis wrightii var wrightii*

The special-status wildlife located within the District's Program Area is listed below:

Species Name	***Scientific Name***
Invertebrates	
Bay checkerspot butterfly	*Euphydryas editha bayensis*
callippe silverspot butterfly	*Speyeria callippe callippe*
Conservancy fairy shrimp	*Branchinecta conservatio*
longhorn fairy shrimp	*Branchinecta longiantenna*
Mission blue butterfly	*Plebejus icarioides missionensis*
Mount Hermon (=barbate) June beetle	*Polyphylla barbata*
Myrtle's silverspot	*Speyeria zerene myrtleae*
Ohlone tiger bettle	*Cicindela ohlone*
San Bruno elfin butterfly	*Callophyrs mossii bayensis*
Smith's blue butterfly	*Euphilotes enoptes smithi*
valley elderberry longhorn beetle	*Desmocerus californicus dimorphus*
vernal pool fairy shrimp	*Branchinecta lynchi*
vernal pool tadpole shrimp	*Lepidurus packardi*
Zayante band-winged grasshopper	*Trimerotropis infantillis*

Fish

Coho salmon – central California coast ESU	*Oncorhynchus kisutch*
hardhead	*Mylopharodon conocephalus*
Kern brook lamprey	*Entosphenus hubbsi*
Sacramento splittail	*Pogonichthys macrolepidotus*
San Joaquin roach	*Lavinia symmetricus ssp. 1*
steelhead – central California coast DPS	*Oncorhynchus mykiss irideus*
steelhead – south/central California coast DPS	*Oncorhynchus mykiss irideus*
tidewater goby	*Eucyclogobius newberryi*

Amphibians

California red-legged frog	*Rana draytonii*
California tiger salamander	*Ambystoma californiense*
Coast Range newt	*Taricha torosa*
foothill yellow-legged frog	*Rana boylii*
northern leopard frog	*Lithobates pipiens*
Santa Cruz long-toed salamander	*Ambystoma macrodactylum croceum*
western spadefoot	*Spea hammondii*

Reptiles

Alameda whipsnake	*Masticophis lateralis euryxanthus*
black legless lizard	*Anniella pulchra nigra*
blunt-nosed leopard lizard	*Gambelia sila*
coast horned lizard	*Phrynosoma blainvillii*
giant garter snake	*Thamnophis gigas*
San Francisco garter snake	*Thamnophis sirtalis tetrataenia*
San Joaquin whipsnake	*Masticophis flagellum ruddocki*
silvery legless lizard	*Anniella pulchra pulchra*
two-striped garter snake	*Thamnophis hammondii*
western pond turtle	*Emys mamorata*

Birds

Alameda song sparrow	*Melospira melodia pusillula*
American peregrine falcon	*Falco peregrinus anatum*
bald eagle	*Haliaeetus leucocephalus*
bank swallow	*Riparia riparia*
black skimmer	*Rynchops niger*
black swift	*Cypseloides niger*
burrowing owl	*Athene cunicularia*
California black rail	*Laterallus jamaicensis cotumiculus*

California clapper rail	*Rallus longirostris obsoletus*
California condor	*Gymnogyps californianus*
California least tern	*Stemula antillarum browni*
golden eagle	*Aquilla chrysaetos*
least Bell's vireo	*Vireo bellii pusillus*
loggerhead shrike	*Lanius ludovicianus*
long-eared owl	*Asio otus*
marbled murrelet	*Brachyramphus marmoratus*
mountain plover	*Charadrius montanus*
northern harrier	*Circus cyaneus*
saltmarsh common yellowthroat	*Geothlypis trichas sinosa*
short-eared owl	*Asio flammeus*
Suisun song sparrow	*Melospiza melodia maxillaris*
Swainson's hawk	*Buteo swainsoni*
tricolored blackbird	*Agelaius tricolor*
western snowy plover	*Charadrius alexandrinus nivosus*
western yellow-billed cuckoo	*Coccyzus americanus occidentalis*
white-tailed kite	*Elanus leucurus*
yellow rail	*Coturnicops noveboracensis*
yellow warbler	*Dendroica petechia brewsteri*
yellow-breasted chat	*Icteria virens*
yellow-headed blackbird	*Xanthocephalus xanthocephalus*

Mammals

Alameda island mole	*Scapanus latimanus parvus*
American badger	*Taxidea taxus*
big free-tailed bat	*Nyctinomops macrotis*
giant kangaroo rat	*Dipodomys ingens*
Monterey dusky-footed woodrat	*Neotoma macrotis luciana*
Nelson's antelope squirrel	*Ammospermophilus nelsoni*
pallid bat	*Antrozous pallidus*
riparian (=San Joaquin Valley) woodrat	*Neotoma fuscipes riparia*
riparian brush rabbit	*Sylvilagus bachmani riparius*
salt-marsh harvest mouse	*Reithrodontomys raviventris*
salt-marsh wandering shrew	*Sorex vagrans halicoetes*
San Francisco dusky-footed woodrat	*Neotoma fuscipes annectens*
San Joaquin kit fox	*Vulpes macrotis mutica*
Townsend's big-eared bat	*Corynorhinus townsendii*
Tulare grasshopper mouse	*Onychomys torridus tularensis*
western mastiff bat	*Eumops perotis californicus*
western red bat	*Lasiurus blossevillii*

5.1.3 Regulatory Environment

The regulatory setting includes the federal, state, and local laws, statues, and regulations pertinent to the Program Area and the terrestrial resources residing therein. These laws include the following:

Federal

> Endangered Species Act of 1973

> Magnusson-Stevenson Fishery Conservation and Management Act of 1996

> Clean Water Act of 1977

> Executive Order 11990

State

> Porter-Cologne Water Quality Control Act of 1970

> California Fish and Game Code Section 1600 et seq.

> California Endangered Species Act of 1984

> California Fish and Game Code Section 5650

> Natural Community Conservation Planning Act

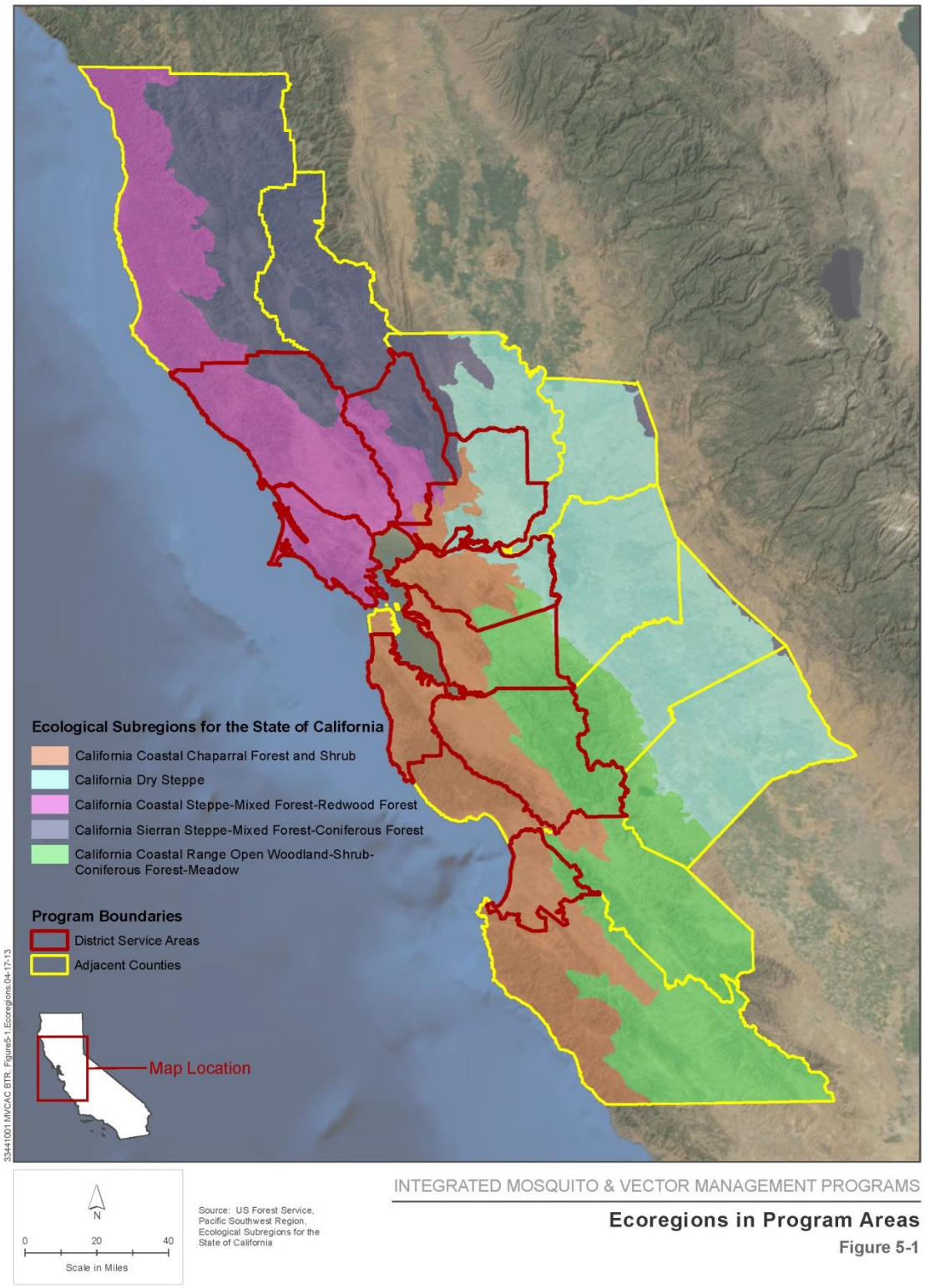
> California Food and Agricultural Code, Section(s) 12976 and 12981

Local

> Local governing bodies may pass ordinances that regulate or restrict pesticide use within their jurisdictional areas.

A description of these laws and regulations is provided in Appendix A, Section 2.5.

Figure 5-1 Terrestrial Ecoregion Provinces



5.1.4 Habitat Conservation Plans and Natural Community Conservation Plans

HCPs are planning documents required as part of an application by a nonfederal entity for incidental take of a species listed under the federal Endangered Species Act as part of their proposed activities. An HCP describes the proposed action(s), and anticipated effects on the individuals and populations of listed species. It also describes how impacts will be minimized and mitigated. An HCP also can include protections for species that are candidates for listing or are proposed for listing. The USFWS or NOAA Fisheries review the HCP, when reviewing a project. If they approve a project, they will issue an incidental take permit for the project actions, which provides for take of these species based on the actions provided for in the HCP, as well as additional measures that they might include.

The California legislature first passed the California Natural Community Conservation Planning Act in 1991, then updated and superseded it in 2003. The primary objective of the NCCP program is to conserve natural communities at the ecosystem level, while accommodating compatible land use. It focuses on the long-term stability of wildlife and habitat and seeks to avoid controversy and delays associated with species listings.

The Santa Clara Valley Habitat Plan provides a framework for promoting the protection and recovery of natural resources, including endangered species, while streamlining the permitting process for planned development, infrastructure, and maintenance activities. The Habitat Plan allows the County of Santa Clara (County), the Santa Clara Valley Water District, the Santa Clara Valley Transportation Authority (VTA) and the cities of Gilroy, Morgan Hill, and San José (collectively, the Local Partners or Permittees) to receive endangered-species permits for activities and projects they conduct and those under their jurisdiction. The Santa Clara Valley Open Space Authority also contributed to Habitat Plan preparation. The Habitat Plan will protect, enhance, and restore natural resources in specific areas of Santa Clara County and contribute to the recovery of endangered species. Rather than separately permitting and mitigating individual projects, the Habitat Plan evaluates natural-resource impacts and mitigation requirements comprehensively in a way that is more efficient and effective for at-risk species and their essential habitats.

The Habitat Plan was developed in association with the U.S. Fish and Wildlife Service (USFWS), and the California Department of Fish and Wildlife (CDFW), and in consultation with stakeholder groups and the general public. The USFWS will issue the Permittees a 50-year permit that authorizes incidental take of listed species under the federal Endangered Species Act (ESA), while CDFW will issue a 50-year permit that authorizes take of all covered species under the Natural Community Conservation Planning Act (NCCP Act). This approach allows the Permittees to streamline future mitigation requirements into one comprehensive program. In addition to obtaining take authorization for each participating agency's respective activities, the cities and County will be able to extend take authorization to project applicants under their jurisdiction.

USFWS and CDFW will also provide assurances to the Permittees that no further commitments of funds, land, or water will be required to address impacts on covered species beyond that described in the Plan to address changed circumstances. In addition to strengthening local control over land use and species protection, the Plan provides a more efficient process for protecting natural resources by creating new habitat reserves that will be larger in scale, more ecologically valuable, and easier to manage than the individual mitigation sites created under the current approach.

The Habitat Plan and associated documents are approved and adopted by the six Local Partners (Cities of Gilroy, Morgan Hill and San Jose, County of Santa Clara, Santa Clara Valley Transportation Authority, and Santa Clara Valley Water District).

5.2 Environmental Evaluation

This section identifies the environmental issues and concerns associated with the Program components

5.2.1 Environmental Concerns

The Program components have the potential to affect terrestrial resources directly by affecting physical habitat and through acute or chronic toxicity to nontarget organisms. Habitat alterations such as removal or reduction of habitat may also indirectly result in effects to the ranges and abundance of prey animals. Exposure of nontarget organisms to pesticides can result in acute or chronic toxicity, depending on the nontarget species and concentrations encountered. Additionally, indirect exposure may occur via ingestion of rodenticide-contaminated prey animals, bioaccumulation of chemicals, or biotransformation of pesticide active ingredients to different compounds.

The following key issues are derived from the public scoping concerns and addressed in the impact analyses contained herein:

> Discuss potential impacts on insect pollinators/bees from chemicals in treatment applications.

- Ground-based mosquito ULV fogging events are scheduled during the night (11 p.m. to 3 a.m.) when bees are not active and are sheltered within hives. Choice of material for fogging is a single pulse of ultra-low volume droplets (3 ounces per acre). Minimal impacts are expected on insect pollinators/bees when apiaries are placed away from the road or temporarily covered with wet burlap.

> Describe the effects of all chemicals that are used and/or proposed for use on wildlife and natural ecosystems, including insect prey, birds, mammals, fish, vegetation and site topography. The loss of prey for birds is a particular concern. Also, consider unwanted effects of the “inactive” portion of the pesticides. What effects will the carrier portion of the chemicals have on the environment?

- Ecosystem effects are minimal due to use of selective materials, such as methoprene, that only target mosquitoes that are still available for predation

> Discuss the potential impact of Bs/Bti products on native species.

- Bacterial toxins, Bs and Bti (var. israelensis) only impact a specific family of flies (Nematocera), which includes mosquitoes, blackflies, midges, and gnats. The protein toxin is only activated by high pH found in the larval gut and will not be activated under other conditions. Studies show that Bs or Bti do not directly impact aquatic predators feeding on treated larvae.

> Describe the role of mosquitoes within the food chain, and subsequent impacts if they were removed in terms of amphibians, birds, reptiles, fish and insects. This issue is also addressed in Section 6.2.

- Although mosquitoes serve a positive role as prey items for some avian insectivores, bats, and small reptiles and amphibians, the loss of a focus area (infested or large population of mosquitoes) will not affect the predator populations overall. The recovery times are short and mosquitoes are generally only one prey source for those predators.

> Pesticides can also kill the natural predators of mosquitoes, which have great difficulty in recovery from pesticides.

- In general, the pesticides used for mosquito control exhibit low or no toxicity to birds or mammals. Little information is available regarding toxic effects to reptile or terrestrial amphibian mosquito predators. Although mosquito pesticides may also affect invertebrate predators (e.g., dragonflies), recovery of predator populations is usually rapid as the predator populations extend beyond the application areas and will rapidly replace any lost individuals.

> Pesticide efficacy attenuation and possible long-term resistance is an issue for all chemically based mosquito control programs. It is addressed by the use of different control methods and different agents over time where possible (BMP and IVM techniques are designed to identify these issues early and modify applications as appropriate and feasible.

5.2.2 Evaluation Methods and Assumptions

Pesticides the Districts use were investigated to provide a preliminary assessment of the potential effects to nontarget ecological receptors. An ecological health assessment was the principal method used to evaluate concerns associated with the Program components (discussed in detail in Appendix B). A comprehensive literature review of published toxicity and fate and transport information was conducted. In addition, information specific to pesticide products used by the District in the Program Area was used to support the potential exposure and toxicity assessment, including:

> Pesticides the District uses or proposes to use

> Pesticide label requirements

> Types of application sites (e.g., habitat types)

> Application procedures

> Frequency of applications

> Total amount used per treatment for each application site, based on seasonal uses

> Physicochemical properties of the pesticides/active ingredients

> Pesticide target (mosquito) efficacy

> Reported adverse effects (e.g., reproductive, developmental, carcinogenic).

The pesticide application scenarios that result in reasonable efficacy with minimal unwanted estimated risk are preferred and are the basis of IPM approaches and BMPs the District employs. BMPs are described in Section 2.9. Each of the pesticides identified as warranting further evaluation in Appendix B are known to exhibit at least one parameter that appears to have a significant role in the resulting potential or perceived risk.

5.2.2.1 Methodology

The methodology used to prepare this section is as follows:

> Obtain source-specific data for Program-specific chemical constituents.

> Evaluate Appendix B sections related to the Program.

> Identify terrestrial resource effects, considering potential effects to nontarget terrestrial organisms.

Appendix B provides the results of review and evaluations of the 42 pesticide (insecticides) active ingredients the District currently uses or proposes for use. Application information, including the target organisms, number of treatments, total amount applied, and specific habitat types was obtained from the District. A comprehensive literature review was conducted to evaluate environmental fate and general toxicity characteristics for the active ingredients and adjuvants. The results of the assessment were used to rank the potential for adverse effects to human health and the environment. Chemical and application characteristics such as the likelihood of exposure for nontarget species and habitats, the potential for drift, and the possible transport and fate of the chemical in various media (i.e., air, surface water/groundwater, soil) were considered in the assessment. Those active ingredients that appear to exhibit a higher level of risk are listed in Table 5-3. These active ingredients may be subjected to additional examination using criteria that are more stringent.

Effects on desired terrestrial plant and animal (e.g., native and listed species) communities and food supply for wildlife using available information on the types of control and treatment and the toxicity of the various chemicals used, the treatment descriptions, and the physical and biological connections between treatment areas and terrestrial ecosystems.

The potential effects of the treatment alternatives will vary depending on the specific treatment applied, the size and location of the treated area, the type of habitat treated, and the timing and frequency of treatment. More targeted treatments would be expected to have lesser effects than less targeted treatments. Small treatment areas or less frequent applications of a treatment would generally be expected to result in lesser effects than the same treatment applied over a larger area or more frequently.

The potential effect of the nonchemical alternatives is based on the type and location of habitats affected and the magnitude and frequency of control activities. The effects of the chemical alternatives were evaluated based on the magnitude and duration of the treatments and the toxicity information presented in Chapter 6, Ecological Health, and in Appendix B. The evaluation of alternatives considered the life histories of the different listed terrestrial species and ecological interactions including effects to the terrestrial food chain.

This evaluation assumes that all pesticides are applied in accordance with product label instructions and USEPA and CDPR requirements. The USEPA requires mandatory statements on pesticide product labels that include directions for use; precautions for avoiding certain dangerous actions; and where, when, and how the pesticide should be applied. This guidance is designed to ensure proper use of the pesticide and prevent unreasonable adverse effects to humans and the environment. All pesticide labels are required to include the name and percentage by weight of each active ingredient in the product/formulation. Toxicity categories for product hazards and appropriate first-aid measures must be properly and prominently displayed. Pesticide labels also outline proper use, storage, and disposal procedures, as well as precautions to protect applicators. The directions for use specify the target organism (pest), appropriate application sites, application rates or dosages, contact times, and required application equipment for the pesticide. Warnings regarding appropriate wind speeds, droplet sizes, or habitats to avoid during application are also prominently displayed.

This evaluation does not include assumptions about which alternative treatment strategy or strategies would be applied in any given area. Therefore, each treatment alternative is considered as a stand-alone option, although the Program may include multiple alternative implementations within a given area (i.e., physical controls followed by larvicide application). Criteria used to trigger a particular alternative based on mosquito abundance and other variables are included in District-specific operating procedures. This evaluation assumes that important parameters such as sediment half-life are dependent on the specific conditions at the time of pesticide application; therefore, the values listed herein serve as reference values.

5.2.2.2 Assumptions

The following assumptions were used in the environmental evaluation:

> Site-specific evaluation is not within the scope of this programmatic evaluation.

> The programmatic evaluation is based on the current proposed control methods and is subject to change based on the results of initial treatment.

Assumptions related to the analysis of hazards, toxicity, and exposure for chemical treatment methods are explained below, including the definition of key terms. The concept of ecological food web is explained as well.

5.2.2.2.1 Hazardous Material

A “hazardous material” is defined in California Health and Safety Code Section 25501 (p): as “any material that, because of its quantity, concentration, or physical or chemical characteristics, poses a significant present or potential hazard to human health and safety or to the environment if released into the workplace or the environment. “Hazardous materials” include, but are not limited to, “hazardous substances, hazardous waste, and any material that a handler or the administering agency has a reasonable basis for believing that it would be injurious to the health and safety of persons or harmful to the environment if released into the workplace or the environment.” Any liquid, solid, gas, sludge,

synthetic product, or commodity that exhibits characteristics of toxicity, ignitability, corrosiveness, or reactivity has the potential to be considered a “hazardous material.”

5.2.2.2.2 Toxicity and Exposure

Toxicology is the study of a compound’s potential to elicit an adverse effect in an organism. The toxicity of a compound is dependent upon exposure, including the specific amount of the compound that reaches an organism’s tissues (i.e., the dose), the duration of time over which a dose is received, the potency of the chemical for eliciting a toxic effect (i.e., the response), and the sensitivity of the organism receiving the dose of the chemical. Toxicity effects are measured in controlled laboratory tests on a dose/response scale, whereby the probability of a toxic response increases as dose increases. Exposure to a compound is necessary for potential toxic effects to occur. However, exposure does not, in itself, imply that toxicity will occur. Thus, toxic hazards can be mitigated by limiting potential exposure to ensure that doses are less than the amount that may result in adverse health effects.

The toxicity data included in the numerous tables and charts in this document are generally derived from rigidly controlled laboratory animal studies designed to determine the potential adverse effects of the chemical under several possible routes of exposure. In these studies, the species of interest is exposed to 100 percent chemical at several doses to determine useful information such as the lowest concentration resulting in a predetermined adverse effect (LOAEL) on numerous selected physiological and behavioral systems. The second component of these tests is to determine the highest concentration of chemical that results in no measurable adverse effect (NOAEL).

However, these, and other, coordinated and focused laboratory tests are designed to document the effects of the chemical when a continuous, controlled, exposure exists and do not realistically reflect the likely exposures or toxicity in the District field application scenarios. As such, the toxicity information is intended as an overview of potential issues and guidance for understanding the completely “safe” maximum exposure levels of applications that would not adversely affect humans or nontarget plant and animal species.

Although the regulatory community uses this basic information to provide a relative comparison of the potential for a chemical to result in unwanted adverse effects and this information is reflected in the approved usage labels and MSDSs, in actual practice, the amounts applied in the District’s Program Area are substantially less than the amounts used in the toxicity studies. Because of these large inherent safety factors in recommended product application rates, the amount of chemical resulting in demonstrated toxicity in the laboratory is nowhere near the low exposure levels associated with an actual application. The application concentrations consistent with the labels or MSDSs are designed to be protective of the health of humans and other nontarget species (i.e., low enough to not kill them, weaken them, or cause them to fail to reproduce).

The toxicity of a chemical is also affected by various biological, chemical, and physical parameters that affect the behavior of a compound in the environment and its potential toxicity. The chemistry, fate, and transport of a compound must be analyzed to fully estimate potential exposure to a given receptor. The fate and transport of a compound is determined by the physical and chemical properties of the compound itself and the environment in which it is released. Thus, the following characteristics of a compound must be evaluated: its half-life in various environmental media (e.g., sediment, water, air); photolytic half-life; lipid and water solubility; adsorption to sediments and plants; and volatilization. Environmental factors that affect fate and transport processes include temperature, rainfall, wind, sunlight, water turbidity, dissolved oxygen concentrations, and water and soil pH. Information pertaining to these parameters allows evaluation of how compounds may be transported between environmental media (e.g., from sediments to biota), how a compound may be degraded into various breakdown products, and how long a compound or its breakdown products may persist in different environmental media. Appendix B provides a discussion of the environmental fate of the pesticide active ingredients and other chemicals associated with specific pesticide formulations used in the Program components.

5.2.2.2.3 Ecological Food Webs

While it is important to evaluate the potential adverse effects of a pesticide application to potentially affected nontarget species, it is neither feasible nor practical to evaluate those potential effects to a representative food web. An ecological food web is represented in the illustration representing some of the multitude of possible biotic and food uptake interactions in an ecosystem. Each of the possible connections between species is also associated with other interactions. These interactions can be the result of higher levels of animal species organization (trophic) or paired interactions between individuals that result in added, positive associations (symbiotic) for both species.

Although ecological food webs could be used to describe the complex system interactions that might be associated with District application scenarios, it is neither feasible nor practical to evaluate those potential effects using a food-web approach. The numerous, complex interactions in typical food webs would be fraught with uncertainty and complex animal associations and, as such, difficult to confidently assess relevant effects. Because of these constraints and complexity, it would be neither practical nor productive to attempt to predict food-web interactions for each of the numerous application scenarios the District uses. It is appropriate, however, to use a food-web analysis to identify and consider the first level of potentially adverse effects to nontarget species that might result from a pesticide application. This information is used to assure minimal effects to nontarget species and is typically a part of the MSDS and Toxicology profiles, providing the basis for the more reasonable, technically feasible approach to evaluate the safety of the pesticides the District commonly uses. Figure 5-2 illustrates the ecological food web concept.

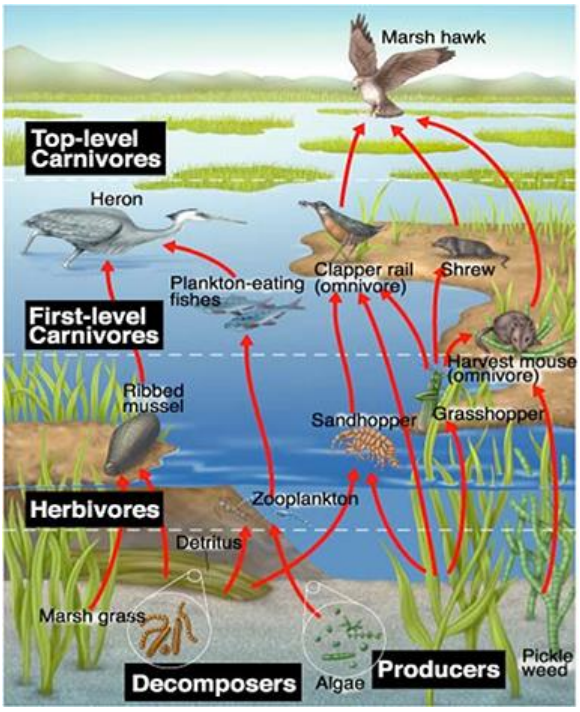


Figure 5-2 Ecological Food Web Concept

Various biological, chemical, and physical parameters affect the behavior of a compound in the environment and its potential toxicity. The chemistry, fate, and transport of a compound must be analyzed to fully estimate potential exposure. The fate and transport of a compound is determined by the physical and chemical properties of the compound itself and the environment in which it is released. Thus, the following characteristics of a compound must be evaluated: its half-life in various environmental media (e.g., sediment, water, air); photolytic half-life; lipid and water solubility; adsorption to sediments and plants; and volatilization. Environmental factors that affect fate and transport processes include temperature, rainfall, wind, sunlight, water turbidity, and water and soil pH. Information pertaining to these parameters allows evaluation of how compounds may be transported between environmental media (e.g., from sediments to biota), how a compound may be degraded into various breakdown products, and how long a compound or its breakdown products may persist in different environmental media. Appendix B provides a discussion of the environmental fate of the pesticide active ingredients and other chemicals associated with specific pesticide formulations used in the Program components.

5.2.3 Surveillance Component

Surveillance activities involve monitoring the abundance of adult and larval mosquitoes, field inspection of mosquito habitat, testing for the presence of antigen or antibodies specific to encephalitis virus in domestic and wild fowl, collection and testing of ticks, small rodent trapping, and/or response to public

service requests regarding pests such as mosquitoes. Mosquito populations are monitored through the use of traps, inspections, and sampling in mosquito habitats. Known and suspected habitats are anywhere that water can collect, be stored, or remain standing for more than a few days, including, but not limited to, catch basins, stormwater detention systems, residential communities, parks, ornamental ponds, unmaintained swimming pools, seeps, seasonal wetlands, tidal and diked marshes, wastewater ponds, sewer plants, winery waste/agricultural ponds, managed waterfowl ponds, canals, creeks, tree holes, and flooded basements. If preexisting roads and trails are not available, low ground pressure ATVs may be used to access sites. Offroad access is minimized and used only when roads and trails are not available. Ticks are collected along trails and sampled for diseases. Rodents are trapped and sampled during disease surveys for plague and hantavirus.

Surveillance activities might result in some physical damage to habitat or associated vegetation from use of ATVs and foot traffic in areas without marked trails to access areas for potential vector inspection. Sensitive species could be directly affected by these activities. The District investigates sites for the presence of special-status and sensitive species prior to initiating any further surveillance measures in natural habitat areas, and only small areas would be disrupted temporarily by access activities.

5.2.4 Physical Control Component

Physical control for mosquitoes consists of the management of aquatic areas that provide mosquito-producing habitat (including freshwater marshes and lakes, saltwater marshes, temporary standing water, vernal pools, and wastewater treatment facilities) especially through water control and maintenance or improvement of channels, tide gates, levees, and other water control facilities. Physical controls reduce or eliminate mosquito development sites by improving the habitat value for mosquito predators (i.e., providing deepwater sanctuary for larvivorous fish) or by reducing the habitat value for mosquitoes. Because mosquitoes breed in stagnant standing water, the District attempts to reduce these habitats through vegetation management, increased circulation, steepening banks, changes in water quality, or by reducing the duration that standing water is allowed to exist. (Vegetation management is discussed below in Section 5.2.5). The District conducts physical control activities, requests/requires landowners and stewards to implement maintenance activities, and advises landowners on source reduction for mosquito habitat.

Three types of physical control practices are implemented:

> Maintenance activities include removal of sediments from existing water circulation ditches, repair of existing water control structures, removal of debris in natural channels, clearance of brush for access to streams tributary to wetland areas, and filling of existing, nonfunctional water circulation ditches to achieve required water circulation dynamics and restore ditched wetlands.

> New construction typically involves the creation of new ditches to enhance tidal flow preventing stagnant water.

> Cultural practices include vegetation and water management (i.e., irrigation practices), placement of culverts or other engineering works, and making other physical changes to the lands.

The District performs these physical control activities in accordance with all appropriate environmental regulations and in a manner that generally maintains or improves habitat values for desirable species. Physical control activities can be relatively minor, typically consisting of reducing habitat for vectors such as restoration of sections of border habitats, or temporary ponding, associated with wetlands. These activities primarily occur in aquatic rather than terrestrial habitats, although by draining areas of standing water, new terrestrial habitat is created. While vernal pools provide breeding habitat for mosquitoes, they also provide habitat for many special-status or sensitive species in California. Therefore, destruction or impairment of vernal pool habitat should be avoided under the Physical Control component. This BMP is listed in Section 2.9: If suitable habitat necessary for special-status species is found, including vernal pools, and if nonchemical physical and vegetation management control methods have the potential for affecting the potential species, then the District will coordinate with the CDFW, USFWS, and/or NMFS

before conducting control activities within this boundary or cancel activities in this area. If the District determines no suitable habitat is present, control activities may occur without further agency consultation.

Concerning physical control measures for other vectors such as yellowjacket wasps, ticks, rats, mice, raccoons, skunks, and opossum, the focus of physical control is on proper sanitation/removal of food sources and exclusion of the animal from the site, which poses a conflict with human activities. Such measures do not directly affect terrestrial habitats containing native or special status species.

5.2.5 Vegetation Management Component

Direct vegetation management by District staff generally consists of activities to reduce the mosquito habitat value of sites by improving water circulation or access by fish and other predators, or to allow access by District staff to standing water for inspections and treatment. The District uses hand tools (e.g., shovels, pruners, chain saws, and weed-whackers) and heavy equipment where necessary for vegetation removal or thinning to improve surveillance or reduce vector habitats. These activities primarily occur in or adjacent to aquatic habitats to assist with the control of mosquitoes but are also implemented in terrestrial habitats to help with the control of other vectors. The District may also perform vegetation management to assist other agencies and landowners with the management of invasive/nonnative vegetation. These actions are typically performed under the direction of the concerned agency, which also maintains any required permits.

HCP/NCCPs generally incorporate measures to protect sensitive habitats and sensitive species, including plants. Protective measures or restoration goals for upland and other terrestrial habitats are often included in these documents and their accompanying permits. The Vegetation Management component would alter habitats to make them less suitable to mosquito larvae, but this would primarily affect aquatic habitat.

5.2.5.1 Physical Management

Nonherbicide management actions may involve reducing standing vegetation using equipment. The use of weed-whackers, chain saws, or shovels may lead to physical damage of terrestrial plants and injury to animals in the treatment area. Manual removal is the primary method of vegetation removal and would not be anticipated to affect substantial patches of vegetation in the affected area. Use of heavy equipment for vegetation management could affect larger areas but would not affect a large enough area to change the quality or functionality of the habitat for nontarget species. Areas of vegetation managed with heavy equipment would generally not be larger than a few acres. The District applies BMPs to reduce these effects by (1) identifying sensitive species locations, if any, in the treatment area prior to commencing any vegetation removal actions, and (2) limiting the extent of heavy equipment use in order to minimize the area affected (Section 2.9.2). Animals return to their selected habitats within a few hours after the cessation of the noise sources for most of the physical application techniques currently used by the Districts.

5.2.6 Biological Control Component

Biological control of mosquitoes involves the intentional use of vector pathogens, parasites, and predators to reduce the mosquito population. It is one of the principal components of the District’s IPM approach, in which the emphasis is on managing mosquitoes in their immature stages.

5.2.6.1 Mosquito Larvae Pathogens

As part of their Biological Control component, the District employs bacterial larvicides (Table 5-1) that are highly specific to mosquitoes. These biological controls include the active ingredients Bs, Bti, and spinosad... Because these materials are registered by EPA as pesticides, Bs or Bti and spinosad are evaluated below under Section 5.2.7.1.1, Chemical Control component. The environmental fate and toxicity of these control agents is discussed further in Appendix B.

Table 5-1 Biological Control Options for Larval Mosquito Abatement as Discussed in Appendix B

Active Ingredient	Appendix B
Bs	Section 4.3.1
Bti	Section 4.3.2
Spinosad	Section 4.3.3

5.2.6.2 Mosquito Predators

Mosquitofish (*Gambusia affinis*) are presently the only commercially available mosquito predators. The District's rearing and stocking of these fish in mosquito habitats is the most commonly used biological control agent for mosquitoes in the world. Used correctly, this fish can provide safe, effective, and persistent suppression in various mosquito sources. However, due to concerns that mosquitofish may potentially adversely affect red-legged frog and tiger salamander populations in natural water bodies, the District limits the use of mosquitofish to artificial water bodies such as ornamental fish ponds, water troughs, water gardens, fountains, and unused swimming pools. These artificial habitats are not included in HCPs/NCCPs.

Currently, no commercial biological control agents or products are available for wasp and yellowjacket control, and the District does not employ predators for rodent control.

5.2.7 Chemical Control Component

Chemical control consists of the application of chemicals to directly reduce populations of vectors that pose a risk to public health. The majority of chemical control tools are used for mosquito abatement. As part of their IVMP, the District prioritizes the least toxic materials available for control of the larval stages, focusing on bacterial larvicides, growth regulators, and surface films rather than OPs or pyrethroids. Control of adult mosquitoes may become necessary under some circumstances, such as in the event of a disease outbreak (documented presence of infectious virus in active host-seeking adult mosquitoes), or lack of access to larval sources and habitats leading to the emergence of large numbers of biting adult mosquitoes. The active ingredients currently used for control of adult mosquitoes have been deliberately selected for lack of persistence and minimal effects on nontarget organisms when applied at label rates for ULV mosquito control. Infrequent and localized ULV treatments with adulticides reduce the risk of developing insecticide resistance.

The District also uses insecticides to control populations of ground-nesting yellowjackets. This activity is generally triggered by public requests rather than as a result of regular surveillance activities. The District does not treat yellowjacket nests that are located inside or on a structure; instead, the resident is encouraged to contact a private pest control company. Likewise, residents complaining of honeybee swarms or hives are referred to the Santa Clara Bee Guild for a referral list of beekeepers. If District technicians deem it appropriate to treat stinging insects, they will apply the insecticide directly within the nest to avoid drift or harm to other organisms. Alternatively, they will place tamper-resistant traps or bait stations, selective for the target insect, in the immediate environment.

The District's rodent management program includes limited use of rodenticides in response to resident requests. Rodent baits containing first and second generation anticoagulants are typically placed in secure bait stations or at underground sites such as sewers, storm drains, or catch basins. In sewer baiting, bait blocks containing bromadiolone are often suspended by wire above the water line. For rodent burrows, fumigants or anticoagulant dust may be blown into the burrows.

All chemicals are applied in strict conformance with label requirements, which have been approved by CDPR for use in California. Pesticide labels are legal requirements and include instructions telling users how to apply the product and precautions the applicator should take to protect human health and the

environment. In addition, chemicals are applied in conformance with the PAP as required by the NPDES Vector Control Permit. All BMPs included in the PAP and product labels are followed and include such measures as restrictions in certain land uses and weather (i.e., wind speed) parameters.

The chemicals the District uses for vector control are presented in Tables 6-1 and 6-2 in Chapter 6, Ecological Health. These pesticides are approved for commercial use by the USEPA and CDPR and, when applied with strict adherence to product label requirements and additional BMPs listed in Section 2.9, should not result in adverse effects to nontarget organisms. Detailed discussions of the environmental fate and toxicity of these active ingredients are provided in Appendix B. A subset of the pesticides (Table 5-2) available for District use was identified for further examination based upon use patterns and toxicity (Appendix B, Table 1-1). The following discussion groups these chemicals based on their target organism or life stage and discusses these pesticides in reference to effects to terrestrial nontarget organisms.

Table 5-2 Chemical Control Active Ingredients and Adjuvants Identified in Appendix B

Active Ingredient	Vector	Potential Issue
Methoprene	Mosquitoes	Prevalent use; toxicity to aquatics and insects
Etofenprox	Mosquitoes	Toxicity to aquatic organisms; no synergist required
Bti	Mosquitoes	Prevalent use; public concerns
Pyrethrins	Mosquitoes	Prevalent use; requires synergist (PBO)
Resmethrin	Mosquitoes	Requires synergist (e.g., PBO); potential endocrine disruptor
Vegetable Oil (coconut oil)/mix	Mosquitoes (surfactant)	Contains low percentage of petroleum distillate
Permethrin	Mosquitoes/ yellowjacket wasps	Toxicity to aquatic organisms; potential endocrine disruptor
Lambda-cyhalothrin	Yellowjacket wasp	Toxicity to aquatic organisms; potential to bioaccumulate
Bromadiolone	Rats	Toxicity to nontarget organisms including mammals, birds, aquatics
Difethialone	Rats	Toxicity to nontarget organisms including mammals, birds, aquatics

Note: See Appendix B, Table 1-1

The District uses a variety of techniques and equipment to apply mosquito larvicides, including hand-held sprayers, backpack sprayers and blowers, truck- or -ATV-mounted spray rigs, and helicopters or other aircraft. The District uses conventional pickup trucks and ATVs as larvicide vehicles. Equipment used in ground applications of liquid formulations include hand-held sprayers (handcans or spray bottles), and backpack sprayers and blowers. Hand-held sprayers (handcans) are standard 1- or 2- or 3-gallon garden style pump-up sprayers used to treat very small isolated areas. Backpack sprayers are either hand pump-up for liquid applications and have a 2.5/3 to 5-gallon tank or are gas powered. When large areas are simultaneously producing mosquito larvae at densities exceeding District treatment thresholds, then the District may use helicopters or other aircraft to apply larvicides. Aerial application of larvicides is a relatively infrequent activity for the Districts, typically occurring 1 to 3 times each year with each application covering around 400 to 1,200 acres. Aerial application of liquid larvicides typically occurs during daylight hours and at an altitude above the treatment site of less than 40 feet. Granular applications would occur during daylight hours at a less-than-50-foot altitude.

Aerial applications using helicopters and fixed-wing aircraft may be used to obtain effective control in difficult to access areas, when avoiding take of salt marsh harvest mouse in designated areas and where

or the application site exceeds the District's capacity to respond by hand or ATV-based applications. . The flight parameters differ by technique. Most operations fly during hours of daylight so their applications begin either at morning's first light or before sunset and work into twilight. The aircraft can be flown at a less than 200-foot altitude, which may make it easier to hit the target area. Other operations may be conducted in the dark of the night, typically after twilight or early in the morning before dawn. The aircraft typically are flown between 200- and 300-foot altitudes. Swath widths vary from operation to operation but are normally set somewhere between 400 and -1,200 feet. Aerial applications may be conducted over, but are not limited to, the following land uses within the Program Area: salt marsh, diked marsh, seasonal wetlands; evaporation ponds and wastewater ponds; and agricultural, residential, commercial, industrial, and recreational areas.

The number and type of vehicles and equipment required would vary by District, as shown in Table 12-8, which also shows the range of noise levels that they typically would generate at 50- and 400-foot distances from the source and the land uses that would be affected. Noise from helicopters also is shown at a 500-foot distance. All land use types potentially could be treated through aerial applications, although those shown are the most likely to be affected. Estimated noise levels and potential sources are included in Table 12-8 of Chapter 12, which addresses the potential effects of noise on humans during routine operations that would be similar to future operations under the Program.

5.2.7.1 Mosquito Larvicides

As part of their Chemical Control component, the District employs bacterial larvicides that are highly specific to mosquitoes. These controls include the active ingredients Bs, Bti, and spinosad. Larvicides are used to manage immature life stages of mosquitoes including larvae and pupae in aquatic habitats. Temporary aquatic habitats are usually targeted because permanent water bodies generally support natural mosquito predators such as fish. The larvicides are applied using ground application equipment, fixed wing aircraft, and rotary aircraft. The effects on wildlife are minimal, as the animals return to their selected habitats within a few hours at most for application techniques currently used by the District.

The toxicity of Bs, Bti, spinosad, methoprene, and monomolecular films are discussed in detail in Appendix B and listed in Table 5-3. The District employs BMPs to reduce the relative potential effects of these chemical alternatives to nontarget organisms as well as to applicators. Because Bs, Bti, and spinosad are applied to aquatic rather than terrestrial environments to control larval mosquitoes, the potential for exposure of terrestrial organisms is low, although some overspray could occur.

Table 5-3 Chemical Control Options for Larval Mosquito Abatement as Discussed in Appendix B

Chemical Classification	Active Ingredient	Appendix B
Bacterial larvicide	Bs	Section 4.3.1
Bacterial larvicide	Bti	Section 4.3.2
Bacterial larvicide	Spinosad	Section 4.3.3
Hydrocarbon ester	Methoprene and s-Methoprene	Section 4.3.4
Organophosphate	Temephos	Section 4.2.2
Surfactant	Alcohol Ethoxylated Surfactant (monomolecular film)	Section 4.3.5

5.2.7.1.1 Bacterial Larvicides (BS, Bti, spinosad)

Bacterial larvicides such as Bti (and Bs are highly selective microbial pesticides (for mosquitoes) that when ingested, produce gut toxins that cause destruction of the insect gut wall leading to paralysis and death. These microbial agents are delivered as endospores in granular, powder, or liquid concentrate formulations. Bs and Bti are applied directly to larval mosquito habitats (water) rather than to terrestrial environments and strictly adhere to product labels and other BMPs. Additionally, Bs and Bti are practically nontoxic to terrestrial organisms, including birds, bees, and mammals.

Spinosad is a natural insecticide derived from the fermentation of a common soil microorganism, *Saacharopolyspora spinosa*. Spinosad causes neurologic effects in insects consistent with the general activation of nicotinic acetylcholine receptors, but by a mechanism that is novel among known insecticides (Mayes et al. 2003). Exposure manifests as constant involuntary nervous system effects ultimately leading to paralysis and death of the insect. Spinosad is highly effective against lepidopteran larvae (e.g., butterflies and moths), as well as some dipteran (mosquitoes and flies), coleopteran (beetles), thysanopteran (e.g., thrips), and hymenopteran (e.g., bees, wasps) (Mayes et al. 2003) species. The effects of spinosad on beneficial pollinators such as honeybees are of concern. The District incorporates BMPs that are designed to minimize exposure of bees to spinosad, such as restricting applications to areas where bees and other nontarget insects may contact residues. Spinosad residues are generally below acute toxicity thresholds to honeybees. Field studies evaluating typical spinosad applications have demonstrated low risk to adult honeybees and little to no effect on hive activity and brood development, provided that the residue is allowed to dry for up to three hours (Mayes et al. 2003).

Spinosad is of low acute toxicity to birds and mammals. Generally, spinosad is applied directly to larval mosquito habitat, thereby reducing potential exposures of sensitive terrestrial insects including moths, butterflies, and honeybees. Application of spinosad follows strict product label descriptions.

5.2.7.1.2 Hydrocarbon Esters (Methoprene)

(S)-Methoprene is a hormone analogue that interferes with insect larval development (growth regulator). This chemical does not exhibit the nonspecific target effects of neurological toxins such as pyrethrin.

Methoprene is used as a larvicide and, as such, is not applied to terrestrial environments. Some drift into terrestrial environments may occur when it applied, but it is almost irrelevant for hand and aerial (e.g., helicopter) applications since treatments are restricted at moderate to high wind speeds. Methoprene is considered one of the safest of all larvicide options, and the District uses methoprene during each season of the year. Methoprene is highly effective against mosquitoes at low concentrations (very low volume applications are used when possible) and degrades quickly in the environment, thereby reducing the potential exposure and risk to nontarget organisms. The District avoids applying methoprene to vernal pools due to the fact that vernal pools provide habitat for many special-status or sensitive species.

Methoprene has high toxicity to nontarget insects such as moths, butterflies, and beetles; however, moths, butterflies, and most species of beetles do not occupy aquatic habitats and so would have very limited exposure.

5.2.7.1.3 Organophosphates

Temephos is the only OP with larvicidal use and may be used to help prevent mosquitoes from developing resistance to the bacterial larvicides. Temephos is used on lakes, ponds, reservoirs, swamps, marshes, tidal areas, intermittently flooded areas, catch basins, drainage systems, irrigation systems, ornamental ponds, wastewater, and polluted and stagnant water (CDPR 2010a). Temephos has extremely low water solubility and binds strongly to soils. It is moderately acutely toxic to mammals and fish, but highly toxic to nontarget aquatic invertebrates (e.g., stoneflies, mayflies). Temephos is applied following label requirements and at low concentrations. It is not expected to have a direct effect on

terrestrial animals and the use of temephos has declined over time in favor of bacterial larvicides, methoprene, and surface oils (USEPA 2000).

5.2.7.1.4 Surfactants (Alcohol ethoxylated surfactant, aliphatic solvents)

Petroleum- and plant-based (ethoxylated isostearyl alcohols) oils are used as 'surface-active agents' effective against larvae and pupae. These oils are effective against these immature life stages by physically blocking access to air at the water thereby drowning the mosquito. These treatments may also be effective against adult mosquitoes during adult emergence. These treatments are specific to aquatic environments and are not applied to terrestrial environments, although some drift may occur.

5.2.7.2 Mosquito Adulticides

In addition to chemical control of mosquito larvae, the District may use pesticides for control of adult mosquitoes when no other tools are available and if specific criteria are met, including species composition, population density (as measured by landing rate count or other quantitative method), proximity to human populations, and/or human disease risk. Treatment of adults is a tertiary line of defense employed when physical controls and larviciding are not sufficiently effective. As with larvicides, adulticides are applied in strict conformance with label requirements (Appendix B). Adulticides the District uses are listed in Table 5-4. Because of the ecological sensitivity of vernal pools, which support numerous species of listed plants and invertebrates, and the toxicity of these chemicals to nontarget organisms, the District avoids use of these adulticides in areas with vernal pools. A detailed discussion of the environmental fate and toxicity of these pesticides is provided in Appendix B. The potential effect on wildlife from noise associated with equipment use would be minimal, as the animals would return to their selected habitats within a few hours at most for application techniques currently used by the District.

Table 5-4 Chemical Control Options for Adult Insect Abatement as Discussed in Appendix B

Chemical Classification	Active Ingredient	Vector	Appendix B
Pyrethrin	Pyrethrin	Mosquito; yellowjacket	Section 4.1.1
Synthetic Pyrethroid	Allethrins and d-*trans* allethrin	Mosquito; yellowjacket	Section 4.1.2
Synthetic Pyrethroid	Phenothrin (sumithrin or d-phenothrin)	Mosquito; yellowjacket	Section 4.1.3
Synthetic Pyrethroid	Prallethrin	Mosquito; yellowjacket	Section 4.1.4
Synthetic Pyrethroid	Deltamethrin	Mosquito; yellowjacket	Section 4.1.5
Synthetic Pyrethroid	Esfenvalerate	Mosquito	Section 4.1.6
Synthetic Pyrethroid	Lambda-cyhalothrin	Mosquito; yellowjacket	Section 4.1.7
Synthetic Pyrethroid	Resmethrin	Mosquito	Section 4.1.8
Synthetic Pyrethroid	Tetramethrin	Mosquito; yellowjacket	Section 4.1.9
Synthetic Pyrethroid	Permethrin	Mosquito; yellowjacket	Section 4.1.10
Pyrethroid-like	Etofenprox	Mosquito	Section 4.1.11
Synergist	PBO	Mosquito; yellowjacket	Section 4.1.12
Potassium Salt	Potassium salts	Yellowjacket	Section 4.4.1

5.2.7.2.1 Pyrethrins

The District uses pyrethrin for mosquito and/or yellowjacket and wasp control. For yellowjacket control, pyrethrin is applied directly into ground nests around parks, and landscaping, For mosquito control, pyrethrin is applied as a ULV fog in populated areas or as a buffer zone around parks and margins of wetlands.

Pyrethrins readily degrade in water and soil, but may persist under anoxic conditions. They tend to strongly adsorb to soil surfaces and, hence, have low potential to leach into groundwater. These chemicals may have low to moderate acute toxicity to mammals; however, proper personal protective equipment would alleviate potential for human exposure, especially when delivered via ULV techniques. Pyrethrins may be highly toxic to fish (freshwater, estuarine, marine) and invertebrates, although exposures would likely be low during and following ULV applications, which are designed to prevent environmental persistence and potential effects to nontarget ecological receptors.

Pyrethrins have low to moderate acute toxicity to mammals via the oral, dermal, and inhalation routes and are practically nontoxic to birds. The risks to nontarget insects such as honeybees are reduced by only applying pyrethrins at night in the dark when bees and other pollinators are inactive. Little risk to nontarget terrestrial organisms is expected when this and other BMPs are applied.

5.2.7.2.2 Pyrethroids and Pyrethroid-Like Compounds

Pyrethroid insecticides are synthetic compounds that are chemically similar to the pyrethrins but have been modified to increase stability and activity against insects. Some synthetic insecticides are similar to pyrethroids, such as etofenprox, but have a slightly different chemical composition. First generation or “Type I” photosensitive pyrethroids include d-allethrin, phenothrin (sumithrin), prallethrin, resmethrin, and tetramethrin. Typically, these pyrethroids are used indoors and around residential areas. The newer second-generation pyrethroids are mostly “Type II” pyrethroids. Type II pyrethroids are more toxic (than Type I pyrethroids) because they are less photosensitive and persist longer in the environment. The active ingredients that fall into this group include deltamethrin, esfenvalerate, lambda-cyhalothrin, and permethrin.

Pyrethroids affect insect neuroactivity by binding to a protein at the nerve fiber that regulates the voltage-gated sodium channel, This binding can delay the closing of sodium channels and/or cause a persistent activation of the sodium channels, which often results in repetitive activity (Type I pyrethroid) or blockage of nerve conduction (Type II pyrethroid). Most pyrethroids and pyrethroid-like compounds are of low toxicity to birds and mammals, but of high toxicity to honeybees. The risks to nontarget insects such as honeybees are reduced by restricting application of these compounds to night and predawn times, when bees and other pollinators are inactive. The active ingredients that have been selected for further evaluation in Appendix B (resmethrin, permethrin, and etofenprox) are discussed individually below.

Resmethrin

The District may apply resmethrin to tree holes, residential areas near reclaimed marshes, and industrial areas for mosquito control. ULV applications of resmethrin may be used and this chemical is usually reserved for use when circumstances are critical (e.g., an outbreak of infectious disease such as dengue). Additionally, resmethrin use is declining in favor of other, less costly alternatives. Studies have shown rapid dissipation/low persistence following aerial ULV applications. Resmethrin is moderately toxic to birds and highly toxic to honeybees; however, little risk to nontarget terrestrial organisms is expected when BMPs are applied.

Permethrin

The District uses permethrin as a repellent for mosquitoes and ticks all year long. Permethrin has low toxicity to mammals and is practically nontoxic to birds. It is highly toxic to honeybees; however, this pesticide is generally used with careful and strict BMP techniques such as using very small, localized applications. When used appropriately, little risk to nontarget terrestrial organisms is expected.

Etofenprox

Etofenprox is a pyrethroid-like compound that does not tend to persist in the environment or appear to pose a risk to mammals and is frequently applied to backyards and patios and sometimes directly to domestic pets (for flea and tick control).

Etofenprox is generally applied during the nighttime hours when sensitive receptors such as honeybees are not active. Based on toxicity, environmental fate, and usage patterns, etofenprox, using BMPs, is not likely to result in adverse effects to nontarget terrestrial organisms.

5.2.7.2.3 Synergist (Piperonyl Butoxide)

PBO was first registered in the 1950s and acts as a synergist. Synergists are chemicals that primarily enhance the pesticidal properties of other active ingredients, such as pyrethrins and synthetic pyrethroids. PBO is a registered active ingredient in products used to control many different types of flying and crawling insects and arthropods, although no products contain only PBO. It is registered for use in agricultural, residential, commercial, industrial, and public health sites. PBO interferes with the insect's ability to detoxify pyrethrins and pyrethroids, by binding to microsomal enzymes in target organisms, thereby inhibiting the breakdown of other pesticides, including pyrethrins and pyrethroids (USEPA 2006a).

PBO degrades relatively rapidly in soil and water and, therefore, does not tend to persist in the environment. PBO may be highly toxic to some species of fish and aquatic invertebrates and is being evaluated as a possible endocrine disruptor. However, it is of low toxicity to terrestrial receptors such as mammals and honeybees. ULV applications of PBO are used whenever possible and in conjunction with BMPs for the co-applied pesticides.

5.2.7.3 Yellowjacket and Tick Abatement

Besides using insecticides for mosquito populations, the District selectively applies them to control ground-nesting yellowjackets that pose an imminent threat to people or to pets. This activity is generally triggered by public requests for District assistance or action rather than as a result of regular surveillance of their populations. For control of yellowjackets, these pesticides are applied in highly localized, upland areas and residential areas.

The District excludes from its yellowjacket control program, structural infestations. Yellowjacket nests that are off the ground may be treated under special circumstances to protect public health and safety of the District's residents. Whenever a District technician learns that a hive is situated inside or on a structure or is above ground, the resident(s) are encouraged to contact a private pest control company that is licensed to perform this work. When a technician encounters a honeybee swarm or unwanted hive, residents are referred to the Santa Clara County Bee Guild, which maintain referral lists of beekeepers that can safely remove the bees. If District technicians deem it appropriate to treat stinging insects, they will apply the insecticide directly within the nest in accordance with the District's policies to avoid drift of the insecticide or harm to other organisms. Alternatively, they will place tamper-resistant traps or bait stations, selective for the target insect, in the immediate environment of the vector.

Pyrethroid-based chemicals are typically used against ground-nesting yellowjackets and ticks. The potential environmental effects of these materials are minimal due to the fact that they are applied directly to the underground nest and to vegetation supporting ticks. This application method prevents drift and further reduces the potential for inadvertent exposure of nontarget and sensitive species to these materials. The pesticides the District uses to control yellowjacket populations are shown in Table 5-5 and those selected for further review in Appendix B have been discussed previously.

5.2.7.3.1 Pyrethrin

The District uses pyrethrin for mosquito and/or yellowjacket wasp control. For yellowjacket control, pyrethrin is applied around parks, onto landscaping, and directly into ground nests. The potential effects on terrestrial

habitats through reduction of the amount or quality of habitat available, to native terrestrial plant or animal populations through direct mortality, or to special-status species are discussed above under Mosquito Adulticides (Section 5.2.7.2).

5.2.7.3.2 Pyrethroids and Pyrethroid-like Compounds

Pyrethroid insecticides are synthetic compounds that are chemically similar to the pyrethrins but have been modified to increase stability and activity against insects. First generation or “Type I” photosensitive pyrethroids include d-allethrin, phenothrin (sumithrin), prallethrin, resmethrin, and tetramethrin. Typically, these pyrethroids are used indoors and around residential areas. The newer second-generation pyrethroids are mostly “Type II” pyrethroids. The active ingredients that fall into this group include deltamethrin, esfenvalerate, lambda-cyhalothrin, and permethrin. Type II pyrethroids are more toxic (than Type I pyrethroids) because they are less photosensitive and persist longer in the environment. Most pyrethroids and pyrethroid-like compounds are of low toxicity to birds and mammals, but of high toxicity to honeybees. The potential effect to terrestrial habitats through reduction of the amount or quality of habitat available, to native terrestrial plant or animal populations through direct mortality, or to special-status species are discussed above under Mosquito Adulticides (Section 5.2.7.2). Lambda-cyhalothrin was identified as a candidate for further evaluation in Appendix B and is discussed in detail below.

5.2.7.3.3 Lambda-cyhalothrin

The potential for persistence of lambda-cyhalothrin and its toxicity to mammals, aquatic organisms (vertebrates and invertebrates), and nontarget insects such as honeybees is of concern from a terrestrial resource perspective.

Lambda-cyhalothrin is available to the public in commonly used products for residential wasp control. Propellants provide a margin of safety to the applicator who may be 5 to 10 feet away from the hive. The District uses lambda-cyhalothrin for targeted application to yellowjacket and paper wasp nests. This product (0.01 percent lambda-cyhalothrin) is used as needed throughout the year. The District may use products containing this active ingredient as a courtesy to the public to assist with wasp control at residences (restricted to yards, gardens, and home exteriors). The amount the public and the District apply directly to wasp nests is minute and little to no potential exists for nontarget organism exposures.

Although potential exists for environmental persistence and exposure to domestic pets and nontarget receptors, this active ingredient is readily available as an insect spray and District uses are generally focused and very localized to minimize or eliminate those exposures. Lambda-cyhalothrin is not applied to vernal pools due to the fact that vernal pools provide habitat for many rare, sensitive, and special-status species. In addition, lambda-cyhalothrin is not applied where bee boxes are present to reduce risk to these important pollinators. Little risk to nontarget terrestrial organisms is expected when these and other BMPs are applied.

The effects of pyrethroids and pyrethroid-like insecticides are discussed above under Mosquito Adulticides (Section 5.2.7.2).

5.2.7.3.4 Potassium Salts

Potassium salts may be used to control a variety of insects and mosses, algae, lichens, liverworts and other vegetation, in or on many food and feed crops, ornamental flower beds, house plants, trees, shrubs, walks and driveways, and on dogs, puppies, and cats. Potassium salts of fatty acids include potassium laureate, potassium myristate, potassium oleate, and potassium ricinoleate. Once applied, however, these salts are degraded quickly in soil by microbes and do not persist in the environment (USEPA 1992). They are of low toxicity to birds and mammals, but highly toxic to fish and aquatic nontarget invertebrates. Potassium salts are applied infrequently and following label requirements.

5.2.7.4 Rodenticides the District Uses

The District developed a rodent management program to serve residents in the Service Area. The District's limited use of rodenticides is not performed as result of surveillance, but in response to District resident requests. Table 5-5 lists the pesticides the District uses for control of rats. The District conducts rodent baiting at underground sites such as sewers, storm drains, or catch basins. Secure bait stations or other accepted methods of rodent baiting are conducted in areas with severe rodent infestations. In sewer baiting, bait blocks containing bromadiolone (a second generation, single-feeding anticoagulant rodenticide) are often used. The block is suspended by wire above the water line to encourage rodent feeding. For rodent burrows, chlorophacinone (a first-generation, multiple-feeding anticoagulant dust) is blown into the burrows.

Table 5-5 Chemical Control Options for Rodent Abatement as Discussed in Appendix B

Chemical Classification	Active Ingredient	Appendix B
First-generation anticoagulant	Chlorophacinone	Section 4.5.1
First-generation anticoagulant	Diphacinone	Section 4.5.2
Second-generation anticoagulant	Brodifacoum	Section 4.5.3
Second-generation anticoagulant	Bromadiolone	Section 4.5.4
Other	Bromethalin	Section 4.5.5
Second-generation anticoagulant	Difethialone	Section 4.5.6
Sterol	Cholecalciferol	Section 4.5.7
Fumigant	Sulfur	Section 4.5.8
Fumigant	Sodium nitrate	Section 4.5.9

5.2.7.4.1 Anticoagulant Rodenticides

The anticoagulant rodenticides are typically grouped into "first-generation" (e.g., chlorophacinone, diphacinone) and "second-generation" (e.g., brodifacoum, bromadiolone, difethialone) compounds.

Second-generation anticoagulants tend to be more acutely toxic than are the first-generation anticoagulants, and they are retained much longer in body tissues of primary consumers. In contrast, the first-generation compounds are less acutely toxic and more rapidly metabolized and/or excreted (Housenger and Melendez 2012). Both classes have the same mode of action but second generation anticoagulants have a significantly longer liver half-life than first generation anticoagulants (Hartless and Jones 2011).

All anticoagulant rodenticides are highly acutely toxic to mammals and birds. Exposure may occur through direct ingestion of the active ingredient in bait or by secondary ingestion (i.e., consumption of poisoned prey by scavengers or predators). Residential treatments involve bait station deployment generally within 100 feet of homes. Bait stations are both tamper-proof and are anchored to treatment locations (e.g., wires, stakes) to ensure that they cannot be dragged away by wildlife. In addition, the wax blocks in bait stations have small openings that prevent the entrance and exposure to nonrodent mammals (e.g., squirrels, skunks, etc.) and do not leach rodenticide material into water. Residents are properly educated regarding the location of deployed tamper-proof bait stations and potential risks to children and pets. The anticoagulant rodenticides (bromadiolone and difethialone) that have been selected for further evaluation in Appendix B and listed in Table 5 are discussed individually below.

Bromadiolone

Bromadiolone is generally applied as food bait blocks or pellets. This second-generation rodenticide is highly toxic to mammals, including humans, domestic pets, and nontarget mammalian wildlife. Bromadiolone is often found in the tissues of wildlife, including avian and mammalian predators. Mortalities of raptors have been associated with secondary bromadiolone poisoning.

The District uses bromadiolone in and around man-made and natural standing and moving water. When deployed in sewers, bromadiolone blocks are sometimes attached to a string and hung below manhole covers. This method of bait deployment reduces the probability of exposure (by multiple routes) to humans and nontarget wildlife, especially dietary exposure (ingestion route) to ground-foraging birds and mammals. In addition, this rodenticide causes rapid mortality of targeted rats; therefore, poisoned individuals tend to expire in the sewers and not represent prey for secondary consumers in the terrestrial environment.

Outside of sewers, bromadiolone is typically contained in tamper-proof bait stations, which are most frequently deployed at residential locations per the request of homeowners, and not near aquatic systems, open lands, or woodlands. Residential treatments involve bait station deployment generally within 50 feet of homes. Bait stations are anchored to treatment locations (e.g., wires, stakes) to ensure that they cannot be dragged away by wildlife. In addition, bait stations have small openings that prevent the entrance and exposure to nonrodent mammals (e.g., squirrels, skunks, etc.). Residents are properly educated regarding the location of deployed tamper-proof bait stations and potential risks to children and pets.

Bromadiolone is a single-dose rodenticide that when used properly (such as in the absence of food competition) causes rapid knock-down of rat populations and has very limited potential for affecting aquatic systems and resulting in exposure to humans and nontarget wildlife. If the District expands use in the future or additional issues arise regarding the use of this rodenticide, new, more protective rodenticide bait station alternatives reported by the USEPA could be considered (http://www.epa.gov/pesticides/mice-and-rats/rodent-bait-station.html). Based on toxicity, environmental fate, and usage patterns, bromadiolone, using BMPs, is not likely to result in unwanted adverse effects to nontarget terrestrial organisms. The use of such alternatives to the bromadiolone would reduce the potential for exposure of nontarget ecological receptors, including birds and small mammals.

Difethialone

Difethialone is generally applied as food bait blocks or pellets. This second-generation rodenticide is highly toxic to mammals, including humans, domestic pets, and nontarget mammalian wildlife. Difethialone is often found in the tissues of wildlife, including avian and mammalian predators. Difethialone has been categorized as “likely to adversely affect” several species of sensitive California wildlife and registered uses of difethialone exceed the Level of Concern for both primary and secondary exposure. Indirect effects to habitat have been suggested for areas where difethialone is used for pest control (Housenger and Melendez 2012).

The District applies difethialone around creeks, parks, and landscaping. Application typically occurs in fall, winter, and spring. Difethialone is used in areas frequented by humans and domestic animals (parks, landscaped areas) during much of the year. The functionality and quality of habitat for both special-status and nontarget species would not be altered substantially. Difethialone poses a risk of harm to nontarget terrestrial organisms. However, the District minimizes this risk by placing difethialone baits in tamper-proof bait stations, which are also anchored at treatment locations (e.g., wires, stakes) to ensure that they cannot be dragged away by wildlife. Consequently, this use would not be likely to conflict with HCPs/NCCPs. The Districts provide public outreach regarding their practices, such as educating citizens about the locations of deployed bait stations and potential risks to pets and children. If the District expands use in the future or additional issues arise regarding the use of this rodenticide, new, more protective rodenticide bait station alternatives reported by the USEPA could be considered (http://www.epa.gov/pesticides/mice-and-rats/rodent-bait-station.html). The use of such alternatives to the

anticoagulants difethialone would reduce the potential for exposure of nontarget ecological receptors, including birds and small mammals.

5.2.7.4.2 Central Nervous System Toxin (Bromethalin)

Bromethalin is used to kill rodents that have become resistant to anticoagulants. Because its name resembles that of the anticoagulant baits bromadiolone and brodifacoum, bromethalin is often mistaken for anticoagulant bait (Dunayer 2003). The mode of action for bromethalin is the uncoupling of oxidative phosphorylation, which leads to decreased cellular ATP production and failure of Na+, K+-ATPase pumps (essentially breaking down the cellular integrity at the cell membrane). Bromethalin is highly toxic to mammals and birds. Some bromethalin products meet the USEPA's new, more protective risk reduction standards. When applied properly by the District, these products present a lower risk of accidental exposure to children, pets, and wildlife. They are applied in tamper-resistant and weather-resistant bait stations, which limit the exposure of nontarget animals (USEPA 2013a).

5.2.7.4.3 Sterol

Cholecalciferol is a sterol (Vitamin D3) and its ingestion results in hypercalcemia from mobilization of calcium from bone matrix into blood plasma leading to metastatic calcification of soft tissues (Clock-Rust and Sutton 2011). Often, use of this compound requires "pre-baiting" prior to addition of the chemical to rat bait to achieve adequate bait acceptance. Although it is highly toxic to target rodents, cholecalciferol is considered of low hazard to nontargets such as birds or domestic dogs. Cholecalciferol is used infrequently. Residential treatments involve bait station deployment generally within 50 feet of homes. Bait stations are anchored to treatment locations (e.g., wires, stakes) to ensure that they cannot be dragged away by wildlife, and this reduces the potential to harm terrestrial habitats or conflict with HCPs/NCCPs. In addition, bait stations have small openings that prevent the entrance and exposure to nonrodent mammals (e.g., squirrels, skunks, etc.). Residents are properly educated regarding the location of deployed tamper-proof bait stations and potential risks to children and pets.

5.2.7.4.4 Fumigants

Sulfur is one of the active ingredients in fumigant (gas-producing) cartridge products, which are used for rodent control on lawns, golf courses, and in gardens. Carbon, sodium and potassium nitrates, sawdust, and sulfur are used in the pyrotechnic fumigant gas-producing cartridge products. After the cartridges are ignited, they produce toxic gases that cause asphyxiation of the pests. These toxic gases, not the active ingredients, are the stressors produced by these products. The gases displace the oxygen in the burrows, creating an unbreathable atmosphere, causing asphyxiation of the target organisms (USEPA 2008a).

Elemental sulfur, when applied as a pesticide, will become incorporated into the natural sulfur cycle. The main processes and dissipation of elemental sulfur are oxidation into sulfate and reduction into sulfide. These processes are mainly mediated by microbes (USEPA 2008a). Sulfur is nontoxic to mammals, birds, and bees.

Sodium nitrate fumigants work by the combustion of charcoal in the formulation of each product. Pyrolysis of these sodium nitrate products results in simple organic and inorganic compounds, mostly in the form of gases such as nitrous oxide and carbon monoxide, which eventually diffuse through burrow openings or into the soil causing organisms to die of asphyxiation (USEPA 1991a). Sodium nitrates are naturally occurring substances and exposure of the environment is limited and localized when the products are used as fumigants in burrows (USEPA 1991b).

When used as indicated by the product label, any organism inside of a treated burrow would likely be killed by the toxic fumes of either of these fumigants. The nonselective nature of this pesticide is particularly problematic when protected species are present. Nontarget species such as burrowing owls, black-footed ferrets, kangaroo rats, or desert tortoises often inhabit pest burrows and may be at risk (Keefover-Ring 2009). Therefore, fumigants should not be applied when evidence exists of nontarget

animal presence. The Districts employ BMPs to determine the presence of sensitive or special-status species in areas to be treated and determine whether or not the use of fumigants is appropriate (Section 2.9.2). These practices reduce or eliminate the potential exposure of sensitive or special-status species.

5.2.8 Other Nonchemical Control/Trapping Component

The trapping of rodents and/or yellowjackets is conducted when these organisms pose a threat to public health and welfare. For both vector species, District staff place the tamper-resistant or baited trap(s) primarily at the request of the property owner or manager. The Districts do not remove rats or yellowjackets that are in or on structures. When these requests are made, residents are referred to the local animal control or to a directory of private pest control companies. Trapping is also used for the removal of nuisance wildlife such as raccoon, skunk, and opossum when these animals pose a threat to public health and safety. While it is conceivable that nontarget wildlife could be inadvertently trapped, the District conducts limited trapping and employs mechanisms and baits specific to target pests to reduce the potential effects to nontarget ecological receptors.

6 Ecological Health

This chapter evaluates the Program components in relation to ecological health. The assessment is primarily based on the evaluation in Appendix B, Human and Ecological Health Assessment Report. Results of the evaluation are provided at the programmatic level. Section 6.1, Environmental Background, presents an overview of hazards, toxicity, and exposure concepts, and contains federal, state, and local ordinances and regulations that are applicable to the Districts. The environmental evaluation is presented in Section 6.2.

Ecological health is the integral relationship between the health and well-being of humans and the natural environment. This chapter places a particular emphasis on potential ecological receptors, in the broad sense that may or may not be at risk from Program components. Chapters 4 and 5 provide evaluations of the potential effects to species and groups of species (nontarget organisms), as well as habitats associated with aquatic and terrestrial resources, respectively. Chapter 7 evaluates the potential human health effects related to the Program components.

6.1 Environmental Background

The Program Area is defined as Santa Clara County and adjacent counties that are affected by unwanted vectors that must be controlled to minimize adverse effects, disease, and environmental effects. The following section provides background information on the environmental fate and toxicity of pesticides and an overview of the regulatory setting with respect to chemical and biological pesticides.

6.1.1 Hazards, Toxicity, and Exposure

A “hazardous material” is defined in California Health and Safety Code Section 25501 (p): as “any material that, because of its quantity, concentration, or physical or chemical characteristics, poses a significant present or potential hazard to human health and safety or to the environment if released into the workplace or the environment. "Hazardous materials" include, but are not limited to, “hazardous substances, hazardous waste, and any material that a handler or the administering agency has a reasonable basis for believing that it would be injurious to the health and safety of persons or harmful to the environment if released into the workplace or the environment.” Any liquid, solid, gas, sludge, synthetic product, or commodity that exhibits characteristics of toxicity, ignitability, corrosiveness, or reactivity has the potential to be considered a “hazardous material.”

6.1.1.1 Toxicity and Exposure

Toxicology is the study of a compound’s potential to elicit an adverse effect in an organism. The toxicity of a compound is dependent upon exposure, including the specific amount of the compound that reaches an organism’s tissues (i.e., the dose), the duration of time over which a dose is received, the potency of the chemical for eliciting a toxic effect (i.e., the response), and the sensitivity of the organism receiving the dose of the chemical. Toxicity effects are measured in controlled laboratory tests on a dose/response scale, whereby the probability of a toxic response increases as dose increases. Exposure to a compound is necessary for potential toxic effects to occur. However, exposure does not, in itself, imply that toxicity will occur. Thus, toxic hazards can be mitigated by limiting potential exposure to ensure that doses are less than the amount that may result in adverse health effects.

The toxicity data included in the numerous tables and charts in this document are generally derived from rigidly controlled laboratory animal studies designed to determine the potential adverse effects of the chemical under several possible routes of exposure. In these studies, the species of interest is exposed to 100 percent chemical at several doses to determine useful information such as the lowest concentration resulting in a predetermined adverse effect (LOAEL) on numerous selected physiological and behavioral

systems. The second component of these tests is to determine the highest concentration of chemical that results in no measurable adverse effect (NOAEL).

However, these, and other, coordinated and focused laboratory tests are designed to document the effects of the chemical when a continuous, controlled, exposure exists and do not realistically reflect the likely exposures or toxicity in the District field application scenarios. As such, the toxicity information is intended as an overview of potential issues and guidance for understanding the completely “safe” maximum exposure levels of applications that would not adversely affect humans or nontarget plant and animal species.

Although the regulatory community uses this basic information to provide a relative comparison of the potential for a chemical to result in unwanted adverse effects and this information is reflected in the approved usage labels and MSDSs, in actual practice, the amounts actually applied in the District’s Program Area are substantially less than the amounts used in the laboratory toxicity studies. Because of the large safety factors used to develop recommended product label application rates, the amount of chemical resulting in demonstrated toxicity in the laboratory is much higher than the low exposure levels associated with an actual application. The application concentrations consistent with the labels or MSDSs are designed to be protective of the health of humans and other nontarget species (i.e., low enough to not kill them, weaken them, or cause them to fail to reproduce). However, adverse effects may still occur to some nontarget organisms.

6.1.1.2 Chemistry, Fate, and Transport

Various biological, chemical, and physical parameters affect the behavior of a compound in the environment and its potential toxicity. The chemistry, fate, and transport of a compound must be analyzed to fully estimate potential exposure. The fate and transport of a compound is determined by the physical and chemical properties of the compound itself and the environment in which it is released. Thus, the following characteristics of a compound must be evaluated: its half-life in various environmental media (e.g., sediment, water, air); photolytic half-life; lipid and water solubility; adsorption to sediments and plants; and volatilization. Environmental factors that affect fate and transport processes include temperature, rainfall, wind, sunlight, water turbidity, and water and soil pH. Information pertaining to these parameters allows evaluation of how compounds may be transported between environmental media (e.g., from sediments to biota), how a compound may be degraded into various breakdown products, and how long a compound or its breakdown products may persist in different environmental media. Appendix B provides a discussion of the environmental fate of the pesticide active ingredients and other chemicals associated with specific pesticide formulations used in the Program components.

6.1.2 Pesticides and the Environment

The pesticide formulations included in the Program are listed in Table 6-1, including the product formulation, active ingredient, and target vector. Appendix B provides the results of review and evaluations of the 33 pesticide (insecticides,) active ingredients the Districts currently use or propose to use.

Table 6-1 Pesticide Products Containing Reported Active Ingredients

Product	Active Ingredient	Vector
Altosid Briquets 30-day	Methoprene	Mosquito
Altosid Liquid Larvicide	Methoprene	Mosquito
Altosid Liquid Larvicide Concentrate	Methoprene	Mosquito
Altosid Pellets	Methoprene	Mosquito

Table 6-1 Pesticide Products Containing Reported Active Ingredients

Product	Active Ingredient	Vector
Altosid Pellets WSP	Methoprene	Mosquito
Altosid XR-Briquets	Methoprene	Mosquito
Altosid XR-G	Methoprene	Mosquito
BVA-2	Petroleum Distillate	Mosquito
Contrac 8 oz. blk	Bromadiolone	Rat
Drione	Pyrethrin and PBO and Amorphous Silica Gel	Yellowjacket wasp
EcoExempt IC2	Rosemary Oil	Mosquito
FirstStrike Soft Bait	Difethialone	Rat
FourStar 180 Bs/Bti	Bs and Bti	Mosquito
FourStar 45 Bti	Bs and Bti	Mosquito
FourStar 90 briq	Bs and Bti	Mosquito
Golden Bear 1111	Aliphatic Petroleum Hydrocarbons	Mosquito
Pyrenone 25-5	Pyrethrins and PBO	Mosquito
Scourge 18% + 54%*	Resmethrin and PBO	Mosquito
Scourge 4% +12%*	Resmethrin and PBO	Mosquito
VectoBac 12AS	Bti	Mosquito
VectoBac G	Bti	Mosquito
VectoLex CG	Bs	Mosquito
VectoLex WSP	Bs	Mosquito
VectoMax CG	Bs and Bti	Mosquito

Scourge pesticides to be replaced with Pyrenone 25-5 Public Health Insecticide, EPA Number 432-1050, in 2012.

6.1.3 Regulatory Setting

Formulations proposed for each Program component for vector control are and would be used according to federal and state regulatory requirements for the registration, transportation, and use of pesticides. The regulatory framework pertaining to the use of pesticides is discussed below.

6.1.3.1 Federal

The USEPA regulates pesticides under two major statutes: the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and the Federal Food, Drug, and Cosmetic Act (FFDCA). Under these acts, the USEPA mandates extensive scientific research to assess risks to humans, domestic animals, wildlife, plants, groundwater, and beneficial insects before granting registration for a pesticide. These studies allow the USEPA to assess the potential for human and ecological health effects. When new data raise concern about the safety of a registered pesticide, the USEPA may take action to suspend or cancel its registration. The USEPA may also perform an extensive special review of a pesticide's risks and benefits and/or work with manufacturers and users to implement changes in a pesticide's approved use (e.g., reducing application rates).

6.1.3.1.1 Federal Insecticide, Fungicide, and Rodenticide Act

FIFRA defines a pesticide as “any substance intended for preventing, destroying, repelling, or mitigating any pest.” FIFRA requires USEPA registration of pesticides prior to their distribution for use in the US, sets registration criteria (testing guidelines), and mandates that pesticides perform their intended functions without causing unreasonable adverse effects on people and the environment when used according to USEPA-approved label directions. FIFRA defines an "unreasonable adverse effect on the environment" as "(1) any unreasonable risk to man or the environment, taking into account the economic, social, and environmental costs and benefits of the use of the pesticide, or (2) a human dietary risk from residues that result from a use of a pesticide in or on any food inconsistent with the standard under Section 408 of the Federal Food, Drug, and Cosmetic Act (21 USC 346a)."

FIFRA regulates only the active ingredients of pesticides, not inert ingredients, which manufacturers are not required to reveal. However, toxicity studies conducted under FIFRA are required to evaluate the active ingredient and the entire product formulation, through which any potential additive or synergistic effects of inert ingredients are established.

6.1.3.1.2 Clean Water Act and National Pollutant Discharge Elimination System

The Clean Water Act (CWA) establishes the principal federal statutes for water quality protection “to restore and maintain the chemical, physical, and biological integrity of the nation’s water, to achieve a level of water quality which provides for recreation in and on the water, and for the propagation of fish and wildlife:”

> Section 303(d) requires each state to provide a list of impaired waters that do not meet or are expected not to meet state water quality standards as defined by that section. The CWA regulates potentially toxic discharges through the NPDES and ambient water quality through numeric and narrative water quality standards. The release of aquatic pesticides into waters of any state may require an NPDES permit, depending on the pesticide considered, and the conditions proposed for application.

> Section 402 requires permits for pollution discharges (except dredge or fill material) into US waters, such that the permitted discharge does not cause a violation of federal and state water quality standards. Biological and residual pesticides discharged into surface waters constitute pollutants and require coverage under an NPDES permit. In California, NPDES permits are issued by the SWRCB or the RWQCBs.

6.1.3.1.3 California Toxics Rule

In 2000, the USEPA developed water quality criteria for priority toxic pollutants to protect human health and the environment. A gap in California’s water quality standards was created when the state’s water quality criteria for priority toxic pollutants were overturned in 1994 (thus causing California to be out of compliance with the CWA). These established criteria are to be applied to inland surface waters, enclosed bays, and estuaries in California. The rule includes aquatic life criteria for 23 priority toxic pollutants, human health criteria for 57 priority toxics, and a compliance schedule.

6.1.3.2 State of California

California’s programs for the registration of pesticides and commercial chemicals parallel federal programs, but many of California’s requirements are stricter than federal requirements. The registration of pesticides and commercial chemicals in California is regulated by the California Environmental Protection Agency (Cal/EPA). Within the Cal/EPA, the CDPR) oversees pesticide evaluation and registration through use enforcement, environmental monitoring, residue testing, and reevaluation. The CDPR works with County Agricultural Commissioners, who evaluate, develop conditions of use, approve, or deny permits for restricted-use pesticides; certify private applicators; conduct compliance inspections; and take formal

compliance or enforcement actions. The Secretary of Resources has certified California's pesticide regulatory program as meeting CEQA requirements (CDPR 2006).

California also requires commercial growers and pesticide applicators to report commercial pesticide applications to local County Agricultural Commissioners. The CDPR compiles this information in annual pesticide use reports. The CDPR's Environmental Hazards Assessment Program collects and analyzes environmental pesticide residue data, characterizes drift and other off-site pesticide movement, and evaluates the effect of application methods on movement of pesticides in air. If a pesticide is determined to be a toxic air contaminant, appropriate control measures are developed with the California Air Resources Board to reduce emissions to levels that adequately protect public health. Control measures may include product label amendments, applicator training, restrictions on use patterns or locations, and product cancellations.

6.1.3.2.1 Porter-Cologne Act and State NPDES Permitting

Under the Porter-Cologne Act (California Water Code Section 13000) the SWRCB, and the state's nine RWQCBs that it oversees, are responsible for administering federal and state water quality regulation and permitting duties.

The SWRCB oversees pesticide NPDES permitting in California. Users of specific larvicide and adulticide registered products are required to obtain coverage under the Statewide NPDES Permit for Biological and Residual Pesticide Discharges to Waters of the US from Vector Control Applications (SWRCB Water Quality Order No. 2012-0003-DWQ; NPDES No. CAG 990004; Vector Control Permit). Pesticides that require state NPDES permitting include Bti, Bs, temephos, spinosad, petroleum distillates, naled, pyrethrin, permethrin, resmethrin, prallethrin, PBO, and etofenprox. Both permits are discussed in detail in Chapter 9, Section 9.1.2.2.9.

6.1.3.2.2 The Safe Drinking Water and Toxic Enforcement Act (Proposition 65)

This act, passed as a ballot initiative in 1986, requires the state to annually publish a list of chemicals known to the state to cause cancer or reproductive toxicity so that the public and workers are informed about exposures to potentially harmful compounds. Cal/EPA's Office of Environmental Health Hazard Assessment administers the act and evaluates additions of new substances to the list. Proposition 65 requires companies to notify the public about chemicals in the products they sell or release into the environment, such as through warning labels on products or signs in affected areas, and prohibits them from knowingly releasing significant amounts of listed chemicals into drinking water sources.

6.1.3.2.3 California Pesticide Regulatory Program

CDPR regulates the sale and use of pesticides in California. CDPR is responsible for reviewing the toxic effects of pesticide formulations and determining whether a pesticide is suitable for use in California through a registration process. Although CDPR cannot require manufacturers to make changes in labels, it can refuse to register products in California unless manufacturers address unmitigated hazards by amending the pesticide label. Consequently, many pesticide labels that are already approved by the United States Environmental Protection Agency (USEPA) also contain California-specific requirements. Pesticide labels defining the registered applications and uses of a chemical are mandated by USEPA as a condition of registration. The label includes instructions telling users how to make sure the product is applied only to intended target pests, and includes precautions the applicator should take to protect human health and the environment. For example, product labels may contain such measures as restrictions in certain land uses and weather (i.e., wind speed) parameters.

6.2 Environmental Evaluation

This section evaluates the Program components in terms of ecological health, with the primary emphasis on the use of active ingredients in pesticides under the Vegetation Management, Biological, and Chemical Control components.

6.2.1 Evaluation Concerns

The public has expressed concerns related to ecological health, which were identified during the scoping process. These concerns are addressed briefly below and in this chapter.

a. Require additional information regarding bait blocks, chemical agents, and poisons in sanitary sewers concerning components and effects.

> The BMPs the District employs ensure that pesticides are used strictly according to the labeling requirements the USEPA established, which are designed to prevent the occurrence of unreasonable adverse effects. The District uses tamper-resistant bait blocks to avoid nontarget species exposure, and they are not used in areas where blocks would come in contact with water. According to recent research, rodenticide blocks have exceptionally low water solubility and low leaching potential. The use, toxicity, and fate and transport characteristics of specific pesticides (including those used in bait blocks) are described in detail in Appendix B. See further discussion in Section 6.2.7, Chemical Control component.

b. Describe the effects of all chemicals that are used and/or proposed for use on wildlife and natural ecosystems, including insect prey, birds, mammals, fish, vegetation and site topography. The loss of prey for birds is a particular concern.

> The toxicity of the 33 active ingredients is evaluated in Appendix B, and select pesticides are discussed in Section 6.2.7. Section 6.2.7 provides an evaluation of the major classes of active ingredients and potential harm to nontarget ecological receptors.

c. Discuss the potential impact of *Bacillus sphaericus* on native species. What would justify its use? What native species would be impacted?

> Bs is a naturally occurring soil bacterium. Data indicate a high degree of specificity with Bs (and Bti) for mosquitoes and demonstrate no toxicity to chironomid larvae at any mosquito control application rate. Bs is capable of cycling in the aquatic environment providing weeks of effective mosquito control after a single dose. It is very effective in water with high organic content. The use, fate and transport, and potential toxicity of Bs is discussed in Section 6.2.7 and described in detail in Appendix B.

d. Discuss effects to bees from chemicals in treatment applications.

> Potential effects on nontarget receptors, including bees, are discussed in Section 6.2.7 and Appendix B.

e. Concern over the “inactive” portion of the pesticides. What effects will the carrier portion of the chemicals have on the environment?

> FIFRA only regulates active ingredients; however, the toxicity studies performed under FIFRA also evaluate the entire product formulation. Cal-EPA and CDPR have approved the inactive ingredients in the Mosquito Vector Control Association of California’s (MVCAC’s) formulations in the NPDES permit. Thus, the potential additive or synergistic effect of inert ingredients is addressed through required laboratory testing protocols, which is beyond the scope of this document.

f. Discuss the effects of pesticides on the natural predators of mosquitoes.

> As part of its IVMP, the District uses pesticides with high mosquito specificity and low toxicity to nontarget species when possible. The District also strictly adheres to labeling requirements to avoid nontarget species exposure.

g. The continued spray program leads to survival of mosquitoes resistant to pesticides – "the pest mill."

> The IPM approach the District uses to control mosquitoes is designed to minimize the potential for resistance to pesticides in the Program Area. Using this approach, the District implements the following practices: vegetative and biological control of mosquito populations, use of pesticides only when necessary, specific and localized spraying, ULV applications, use of pesticides with low persistence, and rotation of pesticides.

h. Describe the role of mosquitoes within the food chain, and subsequent impacts if they were removed in terms of amphibians, birds, reptiles, fish, and insects.

> Although larval and adult mosquitoes serve a positive role as prey items for some invertebrates, fish, avian insectivores, bats, small reptiles and amphibians, the loss of a focus area (infested or large population of mosquitoes) will not affect the predator populations overall. Many species of mosquitoes are short lived or seasonal so they generally serve as only one prey source for predators. The decline in one prey species generally means that a predator will shift its food preference. No predators are known that rely exclusively on mosquitoes (larval or adult) for prey.
> They are likely not important as pollinators although they do feed on floral nectaries.

i. Upon application and broadcast of pesticides, what is the fate and transport of these chemicals? Look at droplet size, dispersal patterns given wind, conversion products (both in storage and environment), and impacts of conversion products. Discuss the persistence of proposed treatment substances in the environment as well as the potential for bioaccumulation.

> The use, fate, and transport of each pesticide included in the Program are described in detail in Appendix B.

j. Include a detailed description and complete assessment of the chemical control impacts (current and future, direct and indirect) on habitats (including endangered, threatened, and locally unique species and sensitive habitats) and on species (sensitive fish, wildlife, or plants).

> Chemical is discussed in Section 6.2.7 and Appendix B. Sensitive aquatic and terrestrial species are discussed in Chapters 4 and 5, respectively.

k. Include a detailed description and complete assessment of biological control (current and future, direct and indirect) on habitats (including endangered, threatened, and locally unique species and sensitive habitats) and on species (sensitive fish, wildlife, or plants).

> Biological control is discussed in Section 6.2.6 (mosquitofish), and biologically-based pathogens (the mosquito larvicides Bs, Bti, and spinosad) are discussed in Section 6.2.7.1 and Appendix B. Sensitive aquatic and terrestrial species are discussed in Chapters 4 and 5, respectively.

6.2.2 Evaluation Methods and Assumptions

Pesticides the District uses were investigated to provide a preliminary assessment of the potential impacts to nontarget ecological receptors. An ecological health assessment was the principal method used to evaluate concerns associated with the Program components (discussed in detail in Appendix B). A comprehensive literature review of published toxicity and fate and transport information was conducted. In addition, the District supplied information specific to pesticide product use in the Program Area to support the potential exposure and toxicity assessment, including:

> Pesticides the District uses

> Pesticide label recommendations

> Types of application sites (e.g., habitat types)

> Application procedures

> Number of treatments per application site

> Total amount used per treatment for each application site, based on seasonal uses

> Physicochemical properties of the pesticides/active ingredients

> Pesticide target vector efficacy

> Reported adverse effects (e.g., reproductive, developmental, carcinogenic).

The pesticide application scenarios that result in reasonable efficacy with minimal unwanted estimated risk are preferred and are the basis of IPM/IVM approaches and BMPs the District employs. BMPs are described in Chapter 2. Each of the pesticides identified as warranting further evaluation in Appendix B is known to exhibit at least one parameter that appears to drive potential or perceived risk.

This evaluation assumes that all pesticides are applied in accordance with product label instructions and USEPA and CDPR requirements. The USEPA requires mandatory statements to be included on pesticide product labels that include directions for use; precautions for avoiding certain dangerous actions; and where, when, and how the pesticide should be applied. This guidance is designed to ensure proper use of the pesticide and prevent unreasonable adverse effects to humans and the environment. All pesticide labels are required to include the name and percentage by weight of each active ingredient in the product/formulation. Toxicity categories for product hazards and appropriate first aid measures must be properly and prominently displayed. Pesticide labels also outline proper use, storage, and disposal procedures, as well as precautions to protect applicators. The directions for use indicate the target organism (pest), appropriate application sites, application rates or dosages, contact times, and required application equipment for the pesticide. Warnings regarding appropriate wind speeds, droplet sizes, or habitats to avoid during application are also prominently displayed.

This evaluation does not include assumptions about which alternative treatment strategy or strategies would be applied in any given area. Criteria used to trigger a particular alternative based on vector abundance and other variables are included in the District's operating procedures. This evaluation assumes that important parameters, such as soil or sediment half-life, are dependent on the specific conditions at the time of pesticide application, and values listed herein serve as references values.

An ecological food web is represented in the illustration representing some of the multitude of possible biotic and food uptake interactions in an ecosystem. In an ecological system, each level in the food web is occupied by dozens or hundreds of species, with consumers using those resources (in this case species from a lower trophic level) in different ways depending on availability and competition for those resources. Their utilization of these resources shifts by time of day and season, and multiple resources being used simultaneously or alternatively. If the availability of one resource decreases, the consumer can generally replace that with another resource. Each of the possible connections between species is also associated with other interactions, such as competitive release, where the abundance of a species increases in response to the decline in a competitor's abundance, or competitive interactions between consumers where one consumer can use a particular resource better than its competitor.

Although ecological food webs could be used to describe the complex system interactions that might be associated with District application scenarios, it is neither feasible nor practical to evaluate those effects using a food-web approach. The numerous interactions in typical food webs are highly complex and would be subject to substantial uncertainty. This would make it exceedingly difficult to confidently assess relevant effects. Because of these constraints and complexity, it would be neither practical nor productive to attempt to predict food-web interactions for each of the numerous application scenarios the District

uses. It is appropriate, however, to utilize a food-web analysis to identify and consider the first level of potentially adverse effects to nontarget species that might result from a pesticide application. This information is used to minimize effects to nontarget species and is typically a part of the MSDS and Toxicology profiles, providing the basis for the more reasonable, technically feasible approach to evaluate the safety of the pesticides the District commonly uses.

6.2.3 Surveillance Component

Vector surveillance is critical to IPM strategies because it provides information that is used to determine when and where to institute other vector control measures. The District's mosquito surveillance activities are conducted in compliance with accepted federal and state guidelines (e.g., *California Mosquito-Borne Virus Surveillance and Response Plan* (CDPH 2010a) and *Best Management Practices for Mosquito Control in California* (CDPH 2010b). These guidelines allow for some reasonable flexibility in selection and specific application of control methods because local areas vary.

The Surveillance component as the District practices would be a continuation of existing activities using applicable techniques, equipment, vehicles, and watercraft. Surveillance activities involve monitoring the abundance of adult and larval mosquitoes, field inspection of mosquito habitat, testing for the presence of SLE, WEE, and WNV antibodies in sentinel chickens or wild birds, collection and testing of ticks, small rodent trapping, and/or response to public service requests regarding nuisance animals or insects (e.g., yellowjacket wasps).

Small effects to terrestrial and aquatic habitats could occur when the District is required to maintain paths and clearings to access surveillance sites and facilitate sampling.

Trapping activities conducted to assess the presence and abundance of rodent populations could lead to capture and mortality of nontarget organisms. The District uses preexisting roads, trails, and walkways for surveillance activities. Therefore, habitat disturbance is minimal to negligible, reducing the potential indirect effects to nontarget species and their habitat. Trapping to assess rodent presence and abundance is infrequently conducted to reduce the chance of nontarget species capture. Nondestructive rodent sampling techniques allow for their release back into the habitat.

6.2.4 Physical Control Component

The Physical Control component as the District practices would be a continuation of existing activities using applicable techniques, equipment, vehicles, and watercraft.

Physical control for mosquitoes consists of the management of mosquito-producing habitat (including freshwater marshes and lakes, saltwater marshes, temporary standing water, and wastewater treatment facilities) especially through water control and maintenance or improvement of channels, tide gates, levees, and other water control facilities. Physical control is usually the most effective mosquito control technique because it provides a long-term solution by reducing or eliminating mosquito developmental sites and ultimately reduces the need for chemical applications. Physical control practices may be categorized into three groups: maintenance, new construction, and cultural practices. The District performs these physical control activities in accordance with all appropriate environmental regulations (wetland fill and dredge permits, endangered species review, water quality review, streambed alteration permits), and in a manner that generally maintains or improves habitat values for desirable species. Physical control for other vectors such as rodents is based on District site inspections to determine conditions promoting infestation, and property owners are provided educational materials on control measures that include information about the removal of food sources and harborage sites and professionals to contact to remove the infestation.

The Physical Control component would not likely result in measurable adverse effects to ecological receptors, including terrestrial and aquatic species. This component employs physical modifications to the natural and engineered environment providing a long-term solution to mosquito control while reducing the

dependence on chemical controls. In addition, these practices are conducted to improve habitat for desirable species, such as native and special-status plants and animals (Appendix A). Chapter 4 discusses in greater detail the potential effects of the Physical Control component on aquatic resources, including sensitive and special-status species. Chapter 5 discusses effects to terrestrial resources.

The District employs a number of BMPs when implementing actions under the Physical Control component. The District performs these activities in accordance with all appropriate environmental regulations and in a manner that generally maintains or improves habitat values for desirable species. Most of these activities occur in aquatic rather than terrestrial habitats, although by draining areas of standing water, new terrestrial habitat is created. Qualified personnel (e.g., District Biologists, Technicians) are regularly appraised regarding presence or absence of special-status and sensitive species in aquatic, terrestrial, and temporary habitats (e.g., vernal pools) within their work zones. Vernal pools provide breeding habitat for mosquitoes but also provide habitat for many special-status or sensitive species in California. Therefore, destruction or impairment of vernal pool habitat should be avoided under the Physical Control component. The presence of special-status or sensitive species at aquatic or terrestrial sites or the presence of suitable habitat for sensitive or special-status species would result in cancellation of scheduled physical control activities.

6.2.5 Vegetation Management Component

The Vegetation Management component as the District practices would be a continuation of existing activities using applicable techniques, equipment, vehicles, and watercraft.

The District uses hand tools (e.g., shovels, pruners, chain saws, and weed-whackers) and heavy equipment where necessary for vegetation removal or thinning to improve surveillance or reduce vector habitats. Vegetation removal or thinning primarily occurs in aquatic habitats to assist with the control of mosquitoes and in terrestrial habitats to help with the control of other vectors. To reduce the potential for mosquito breeding associated with water retention and infiltration structures, District staff may systematically clear weeds and other obstructing vegetation in wetlands and retention basins (or request the structures' owners to perform this task). Surveys for special-status plants, coordination with the landowner, and acquisition of necessary permits are completed before any work is undertaken. In some sensitive habitats and/or where sensitive species concerns exist, vegetation removal and maintenance actions would be restricted to those months or times of the year that minimize disturbance. Vegetation management is also performed to assist other agencies and landowners with the management of invasive/nonnative weeds. These actions are typically performed under the direction of the concerned agency, which also maintains any required permits.

Vegetation management in the form of removal could include the use of weed-whackers, chain saws, and shovels. These activities could lead to physical damage to sensitive species of terrestrial plants and animals. The District applies BMPs to reduce these effects, including the identification of sensitive species in treatment areas prior to commencing any vegetation removal actions. The Vegetation Management component is not expected to result in adverse ecological effects. These activities are generally coordinated with and monitored by public agencies and conducted during times to alleviate potential effects to nontarget organisms.

6.2.6 Biological Control Component

Biological control of mosquitoes and other vectors involves the intentional use of vector pathogens (diseases), parasites, and/or predators to reduce the population size of target vectors. Biological control is employed as a method to protect the public from mosquitoes and associated diseases using mosquito parasites, pathogens, and predators. Mosquito parasites are not currently available in the commercial market. Bacterial type pesticides used on mosquito larvae are considered a form of biological control. While these products are considered as a biological control treatment;, they are registered and regulated

as pesticides by USEPA and are, therefore, covered more thoroughly in Section 6.2.7, Chemical Control component. A discussion of mosquitofish as a biological control is discussed in Chapter 4 (Biological Resources – Aquatic).

6.2.6.1 Mosquito Larvae Pathogens

Mosquito pathogens are highly host-specific bacteria or viruses that are ingested during filter-feeding behavior of mosquito larvae in aquatic environments. These pathogens may multiply rapidly in the host, destroying internal organs and consuming nutrients. The pathogen can be spread to other mosquito larvae in some cases when larval tissue disintegrates and the pathogens are released into the water and subsequently ingested by other mosquito larvae. The District uses two types of pathogenic bacteria, Bs, and strains of Bti), and potentially, *Saacharopolyspora spinosa* in the future (Table 6-2). Bs and Bti produce proteins that are toxic to most mosquito larvae, while the fermentation of *S. spinosa* produces spinosysns, which are highly effective mosquito neurotoxicants. Bs can reproduce in natural settings for some time following release. Bti materials do not contain live organisms, but only spores made up of specific protein molecules.

All three bacteria are naturally occurring soil organisms, which are commercially produced as mosquito larvicides. Because these forms of biological control are applied in a similar manner to chemical pesticides, they are evaluated under Section 6.2.7, Chemical Control component. The environmental fate and toxicity of these control agents are described in detail in Appendix B.

Table 6-2 Biological Control Agents Employed for Mosquito Larvae Abatement

Active Ingredient	Appendix B
Bs	Section 4.3.1
Bti	Section 4.3.2
spinosad	Section 4.3.3

6.2.6.2 Mosquito Predators

Mosquitofish (*Gambusia affinis*) are currently the only commercially available mosquito predators. The District's rearing and stocking of these fish in mosquito habitats is the most commonly used biological control agent for mosquitoes in the world. Used correctly, this fish can provide safe, effective, and persistent suppression in various mosquito sources. However, due to concerns that mosquitofish may potentially affect red-legged frog and tiger salamander populations, the District limits the use of mosquitofish to ornamental fish ponds, water troughs, water gardens, fountains, and unused swimming pools. This BMP is sufficient to avoid harm to sensitive species in natural habitats.

6.2.7 Chemical Control Component

Chemical control is a Program tool that consists of the application of nonpersistent selective insecticides to directly reduce populations of larval or adult mosquitoes and other invertebrates (e.g., yellowjacket wasps), and rodenticides to control rats and mice. If and when inspections reveal that mosquitoes or other vector populations are present at levels that trigger the District's criteria for chemical control – based on the vector's abundance, density, species composition, proximity to human settlements, water temperature, presence of predators and other factors – staff will apply pesticides to the site in strict accordance with the pesticide label instructions. The threshold criteria for these response triggers are based on prescheduled application periods relating to the documented and previously monitored likely vector outbreaks or expansions or unwanted population expansions. Additional response triggers are based on verified outbreaks, nuisance issues, and public concern about select vectors.

The chemicals the District uses for vector control are presented in Tables 6-1 and 6-2. These pesticides are approved for commercial use by the USEPA and CDPR and, when applied with strict adherence to product label requirements, should not result in adverse effects to nontarget organisms. Detailed discussions of the environmental fate and toxicity of these active ingredients are provided in Appendix B. A subset of these chemicals was selected for further examination based upon issues regarding use patterns, environmental fate, or toxicity characteristics (Table 6-3). These chemicals are highlighted in the following section specifically in reference to potential ecological health implications associated with their use for vector control.

Table 6-3 Chemicals Identified for Further Evaluation in Appendix B

Active Ingredient	Vector	Potential Issue
Methoprene	Mosquitoes	Prevalent use; toxicity to aquatics and insects
Etofenprox	Mosquitoes	Toxicity to aquatic organisms; no synergist required
Bti	Mosquitoes	Prevalent use; public concerns
Pyrethrins	Mosquitoes	Prevalent use; requires synergist (PBO)
Resmethrin	Mosquitoes	Requires synergist (e.g., PBO); potential endocrine disruptor
Vegetable Oil (coconut oil)/mix	Mosquitoes	Contains low percentage of petroleum distillate
Permethrin	Mosquitoes/yellowjacket wasps	Toxicity to aquatic organisms; potential endocrine disruptor
Lambda-cyhalothrin	Yellowjacket wasp	Toxicity to aquatic organisms; potential to bioaccumulate
Bromadiolone	Rats	Toxicity to nontarget organisms including mammals, birds, aquatics
Difethialone	Rats	Toxicity to nontarget organisms including mammals, birds, aquatics

6.2.7.1 Mosquito Larvicides

Larvicides are used to manage immature life stages of mosquitoes including larvae and pupae in aquatic habitats. Temporary aquatic habitats are usually targeted because permanent water bodies generally support natural mosquito predators such as fish. The larvicides are applied using ground application equipment, fixed wing aircraft, and rotary aircraft. The mosquito larvicides the District uses include bacterial larvicides, hydrocarbon esters, and surfactants (Table 6-4).

The toxicity of Bs, Bti, spinosad, methoprene, and monomolecular films are discussed in detail in Appendix B. The District employs practices that alleviate the potential for exposure and adverse effects to nontarget organisms (see Appendix A for an inventory of special-status organisms inhabiting the Program Area).

Table 6-4 Chemicals Employed for Larval Mosquito Abatement

Chemical Classification	Active Ingredient	Appendix B
Organophosphate	Temephos	Section 4.2.2
Bacterial larvicide	Bs	Section 4.3.1
Bacterial larvicide	Bti	Section 4.3.2
Bacterial larvicide	Spinosad	Section 4.3.3
Hydrocarbon ester	Methoprene	Section 4.3.4
Surfactant	Alcohol Ethoxylated Surfactant (monomolecular film, BVA-2, CoCoBear)	Section 4.3.5

6.2.7.1.1 Organophosphates

OP insecticides irreversibly block acetylcholinestarase activity, which causes accumulation of the neurotransmitter acetylcholine in the central nervous system, leading to excessive neuronal stimulation and then depression. OPs are quickly degraded and exhibit very low environmental persistence. The District may use OPs in rotation with other active ingredients to avoid the development of resistance.

Temephos

Temephos is a cholinesterase inhibitor registered by the USEPA in 1965 to control mosquito larvae (USEPA 2000). Temephos is the only OP employed as a mosquito larvicide. It is used in various water bodies including lakes, marshes, drainage systems, irrigation systems, and polluted and stagnant water (CDPR 2010a). Temephos is a broad-spectrum insecticide and has also been used operationally to control midges and black flies for many years. However, the concentration that effectively controls mosquito larvae is well below that needed for control of other insects.

Temephos has extremely low water solubility and binds strongly to soils. It has low toxicity for vertebrates at the levels used for mosquito control (USEPA 2000). It is moderately acutely toxic to mammals and fish, but highly toxic to nontarget aquatic invertebrates (e.g., stoneflies, mayflies). Field applications result in concentrations of temephos far lower than those at which fish are affected. Field studies have repeatedly demonstrated a lack of effects on fish inhabiting treated sites. In addition, many groups of aquatic invertebrates are only harmed at concentrations far above those used for mosquito control applications (USEPA 2000).

Temephos is an effective method of control in isolated sources that may be difficult to treat by other means, such as sources with high concentrations of organic material, and ones in which other less toxic alternatives have failed to produce adequate levels of control. Temephos was used prevalently in California for mosquito abatement from 1965 into the mid-1980s; however, microbial pesticides (e.g., Bs, Bti, and spinosad), methoprene, and surface oils are used much more frequently now. Temephos can help prevent the development of resistance to bacterial larvicides and insect growth regulators in suitable habitat.

When applied using strict adherence to product label requirements and District BMPs, temephos applied at low concentrations for mosquito control (well below that required for other insects) should not cause adverse ecological effects.

6.2.7.1.2 Bacterial Larvicides (Bs, Bti, and spinosad)

Bacterial larvicides such as Bs and Bti are highly selective microbial pesticides (for mosquitoes) that, when ingested, produce gut toxins that cause destruction of the insect gut wall leading to paralysis and

death. These microbial agents are delivered as endospores in granular, powder, or liquid concentrate formulations. The District applies Bs and Bti directly to mosquito habitats (marshes, wetlands, ditches, channels, standing water, ponds, waterways, sewers, and storm drains; see Appendix B, Attachment 1) rather than to terrestrial environments. Additionally, Bs and Bti are practically nontoxic to terrestrial organisms, including birds, bees, and mammals. Applications follow strict guidelines in District BMPs and product label requirements. Microbial larvicides are one of the safest forms of natural pesticides available for commercial use. Bti is a naturally occurring toxicant of mosquito larvae and, therefore, does not pose risk to nontarget ecological receptors.

Spinosad is a natural insecticide derived from the fermentation of a common soil microorganism, *Saacharopolyspora spinosa*. Spinosad alters nicotine acetylcholine receptors, impeding the nervous system and ultimately leading to paralysis and death. It is of low acute toxicity to birds, but is very highly toxic to moths and butterflies. The District strictly adheres to product label requirements and BMPs for the protection of ecological health.

6.2.7.1.3 Hydrocarbon Esters (Methoprene)

The District widely uses methoprene, an insect growth regulator and selective larvicide. It exhibits toxicity to aquatic invertebrates and some nontarget insects such as moths, butterflies, and beetles. Methoprene is also moderately toxic to fish. The concentrations of methoprene applied for mosquito larvae control are unlikely to affect nontarget aquatic species, except for some fly species closely related to mosquitoes.

Although methoprene exhibits some toxicity to aquatic organisms and insects, it is effective at much lower concentrations than alternative larvicide products. Lower concentrations can translate to reduced acute exposures to nontarget organisms, as well as potential effects to a limited number of midges and chironomids. Extended release forms including granular and briquette varieties are also available (e.g., 90-day briquettes), which are longer-lasting and require fewer applications. This product may be more residual in the environment; however, the methoprene active ingredient in this formulation has a short half-life in water and does not migrate through soil, significantly reducing the potential for groundwater effects.

Considered one of the safest of larvicides available, the District uses methoprene prevalently during each season of the year. Liquid and granular forms are most prevalently used in residential and ornamental pond application scenarios. Treatments to wetlands including marshes require the granular form (e.g., Altosid XRG with Bti) to penetrate dense aquatic vegetation including cattails and tules. Methoprene is also sometimes co-applied with Bti to prevent resistance and ensure all larval stages are controlled.

The larger droplet sizes of aerial (e.g., helicopter) larvicide applications (e.g., methoprene) reduces drift (compared to that of ULV sprays). In addition, aerial treatments are restricted to times when no wind occurs. Methoprene is generally applied in extremely small amounts during treatments due to its efficacy against mosquitoes even at low concentrations. For example, the District applies it at a maximum concentration of 0.5 µg/L. At this application rate, little to no toxicity occurs to nontarget aquatic organisms with the exception of some midges (*Chironomidae*) and blackflies (*Simuliidaes*) (Chapter 4; Appendix B). Methoprene can be toxic to fish; however, the lowest LC_{50} (4.62 mg/L for bluegill) is several orders of magnitude greater than the concentration used to control mosquitoes (Maffei, pers. comm., 2013). When handled and applied using District BMPs, methoprene is one of the safest larvicides available.

6.2.7.1.4 Alcohol Ethoxylated Surfactant (monomolecular film)

Monomolecular films are alcohol-ethoxylated surfactants, which are low-toxicity pesticides that spread a thin film on the surface of water that makes it difficult for mosquito larvae, pupae, and emerging adults to attach to the water's surface, causing them to drown (USEPA 2007a). The films also disrupt larval respiration of some other classes of air-breathing aquatic insects. They are used on an assortment of water bodies including ornamental ponds, pastures, irrigation systems, drainage systems, and drinking water systems (CDPR 2010a).

Alcohol ethoxylated surfactant could result in reductions to populations of surface-breathing insects (other than mosquitoes) during treatment; however, it is unlikely that these reductions would result in lasting or observable effects on nontarget organisms when applied within product label limits. Monomolecular films are not environmentally persistent and typically degrade within 21 days. In addition, populations recover quickly following recolonization from adjacent and neighboring sites and habitats.

6.2.7.2 Mosquito Adulticides

In addition to chemical control of mosquito larvae, the District may use pesticides for control of adult mosquitoes when no other tools are available and if specific criteria are met, including species composition, population density (as measured by landing count or other quantitative method), proximity to human populations, and/or human disease risk. Adulticide materials are used seasonally as needed to control mosquito populations.

Adulticides the District potentially uses include pyrethrins, synthetic pyrethroids, pyrethroid-like compounds, and synergists. Table 6-5 lists the adulticides the District uses for mosquito abatement. Several of these active ingredients are also used for the control of yellowjacket wasps (Table 6-5 and this section and Section 6.2.7.3). A subset of these active ingredients required further evaluation in Appendix B and further discussion is provided below. A detailed discussion of the environmental fate and toxicity of these pesticides is provided in Appendix B.

Table 6-5 Chemicals Employed for Adult Insect Abatement

Chemical Classification	Active Ingredient	Vector	Appendix B
Pyrethrin	Pyrethrins	Mosquito; yellowjacket wasp	Section 4.1.1
Pyrethroid	Allethrins and d-*trans* allethrin	Mosquito; yellowjacket wasp	Section 4.1.2
Pyrethroid	Phenothrin (sumithrin or d-phenothrin)	Mosquito; yellowjacket wasp	Section 4.1.3
Pyrethroid	Prallethrin	Mosquito; yellowjacket wasp	Section 4.1.4
Pyrethroid	Deltamethrin	Mosquito; yellowjacket wasp	Section 4.1.5
Pyrethroid	Esfenvalerate	Mosquito	Section 4.1.6
Pyrethroid	Lambda-cyhalothrin	yellowjacket wasp	Section 4.1.7
Pyrethroid	Resmethrin	Mosquito	Section 4.1.8
Pyrethroid	Tetramethrin	Mosquito; yellowjacket wasp	Section 4.1.9
Pyrethroid	Permethrin	Mosquito; yellowjacket wasp	Section 4.1.10
Pyrethroid-like compound	Etofenprox	Mosquito	Section 4.1.11
Synergist	PBO	Mosquito; yellowjacket wasp	Section 4.1.12
Potassium salt	Potassium salts	Yellowjacket wasp	Section 4.4.1

6.2.7.2.1 Pyrethrins

Pyrethrins are naturally occurring products distilled from the flowers of certain Chrysanthemum species. Pyrethrins readily degrade in water and soil, but may persist under anoxic conditions. They tend to strongly adsorb to soil surfaces and, hence, have low potential to leach into groundwater. Pyrethrins may be highly toxic to fish (freshwater, estuarine, marine) and invertebrates, although exposures would likely be low during and following ULV applications, which are designed to prevent environmental persistence and potential harm to nontarget ecological receptors.

The District uses pyrethrin for mosquito and/or yellowjacket wasp control. For yellowjacket wasp control, pyrethrin is applied around parks, landscaping, and directly into ground nests. For mosquito control, pyrethrin is applied as an ULV application against adult stages.

Pyrethrins are of concern because they are used prevalently and are sometimes combined with the use of the synergist PBO, which is toxic to aquatic invertebrates and is currently under evaluation as a possible endocrine-disruptor (Section 6.2.7.2.2). However, the District uses pyrethrins only when absolutely necessary and, even then, minimal amounts are applied (ULV), thus reducing the potential for harm to nontarget ecological receptors. As an additional measure, pyrethrin products are only used at night and during predawn hours when bees are not on the wing, and applications are canceled during less than ideal wind and potential drift conditions. For wasp (yellowjacket and paper wasps) control, the District applies pyrethrins in minute volumes directly to ground and tree/house eave nests, which essentially negates any effects to nontarget species. The District ensures that all applications are made in accordance with label specifications and USEPA and CDPR recommendations for use with mosquitoes. Other practices that can alleviate risk to aquatic receptors include minimizing the amount, frequency, and area with which these pesticides are applied over water bodies, especially those with the potential to contain special-status species. The District also minimizes the amount, frequency, and area with which these pesticides are applied over waters draining directly to the waters above. In addition, the risks to nontarget insects such as honeybees are reduced by restricting pyrethrin applications to nighttime hours when bees and other pollinators are inactive. Also, note that pyrethrins are available in can form to the public but not in vessels used for ULV applications.

6.2.7.2.2 Pyrethroids and Pyrethroid-like Compounds

Pyrethroids are synthetic compounds that are chemically similar to the pyrethrins but have been modified to increase stability and activity against insects. Pyrethroids bind to neuronal voltage-gated sodium channels, preventing them from closing; this persistent activation of the channels then leads to paralysis.

First generation or “Type I” pyrethroids include d-allethrin, phenothrin (sumithrin), prallethrin, resmethrin, and tetramethrin. These pyrethroids are used to control flying and crawling insects in a number of commercial and horticultural applications and are sold for residential use and application on pets to control fleas and ticks. They have effective insect knock-down capabilities but are unstable in sunlight (highly photosensitive). The newer second-generation/“Type II” pyrethroids contain an α-cyano group, which reduces their photosensitivity, thereby increasing their persistence and toxicity. The active ingredients that fall into this group include deltamethrin, esfenvalerate, lambda-cyhalothrin, and permethrin.

Some synthetic insecticides are similar to pyrethroids, such as etofenprox, but have a slightly different chemical composition. The pyrethroids that were identified for further evaluation in Appendix B are discussed below.

Resmethrin

Resmethrin is a pyrethroid (a synthetic class of compounds modified from pyrethrins to increase stability and insecticidal specificity) and the active ingredient in Scourge®. It a restricted-use pesticide due to its toxicity to fish and is available for this use only by certified pesticide applicators or persons under their direct supervision.

Resmethrin may also be persistent in environments free of light (e.g., bound to organic matter in anoxic soils and sediments). Due to the potential for persistence and high toxicity to both aquatic and estuarine/marine fish and invertebrates, use with PBO, as well as the potential for endocrine disruption, resmethrin may be of concern from an ecological health perspective.

The District may apply resmethrin to residential, commercial or industrial areas for mosquito control. Studies have shown rapid dissipation/low persistence and no observed aquatic fish and invertebrate toxicity following aerial ULV applications. Scourge® may be phased out with a nonresmethrin alternative, making this product less problematic. The District plans to use resmethrin only when absolutely necessary and then in ULV applications so that the rapid degradation of the products reduces the potential for harm to nontarget ecological receptors.

Permethrin

Permethrin is a pyrethroid that may persist in environments free of light (e.g., bound to organic matter in anoxic soils and sediments). Due the potential for persistence and high toxicity to both aquatic and estuarine/marine fish and invertebrates, use with PBO, as well as the potential for endocrine disruption, permethrin may be of concern from an ecological health perspective.

The District uses permethrin as a repellant for staff personal protection from ticks, fleas and other vector species.

Studies have shown rapid dissipation/low persistence and no observed aquatic fish and invertebrate toxicity following aerial ULV applications. Based on its potential for endocrine disruption and usage patterns, this product is not generally used as a mosquito control product. Permethrin use is restricted to situations when it is absolutely necessary and in ULV applications that are designed to degrade rapidly and, thus, reduce the potential for harm to nontarget ecological receptors.

Etofenprox

Etofenprox is a pyrethroid-like insecticide that is the active ingredient in Zenivex. Etofenprox does not tend to persist in the environment or appear to pose a risk to mammals as it is frequently applied to backyards and patios and sometimes directly to domestic pets. It does exhibit some toxicity to fish and aquatic invertebrates; however, it degrades rapidly in surface waters, thereby reducing the potential for long-term exposures and adverse effects. Zenivex does not require synergists such as PBO; therefore, it likely exhibits less toxicity than others that require co-application. In addition, the District strictly adheres to BMPs and product label requirements. Etofenprox is generally applied during the nighttime hours when sensitive receptors such as honeybees are not active.

6.2.7.2.3 Synergists (PBO)

PBO is a pesticide synergist that enhances the effectiveness of pesticide active ingredients, such as pyrethrins and pyrethroids, by inhibiting microsomal enzymes and, thus, the breakdown of the other active ingredient(s) (USEPA 2006a). It is a registered active ingredient in products used to control flying and crawling insects and arthropods in agricultural, residential, commercial, industrial, and public health settings. No products contain only PBO. It degrades quickly in soil and water but exhibits toxicity to fish and aquatic invertebrates. As a synergist, PBO is applied using the same guidelines as those for pyrethroids and pyrethrins: ULV application (to prevent environmental persistence and adverse ecological effects) with a backpack mister or ATV-mounted or handheld ULV, and it is not applied when wind occurs.

6.2.7.3 Yellowjacket Wasp Adulticides

The District also selectively applies chemicals to control ground-nesting yellowjacket wasps, as well as paper wasps that nest in trees. This activity is generally triggered by public requests for District assistance or action rather than as a result of regular surveillance of their populations. Yellowjacket nests that are off the ground would be treated under special circumstances to protect public health and safety of residents.

Whenever District technicians learn that a hive is situated inside or on a structure or is above ground, the resident(s) are encouraged to contact a private pest control company that is licensed to perform this work. When a technician encounters a honeybee swarm or unwanted hive, residents are referred to the Santa Clara Bee Guild, which maintains a referral list of beekeepers that can safely remove the bees. If District technicians deem it appropriate to treat stinging insects, they will apply the insecticide directly within the nest in accordance with the District's policies to avoid drift of the insecticide or harm to other organisms. Alternatively, they will place tamper-resistant traps or bait stations, selective for the target insect, in the immediate environment of the vector.

Pyrethroid-based chemicals are typically used against ground-nesting yellowjackets, as well as ticks. The potential environmental effects of these materials is minimal due to two factors: (1) their active ingredients consist largely of pyrethrins (a photosensitive natural insecticide manufactured from a Chrysanthemum species), or allethrin, and phenothrin (first generation synthetic pyrethroids with similar photosensitive, nonpersistent characteristics as pyrethrin); and (2) the mode of their application for yellowjacket population control (i.e., directly into the underground nest), which prevents drift and further reduces the potential for inadvertent exposure to these materials. The pesticides the District uses to control yellowjacket wasps are shown in Table 6-6.

6.2.7.3.1 Lambda-cyhalothrin

Lambda-cyhalothrin is available to the public in commonly used products for residential wasp control. The District uses it for targeted application to yellowjacket and paper wasp nests. This product (0.01 percent lambda-cyhalothrin) is used as needed throughout the year. The District may use products containing this active ingredient as a courtesy to the public to assist with wasp control at residences (restricted to yards, gardens, and home exteriors).

The potential for persistence (in the absence of light) of this chemical and its toxicity to mammals, aquatic organisms (vertebrates and invertebrates), and nontarget insects such as honeybees is of concern from a potential ecological health perspective.

Although a potential exists for environmental persistence and exposure to domestic pets and nontarget receptors, this active ingredient is readily available as an insect spray and the District uses are generally focused and localized (wasp nests) to minimize or eliminate exposures. In addition, lambda-cyhalothrin is not applied to vernal pools or where bee boxes are present.

6.2.7.3.2 Potassium Salts

Potassium salts are used to control a variety of insects (e.g., yellowjacket wasps) and mosses, algae, lichens, liverworts, and other weeds in or on many food and feed crops, ornamental flower beds, house plants, trees, shrubs, walks and driveways, and on dogs, puppies, and cats. Potassium salts of fatty acids include potassium laureate, potassium myristate, potassium oleate, and potassium ricinoleate. Once applied, however, these salts are degraded quickly in soil by microbes and do not persist in the environment (USEPA 1992).

Potassium salts are of low toxicity to birds and mammals, but highly toxic to fish and aquatic nontarget invertebrates. The District does not apply potassium salts directly to water and, therefore, pose little risk to sensitive aquatic invertebrates (USEPA 1992). Currently, the District uses potassium salts infrequently. Following product label requirements and District BMPs, potassium salts may be effective in a variety of application sites with little risk to nontarget ecological receptors.

6.2.7.4 Rodenticides

The District has an ongoing residential rodent inspection service to serve residents in the Program Area. Table 6-6 lists the pesticides the District uses or may use for control of rats. Two different groups of anticoagulant rodenticides, including first-generation and second-generation rodenticides, are employed for

rapid knock-down of rat populations. First-generation rodenticides require consecutive multiple doses or feedings over a number of days to be effective. Second-generation rodenticides are lethal after one dose and are effective against rodents that have become resistant to first-generation rodenticides.

The District may conduct rodent baiting at underground sites such as sewers, storm drains, or catch basins. Secure bait stations or other accepted methods of rodent baiting are conducted in areas with severe rodent infestations. In sewer baiting, bait blocks containing bromadiolone (a second generation, single-feeding anticoagulant rodenticide) are often used. The block is suspended by wire above the water line to encourage rodent feeding. For burrowing rodents, chlorophacinone (a first-generation, multiple-feeding anticoagulant dust) is blown directly into burrows.

Table 6-6 Chemicals Employed for Rodent Abatement

Chemical Classification	Active Ingredient	Appendix B
First-generation Anticoagulant	Chlorophacinone	Section 4.5.1
First-generation Anticoagulant	Diphacinone	Section 4.5.2
Second-generation Anticoagulant	Brodifacoum	Section 4.5.3
Second-generation Anticoagulant	Bromadiolone	Section 4.5.4
Second-generation Anticoagulant	Difethialone	Section 4.5.6
Neurotoxin	Bromethalin	Section 4.5.5
Sterol	Cholecalciferol	Section 4.5.7
Fumigant	Sulfur	Section 4.5.8
Fumigant	Sodium nitrate	Section 4.5.9

6.2.7.4.1 Anticoagulants

As their name suggests, anticoagulants function by inhibiting the production of blood-clotting factors. First-generation rodenticides (e.g., chlorophacinone, diphacinone) are effective if consumed over multiple doses. Chlorophacinone is currently registered for the control of rodents in and around buildings and residences, industrial areas, and food processing, handling, and storage areas and facilities. Diphacinone baits are typically used in/around buildings and similar man-made structures.

The newer second-generation rodenticides (e.g., brodifacoum, bromadiolone, difethialone) exhibit the same mode of action as their first-generation counterparts, but are fatal to rodents after a single dose. The acute toxicity of second-generation rodenticides presents a greater hazard to wildlife and pets as they are retained much longer in body tissues of primary consumers (Hartless and Jones 2011). Second-generation anticoagulants also have a significantly longer liver half-life than first generation anticoagulants (Hartless and Jones 2011). Brodifacoum has the greatest acute toxicity of the Program rodenticides, but the District uses it very infrequently. Anticoagulants may pose some risk to secondary avian predators and scavengers (e.g., birds of prey, coyotes), which may feed on poisoned rodents. In addition, small mammals and ground-foraging birds could be at risk from primary consumption of anticoagulant rodenticides. However, primary risks to mammals and avian receptors are reduced by proper use of bait stations, which preclude entry of larger nontarget wildlife.

Products containing second-generation active ingredients are no longer permitted to be sold to the general public. These products remain available to professional pest control personnel, and strict adherence to product label requirements and District BMPs can ensure their safe use for controlling and eradicating nuisance rodent populations, including the use of tamper-proof bait stations; securing bait stations at deployment locations to prevent disruption and/or removal by wildlife; and proper education of citizens including residents about the potential risk to pets, wildlife, and children.

The anticoagulant rodenticides, bromadiolone and difethialone, that were selected for further evaluation in Appendix B are discussed below. In addition, bromethalin, a neurotoxin rodenticide sometimes employed when anticoagulants lose efficacy on targeted rodent populations (considered for future use by the District) is also described.

Bromadiolone

Bromadiolone, the active ingredient in Contrac products, is a second-generation anticoagulant rodenticide. It is moderately persistent in soils and is generally applied as food bait blocks or pellets. Bromadiolone is highly toxic to mammals, domestic pets, and nontarget mammalian wildlife. Bromadiolone is often found in the tissues of wildlife, including avian and mammalian predators. Bromadiolone is also usually wax-encased (e.g., Contrac Blox) in block form, which has exceptionally low water solubility and low leaching potential. Therefore, risk to downstream water bodies is negligible.

Bromadiolone is a single-dose rodenticide that when used properly (such as in the absence of food competition), causes rapid knock-down of rat populations and very limited potential for affecting aquatic systems and resulting in exposure to nontarget wildlife.

The District adheres to BMPs and product label requirements when using this rodenticide in residential locations, parks, and commercial settings. Bromadiolone blocks are sometimes deployed in sewers, suspended by a string usually below manhole covers. This method of bait deployment reduces the probability of exposure (by multiple routes) to nontarget wildlife. This technique essentially negates the possibility of unwanted dietary exposure to ground-foraging birds and mammals present above ground. The rapid mortality that results for target rodents in sewers prevents the likelihood for ingestion by secondary terrestrial consumers.

The District also places bromadiolone baits in tamper-proof bait stations, which are also anchored at treatment locations (e.g., wires, stakes, etc.) to ensure that they cannot be dragged away by wildlife. The District provides public outreach regarding their practices, such as educating citizens about the locations of deployed bait stations and potential risks to pets and children.

The District will consider new, more protective rodenticide bait stations (reported by the USEPA; http://www.epa.gov/pesticides/mice-and-rats/rodent-bait-station.html) as those products become available. The use of such alternatives to bromadiolone would reduce the potential for harm to nontarget ecological receptors, including birds and small mammals, even further than occurs at present.

Difethialone

Difethialone is persistent in soils and is generally applied as food bait blocks or pellets. This second-generation rodenticide is highly toxic to mammals, domestic pets, and nontarget mammalian wildlife. Difethialone is often found in the tissues of wildlife, including avian and mammalian predators. Difethialone has been categorized as “likely to adversely affect” several species of sensitive California wildlife and registered uses of difethialone exceed the (lowest observed concentration) for effects related to both primary and secondary exposure. Indirect effects to habitat have been suggested for areas where difethialone is used for pest control (Housenger and Melendez 2011).

The District adheres to BMPs and product label requirements when using this rodenticide in residential locations, parks, and commercial settings. Difethialone baits are deployed in tamper-proof bait stations, which are also anchored at treatment locations (e.g., wires, stakes, etc.) to ensure that they cannot be

dragged away by wildlife. The District provides public outreach regarding their practices, such as educating citizens about the locations of deployed bait stations and potential risks to pets and children (see Chapter 7, Human Health).

The District will consider new, more protective rodenticide bait stations (reported by the USEPA; http://www.epa.gov/pesticides/mice-and-rats/rodent-bait-station.html) as those products become available. The use of such alternatives to the anticoagulant difethialone would reduce the potential for harm to nontarget ecological receptors, including birds and small mammals, even further than occurs at present.

Chemical Nervous System Toxins (Bromethalin)

Bromethalin is used to kill rodents that have become resistant to anticoagulants. Because its name resembles that of the anticoagulant baits bromadiolone and brodifacoum, bromethalin is often mistaken for anticoagulant bait (Dunayer 2003). The mode of action for bromethalin is the uncoupling of oxidative phosphorylation, which leads to decreased cellular ATP production and failure of Na+, K+-ATPase pumps. Bromethalin is highly toxic to mammals and birds. Some bromethalin products meet USEPA's new, more protective risk reduction standards. When applied properly, these products present a lower risk of accidental exposure to children, pets, and wildlife and USEPA has proposed them as safer alternatives to anticoagulants. They are applied in tamper-resistant and weather-resistant bait stations (USEPA 2013a), which prevent entry by small mammals and birds. Bait stations are secured to the ground or structures to avoid being dragged away by wildlife from deployment locations. The District educates citizens about the locations of deployed bait stations and potential risks to pets.

6.2.7.4.2 Sterol (Cholecalciferol)

Cholecalciferol is a sterol (Vitamin D3) and its ingestion results in hypercalcemia from mobilization of calcium from bone matrix into blood plasma leading to metastatic calcification of soft tissues (Clock-Rust and Sutton 2011). Use of this compound usually requires "prebaiting" prior to addition of the chemical to achieve adequate bait acceptance. Although it is highly toxic to target rodents, cholecalciferol is considered of low hazard to nontarget ecological receptors.

Residential treatments involve bait station deployment generally within 50 feet of homes. Bait stations are anchored to treatment locations (e.g., wires, stakes) to ensure that they cannot be dragged away by wildlife. In addition, bait stations have small openings that prevent the entrance and exposure to nontarget small mammals (e.g., squirrels, skunks, etc.). Residents are properly educated regarding the location of deployed tamper-proof bait stations and potential risks to children and pets.

6.2.7.4.3 Fumigants

Sulfur is also one of the active ingredients in four fumigant (gas-producing) cartridge products, which are used for rodent control on lawns, on golf courses, and in gardens. Carbon, sodium and potassium nitrates, sawdust, and sulfur are used in the fumigant-gas producing cartridge products. After the cartridges are ignited, they produce toxic gases that cause asphyxiation of the pests. These toxic gases, not the active ingredients, are the stressors for these products. The gases displace the oxygen in the burrows, creating an unbreathable atmosphere, causing asphyxiation of the target organisms (USEPA 2008a).

Elemental sulfur, when applied as a pesticide, will become incorporated into the natural sulfur cycle. The main processes and dissipation of elemental sulfur are oxidation into sulfate and reduction into sulfide. These processes are mainly mediated by microbes (USEPA 2008a). Sulfur is nontoxic to mammals, birds, and bees.

Sodium nitrate fumigants work by the combustion of charcoal in the formulation of each product. Pyrolysis of these sodium nitrate products results in simple organic and inorganic compounds, mostly in the form of gases such as nitrous oxide and carbon monoxide, which eventually diffuse through burrow openings or

into the soil causing organisms to die of asphyxiation (USEPA 1991a). Sodium nitrates are naturally occurring substances and exposure of the environment is limited and localized when the products are used as fumigants in burrows (USEPA 1991b). When used as indicated by the product label, any organism inside of a treated burrow would likely be killed by the toxic fumes. The District does not apply sodium nitrate fumigants when evidence of nontarget animal presence exists (see Chapter 5). The District employs BMPs to determine the presence of sensitive or special-status species and determine whether or not the use of fumigants is appropriate. These practices reduce or eliminate the potential exposure of sensitive or special-status species.

6.2.8 Other Nonchemical Control/Trapping Component

The trapping of rodents is conducted when these organisms pose a threat to public health and welfare or during disease surveillance projects. District staff place the tamper-resistant or baited trap(s) primarily at the request of the property owner or manager. The District does not remove rats or yellowjackets that are in or on structures. When these requests are made, residents are referred to the local animal control or to a directory of private pest control companies. Trapping is also used for the removal of nuisance wildlife such as raccoon, skunk, and opossum when these animals pose a threat to public health and safety. The District conducts limited trapping for vectors and nuisance wildlife, employing mechanisms and baits specific to target pests to reduce the potential effects to nontarget ecological receptors.

7 Human Health

Chapter 7 evaluates the Program in relation to human health. Results of the evaluation are provided at the programmatic level. Section 7.1, Environmental Background, presents an overview of the District's human population and growth estimates and the federal and state regulations that are applicable to the Program. Section 7.2presents the environmental evaluation.

7.1 Environmental Background

The Program Area is defined as Santa Clara County and adjacent counties. The following section provides the population characteristics of the Program Area, background information on the environmental fate and toxicity of pesticides, and an overview of the regulatory setting with respect to chemical and biological pesticides.

7.1.1 Population Characteristics of the Program Area

The size of the population in the District's Service Area and the larger Program Area are shown in the following two tables. In 2010, the population of California was estimated at 37.3 million (US Census Bureau, (http://www.bayareacensus.ca.gov/counties/counties.htm). The population of the nine counties in the nine Districts' Service Areas is approximately 6.76 million, which represents 18 percent of the statewide total (see Table 7-1).

Table 7-1 Population and Growth in the Santa Clara County VCD Program Area (1990–2010)

County / Area	Population			Population Growth (Compound Annual Average)	
	1990	2000	2010	1990–2000	2000–2010
Santa Clara	1,497,577	1,682,585	1,781,642	1.17%	0.57%
Statewide Area				**1.30%**	**0.96%**

Table 7-2 provides the population counts and projected growth in the 10 counties adjacent to the Districts' Service Areas that are included in the Districts' Program Areas.[15]

Table 7-2 Population and Growth in the Six Counties Adjacent to the Districts (1990–2010)

County / Area	Population			Population Growth (Compound Annual Average)	
	1990	2000	2010	1990–2000	2000–2010
Alameda	1,279,182	1,443,741	1,510,271	1.22%	0.45%
Merced	178,403	212,258	255,793	1.75%	1.88%
San Benito	36,697	53,781	55,269	3.90%	0.27%
San Mateo	649,623	707,161	718,451	0.85%	0.16%

[15] Each District should create one Table 7-1 from the two tables provided that is comprised of their Service Area county and adjacent counties included in their Program Area (based on Figure 2-1).

Santa Cruz	229,734	255,835	262,382	1.08%	0.25%
Stanislaus	370,552	449,471	514,453	1.95%	1.36%
Adjacent County Total				1.40%	1.20%
Statewide Total	**29,760,021**	**33,871,648**	**37,253,956**	**1.30%**	**0.96%**

The California Department of Finance projects steady population growth in the future, with total state population reaching over 44 million by 2030. These projections represent a compound annual average population growth of 0.86 percent.

7.1.2 Hazards, Toxicity, and Exposure

A “hazardous material” is defined in California Health and Safety Code Section 25501 (p): as “any material that, because of its quantity, concentration, or physical or chemical characteristics, poses a significant present or potential hazard to human health and safety or to the environment if released into the workplace or the environment. "Hazardous materials" include, but are not limited to, “hazardous substances, hazardous waste, and any material that a handler or the administering agency has a reasonable basis for believing that it would be injurious to the health and safety of persons or harmful to the environment if released into the workplace or the environment.” Any liquid, solid, gas, sludge, synthetic product, or commodity that exhibits characteristics of toxicity, ignitability, corrosiveness, or reactivity has the potential to be considered a “hazardous material.”

7.1.2.1 Toxicity and Exposure

Toxicology is the study of a compound’s potential to elicit an adverse effect in an organism. The toxicity of a compound is dependent upon exposure, including the specific amount of the compound that reaches an organism’s tissues (i.e., the dose), the duration of time over which a dose is received, the potency of the chemical for eliciting a toxic effect (i.e., the response), and the sensitivity of the organism receiving the dose of the chemical. Toxicity effects are measured in controlled laboratory tests on a dose/response scale, whereby the probability of a toxic response increases as dose increases. Exposure to a compound is necessary for potential toxic effects to occur. However, exposure does not, in itself, imply that toxicity will occur. Thus, toxic hazards can be mitigated by limiting potential exposure to ensure that doses are less than the amount that may result in adverse health effects.

The toxicity data included in the numerous tables and charts in this document are generally derived from rigidly controlled laboratory animal studies designed to determine the potential adverse effects of the chemical under several possible routes of exposure. In these studies, the species of interest is exposed to 100 percent chemical at several doses to determine useful information such as the lowest concentration resulting in a predetermined adverse effect (LOAEL) on numerous selected physiological and behavioral systems. The second component of these tests is to determine the highest concentration of chemical that results in no measurable adverse effect (NOAEL).

However, these, and other, coordinated and focused laboratory tests are designed to document the effects of the chemical when a continuous, controlled, exposure exists and do not realistically reflect the likely exposures or toxicity in the District field application scenarios. As such, the toxicity information is intended as an overview of potential issues and guidance for understanding the completely “safe” maximum exposure levels of applications that would not adversely affect humans or nontarget plant and animal species.

Although the regulatory community uses this basic information to provide a relative comparison of the potential for a chemical to result in unwanted adverse effects and this information is reflected in the approved usage labels and MSDSs, in actual practice, the amounts applied in the District’s Program Area

are often substantially less than the amounts used in the laboratory toxicity studies. Because of these large safety factors used to develop recommended product label application rates, the amount of chemical resulting in demonstrated toxicity in the laboratory is much higher than the low exposure levels associated with an actual application. The application concentrations consistent with the labels or MSDSs are designed to be protective of the health of humans and other nontarget species (i.e., low enough to not kill them, weaken them, or cause them to fail to reproduce). However, adverse effects may still occur to some nontarget organisms.

7.1.3 Pesticides and the Environment

The pesticide formulations included in the Program are listed in Table 7-3, including the product formulation, active ingredient, target vector, and District use.

Table 7-3 Pesticide Products Containing Reported Active Ingredients used or potentially used by Santa Clara County Vector Control District

Product	Active Ingredient	Vector
Agnique MMF	Biodegradable Alcohol Ethoxylated Surfactant	Mosquito
Agnique MMF G	Biodegradable Alcohol Ethoxylated Surfactant	Mosquito
Altosid Briquets	Methoprene	Mosquito
Altosid Briquets 30-day	Methoprene	Mosquito
Altosid Liquid Larvicide	Methoprene	Mosquito
Altosid Liquid Larvicide Concentrate	Methoprene	Mosquito
Altosid Pellets	Methoprene	Mosquito
Altosid Pellets WSP	Methoprene	Mosquito
Altosid SBG Single Brood Granule	Methoprene	Mosquito
Altosid XR-Briquets	Methoprene	Mosquito
Altosid XR-G	Methoprene	Mosquito
Astro®, Ortho® products, Bonide® products, Tengard® products, etc.	Permethrin	Yellowjacket wasp
Bell Terad 3 Blox	Cholecalciferol	Rat
BVA-2	Petroleum Distillate	Mosquito
Clarke Biomist 4 + 12 ULV	Permethrin and PBO	Mosquito
Contrac 8 oz blk	Bromadiolone	Rat
Contrac All-Weather Blox	Bromadiolone	Rat
Contrac Super Blox	Bromadiolone	Rat
Delta Dust	Deltamethrin	Yellowjacket wasp
Ditrac Blox	Diphacinone	Rat
Ditrac Tracking Powder	Diphacinone	Rat
Drione	Pyrethrin and PBO and Amorphous Silica Gel	Yellowjacket wasp
EcoExempt IC2	Rosemary Oil	Mosquito
FirstStrike Soft Bait	Difethialone	Rat

Table 7-3 Pesticide Products Containing Reported Active Ingredients used or potentially used by Santa Clara County Vector Control District

Product	Active Ingredient	Vector
FourStar 180 Bs/Bti	Bs and Bti	Mosquito
FourStar 45 Bti	Bs and Bti	Mosquito
FourStar 90 briq	Bs and Bti	Mosquito
FourStar SBG	Bti	Mosquito
Kontrol 4-4	Permethrin and PBO	Mosquito
MetaLarv SP-T	Methoprene	Mosquito
MGK Pyrocide 7396	Pyrethrins and PBO	Mosquito
Natular 2EC	Spinosad	Mosquito
Natular G30	Spinosad	Mosquito
Natular XRT	Spinosad	Mosquito
Permanone	Permethrin and PBO	Mosquito
Pyrenone 25-5	Pyrethrins and PBO	Mosquito
Pyrocide Mosquito Adulticiding Concentrate for ULV Fogging 7067	Pyrethrins and PBO	Mosquito
Scourge 4% +12%	Resmethrin and PBO	Mosquito
Scourge 18% + 54%	Resmethrin and PBO	Mosquito
Skeeter Abate	Temephos	Mosquito
Spectracide Pro®	Tetramethrin and Permethrin and PBO	Yellowjacket wasp
Spectracide®	Prallethrin and Lambda-cyhalothrin	Yellowjacket wasp
Teknar HP-D	Bti	Mosquito
Teknar SC	Bti	Mosquito
VectoBac 12AS	Bti	Mosquito
VectoBac G	Bti	Mosquito
VectoBac GS Biological Larvicide	Bti	Mosquito
VectoBac Technical Powder Biological Larvicide	Bti	Mosquito
VectoBac WDG Biological Larvicide	Bti	Mosquito
VectoLex CG	Bs	Mosquito
VectoLex WDG	Bs	Mosquito
VectoLex WSP	Bs	Mosquito
VectoMax CG	Bs and Bti	Mosquito
VectoMax WSP	Bs and Bti	Mosquito
Wasp-Freeze	Phenothrin and Trans Allethrin	Yellowjacket wasp
Zenivex E20	Etofenprox	Mosquito

7.1.4 Regulatory Environment

Formulations proposed for each Program component for vector control are and would be used according to federal and state regulatory requirements for the registration, transportation, and use of pesticides. The regulatory framework pertaining to the use of pesticides is discussed below.

7.1.4.1 Federal

The USEPA regulates pesticides under two major statutes: the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and the Federal Food, Drug, and Cosmetic Act (FFDCA). Under these acts, the USEPA mandates extensive scientific research to assess risks to humans, domestic animals, wildlife, plants, groundwater, and beneficial insects before granting registration for a pesticide. These studies allow the USEPA to assess the potential for human and ecological health effects. When new data raise concern about a registered pesticide's safety, the USEPA may take action to suspend or cancel its registration. The USEPA may also perform an extensive special review of a pesticide's risks and benefits and/or work with manufacturers and users to implement changes in a pesticide's approved use (e.g., reducing application rates).

7.1.4.1.1 Federal Insecticide, Fungicide, and Rodenticide Act

FIFRA defines a pesticide as "any substance intended for preventing, destroying, repelling, or mitigating any pest." The act requires USEPA registration of pesticides prior to their distribution for use in the US, sets registration criteria (testing guidelines), and mandates that pesticides perform their intended functions without causing unreasonable adverse effects on people and the environment when used according to USEPA-approved label directions. FIFRA defines an "unreasonable adverse effect on the environment" as "(1) any unreasonable risk to man or the environment, taking into account the economic, social, and environmental costs and benefits of the use of the pesticide, or (2) a human dietary risk from residues that result from a use of a pesticide in or on any food inconsistent with the standard under Section 408 of the Federal Food, Drug, and Cosmetic Act (21 USC 346a)."

FIFRA regulates only the active ingredients of pesticides, not inert ingredients, which manufacturers are not required to reveal. However, toxicity studies conducted under FIFRA are required to evaluate the active ingredient and the entire product formulation, through which any potential additive or synergistic effects of inert ingredients are established.

7.1.4.1.2 Federal Food, Drug, and Cosmetic Act

The FFDCA authorizes the USEPA to set tolerances (i.e., maximum allowable amounts) for pesticide residues in/on food. Thus, the FFDCA does not expressly regulate pesticide use, but exceedance of tolerances may result in prosecution or changes in the approved use of a pesticide regulated under FIFRA.

7.1.4.1.3 Clean Water Act and National Pollutant Discharge Elimination System

The CWA establishes the principal federal statutes for water quality protection "to restore and maintain the chemical, physical, and biological integrity of the nation's water, to achieve a level of water quality which provides for recreation in and on the water, and for the propagation of fish and wildlife."

> Section 303(d) requires each state to provide a list of impaired waters that do not meet or are expected not to meet state water quality standards as defined by that section. The CWA regulates potentially toxic discharges through the NPDES and ambient water quality through numeric and narrative water quality standards. The release of aquatic pesticides into waters of any state may require an NPDES permit, depending on the pesticide considered, and the conditions proposed for application.

> Section 402, the NPDES, requires permits for pollution discharges (except dredge or fill material) into US waters, such that the permitted discharge does not cause a violation of federal and state water

quality standards. Biological and residual pesticides discharged into surface waters constitute pollutants and require coverage under an NPDES permit. In California, NPDES permits are issued by the SWRCB or the RWQCBs.

7.1.4.1.4 Safe Drinking Water Act of 1974

Under the Safe Drinking Water Act of 1974, the USEPA establishes Maximum Contaminant Levels (MCLs), which are specific concentrations that cannot be exceeded for a given contaminant in surface water or groundwater. USEPA has the ability to enforce these nationwide standards or delegate administration and enforcement duties to state agencies. The CDPH administers the federal Safe Drinking Water Act in California.

7.1.4.1.5 California Toxics Rule

In 2000, the USEPA developed water quality criteria for priority toxic pollutants to protect human health and the environment when a gap in California's water quality standards was created when the state's water quality control plans containing water quality criteria for priority toxic pollutants were overturned in 1994 (thus causing California to be out of compliance with the CWA). These established criteria are to be applied to inland surface waters, enclosed bays, and estuaries in California. The rule includes aquatic life criteria for 23 priority toxic pollutants, human health criteria for 57 priority toxics, and a compliance schedule.

7.1.4.2 State of California

California's programs for the registration of pesticides and commercial chemicals parallel federal programs, but many of California's requirements are stricter than federal requirements. The Cal/EPA regulates registration of pesticides and commercial chemicals in California. Within Cal/EPA, the CDPR oversees pesticide evaluation and registration through use enforcement, environmental monitoring, residue testing, and reevaluation. The CDPR works with County Agricultural Commissioners, who evaluate, develop conditions of use, approve, or deny permits for restricted-use pesticides; certify private applicators; conduct compliance inspections; and take formal compliance or enforcement actions. The Secretary of Resources has certified California's pesticide regulatory program as meeting CEQA requirements (CDPR 2006).

California also requires commercial growers and pesticide applicators to report commercial pesticide applications to local county agricultural commissioners. The CDPR compiles this information in annual pesticide use reports. The CDPR's Environmental Hazards Assessment Program collects and analyzes environmental pesticide residue data, characterizes drift and other off-site pesticide movement, and evaluates the effect of application methods on movement of pesticides in air. If a pesticide is determined to be a toxic air contaminant, appropriate control measures are developed with the California Air Resources Board to reduce emissions to levels that adequately protect public health. Control measures may include product label amendments, applicator training, restrictions on use patterns or locations, and product cancellations.

7.1.4.2.1 Porter-Cologne Act and State NPDES Permitting

Under the Porter-Cologne Act (California Water Code Section 13000) the SWRCB, and the state's nine RWQCBs that it oversees, are responsible for administering federal and state water quality regulation and permitting duties.

The SWRCB oversees pesticide NPDES permitting in California. Users of specific larvicide and adulticide registered products are required to obtain coverage under the Statewide NPDES Permit for Biological and Residual Pesticide Discharges to Waters of the US from Vector Control Applications (SWRCB Water Quality Order No. 2012-0003-DWQ; NPDES No. CAG 990004; Vector Control Permit). Pesticides that require state NPDES permitting include Bti, Bs, temephos, spinosad, petroleum distillates, naled,

pyrethrin, permethrin, resmethrin, prallethrin, PBO, and etofenprox. That permit is discussed in detail in Chapter 9, Section 9.1.2.2.9.

7.1.4.2.2 Safe Drinking Water Act 1976

The CDPH administers the federal Safe Drinking Water Act in California. In addition to enforcing the primary MCLs (discussed above in Section 7.1.4.1), CDPH uses as guidelines Secondary MCLs that regulate constituents that affect water quality aesthetics (such as taste, odor, or color).

Additionally, under the California Safe Drinking Water Act, Cal/EPA's Office of Environmental Health Hazard Assessment develops Public Health Goals (PHGs) for contaminants in California's publicly supplied drinking water. PHGs are concentrations of drinking water contaminants that pose no significant health risk if consumed for a lifetime, based on current risk assessment principles, practices, and methods. Public water systems use PHGs to provide information about drinking water contaminants in their annual Consumer Confidence Reports.

7.1.4.2.3 The Safe Drinking Water and Toxic Enforcement Act (Proposition 65)

This act, passed as a ballot initiative in 1986, requires the state to annually publish a list of chemicals known to the state to cause cancer or reproductive toxicity so that the public and workers are informed about exposures to potentially harmful compounds. Cal/EPA's Office of Environmental Health Hazard Assessment administers the act and evaluates additions of new substances to the list. Proposition 65 requires companies to notify the public about chemicals in the products they sell or release into the environment, such as through warning labels on products or signs in affected areas, and prohibits them from knowingly releasing significant amounts of listed chemicals into drinking water sources.

7.1.4.2.4 California Pesticide Regulatory Program

CDPR regulates the sale and use of pesticides in California. CDPR is responsible for reviewing the toxic effects of pesticide formulations and determining whether a pesticide is suitable for use in California through a registration process. Although CDPR cannot require manufacturers to make changes in labels, it can refuse to register products in California unless manufacturers address unmitigated hazards by amending the pesticide label. Consequently, many pesticide labels that are already approved by the United States Environmental Protection Agency (USEPA) also contain California-specific requirements. Pesticide labels defining the registered applications and uses of a chemical are mandated by USEPA as a condition of registration. The label includes instructions telling users how to make sure the product is applied only to intended target pests, and includes precautions the applicator should take to protect human health and the environment. For example, product labels may contain such measures as restrictions in certain land uses and weather (i.e., wind speed) parameters.

7.2 Environmental Evaluation

This section evaluates Program components in terms of potential effects to human health specific to the use of selected chemical and biological pesticides.

7.2.1 Evaluation Concerns and Criteria

The public has indicated concerns about some of the following issues. The responses to the concerns that are provided below help to direct the reader to the appropriate section or Appendix B, *Ecological and Human Health Assessment Report*, or they provide explanatory information in concise form.

> Address effects on people and pets through ingestion and absorption pathways and proposed mitigation. Address impacts on chemically sensitive people and sensitive populations such as children, the elderly, pregnant women. Exposure to pesticides can result in compromised immune system, which would allow for development of allergies or autoimmune disorders.

- Potential Chemical Control component impacts are discussed in Section 7.2.7, and toxicity of individual active ingredients is evaluated in greater detail in Appendix B, Human and Ecological Health Assessment Report.

> List any and all biological or chemical agents proposed for use.

- The biological and chemical pesticide formulations included in the Program are listed in Table 7-3, Pesticide Products Containing Reported Active Ingredients.

> CDPH should be consulted to ensure all potential risks are identified, characterized, and evaluated.

- The document and information will be made publicly available.

> Supply additional information regarding bait blocks, chemical agents, and poisons in sanitary sewers concerning components and effects. Could affect the operation of wastewater treatment plants.

- The use of bait blocks and other pesticide applications are discussed in Section 7.2.7 and evaluated in greater detail in Appendix B.

> Concern expressed over public safety and health with regards to existing vegetable gardens and fruit trees within the project area. Local swimming holes could be a potential habitat for breeding mosquitoes, and chemical treatment could impact humans.

- BMPs to reduce exposure to nontarget species and areas are discussed in Chapter 2, Section 7.2.7, summarized in several other relevant chapters, and evaluated in greater detail in Appendix B.

> Concerned with use of Zenivex; it mimes chrysanthemums but is a harmful neurotoxin.

- Etofenprox, the active ingredient in Zenivex, is discussed in Section 7.2.7.2.2 and evaluated in greater detail in Appendix B. It does not require concomitant use of a synergist, such as PBO. Therefore, it likely exhibits less toxicity than others that require co-application with other chemicals. Based on toxicity, environmental fate, and usage patterns, etofenprox is not likely to result in unwanted adverse impacts to humans when BMPs are used.

> Adulticides present greater danger to humans than the threat of WNV, as many are known carcinogens and endocrine disruptors.

- The District's BMPs provide that adulticides are generally applied as aerosols using ULV techniques to minimize exposure to nontarget species. Aerial and ground application techniques are used to distribute the insecticides. The potential toxicity of the various adulticides included in the Program are discussed in Section 7.2.7 and evaluated in greater detail in Appendix B.

> Pyrethrins disrupt the normal functioning of sex hormones while PBO affects the functioning of hormone-related organs.

- The District generally uses pyrethrins in ULV applications, which are designed to prevent environmental persistence and potential impacts to nontarget species.
- As a synergist for pyrethrins and pyrethroids, PBO is also generally applied in ULV, and it degrades rapidly in soil and water. Its potential toxicity is discussed in Appendix B.

> How long are pesticides retained in humans (young infant through elderly), pets, home garden vegetables and fruit, etc.?

- The half-lives of the 42 active ingredients and 4 adjuvants/surfactants included in the Program components are listed in Appendix B.

> In addition to short-term effects, what are the long-term effects of repeated exposure to these chemicals?

- The chronic effects of the various pesticides are discussed in detail in Appendix B.

7.2.2 Evaluation Methods and Assumptions

Pesticides the District uses were investigated to provide a preliminary assessment of the potential effects to humans (discussed in detail in Appendix B). A comprehensive literature review was conducted and the District supplied information to assess potential exposure and toxicity using the following:

> Pesticides the District uses

> Pesticide label recommendations

> Types of application sites (e.g., habitat types)

> Application procedures

> Number of treatments per application site

> Total amount used per treatment for each application site, based on yearly totals.

> Physicochemical properties of the pesticides/active ingredients

> Efficacy of the pesticide to eradicate the target pest

> Reported adverse effects (e.g., reproductive, developmental, carcinogenic)

The pesticide application scenarios that result in reasonable efficacy with minimal unwanted estimated risk are preferred and are the basis of IPM approaches the District practices. Each of the pesticides identified as warranting further evaluation in Appendix B are known to exhibit at least one parameter that appears to drive potential or perceived risk. Toxicity levels (e.g., slight, low, moderate, high, etc.) are used prevalently in the published literature but are not standardized or representative of specific criteria. They qualitatively describe toxicity in relative terms in the evaluations of pesticides in this document and in Appendix B. Toxicity levels are helpful in making significance determinations.

This evaluation assumes that all pesticides are applied in accordance with label instructions and USEPA and Cal/EPA requirements. The USEPA requires mandatory statements to be included on pesticide product labels that include directions for use; precautions for avoiding certain dangerous actions; and where, when, and how the pesticide should be applied. This guidance is designed to ensure proper use of the pesticide and prevent unreasonable adverse effects to humans and the environment. All pesticide labels are required to include the name and percentage by weight of each active ingredient in the product/formulation. Toxicity categories for product hazards and appropriate first-aid measures must be properly and prominently displayed. Pesticide labels also outline proper use, storage, and disposal procedures, as well as precautions to protect applicators. The directions for use indicate target organism (pest), appropriate application sites, application rates or dosages, contact times, and required application equipment for the pesticide. Warnings regarding appropriate wind speeds, droplet sizes, or habitats to avoid during application are also prominently displayed

This evaluation does not include assumptions about which alternative treatment strategy or strategies would be applied in any given area. This evaluation assumes that important parameters, such as media half-life, are dependent on the specific conditions at the time of pesticide application, and values listed herein that serve as references values.

7.2.3 Surveillance Component

Vector surveillance is critical to IPM strategies because it provides information that is used to determine when and where to institute other vector control measures. The District's mosquito surveillance activities are conducted in compliance with accepted federal and state guidelines (e.g., *California Mosquito-Borne Virus Surveillance and Response Plan* (CDPH 2010a) and *Best Management Practices for Mosquito Control in California* (CDPH 2010b). These guidelines allow for flexibility in selection and specific

application of control methods because local areas vary. Surveillance activities involve monitoring the abundance of adult and larval mosquitoes, field inspection of mosquito habitat, testing for the presence of encephalitis virus-specific antibodies in sentinel chickens or wild birds, collection and testing of ticks, small rodent trapping, and/or response to public service requests regarding nuisance animals or insects (e.g., yellowjacket and wasps). Surveillance of potential areas of concern is a critical element for directing and responding to potential outbreaks of mosquitoes and the potential for conveying mosquito-borne diseases.

7.2.4 Physical Control Component

Physical Control for mosquitoes consists of the management of mosquito-producing habitat (including freshwater marshes and lakes, saltwater marshes, temporary standing water, and wastewater treatment facilities) especially through water control and maintenance or improvement of channels, tide gates, levees, and other water control facilities. Physical control is usually the most effective mosquito control technique because it provides a long-term solution by reducing or eliminating mosquito developmental sites and ultimately reduces the need for chemical applications. The physical control practices may be categorized into three groups: maintenance, new construction, and cultural practices. The District performs these physical control activities in accordance with all appropriate environmental regulations (wetland fill and dredge permits, endangered species review, water quality review, streambed alteration permits, etc.), and in a manner that generally maintains or improves habitat values for desirable species. Physical control for other vectors such as rodents is based on the District's site inspections to determine conditions promoting infestation, and property owners are provided educational materials on control measures that include removal of food sources and professionals to contact to remove the infestation. Physical control techniques have minimal effect on humans due to prior identification and avoidance of potential problem areas and wildlife habitats by publishing scheduled treatment times and locations.

7.2.5 Vegetation Management Component

The District uses hand tools (e.g., shovels, pruners, chain saws, and weed-whackers) and heavy equipment where necessary for vegetation removal or thinning to improve surveillance or reduce vector habitats. Vegetation removal or thinning primarily occurs in aquatic habitats to assist with the control of mosquitoes and in terrestrial habitats to help with the control of other vectors. To reduce the potential for mosquito breeding associated with water retention and infiltration structures, District staff may systematically clear weeds and other obstructing vegetation in wetlands and retention basins (or request the structures' owners to perform this task). Vegetation management is also performed to assist other agencies and landowners with the management of invasive/nonnative weeds. These actions are typically performed under the direction of the concerned agency, which also maintains any required permits. These activities are conducted during predetermined times of recreational inactivity to provides an additional measure of safety to the public.

7.2.6 Biological Control Component

Biological control of mosquitoes and other vectors involves the intentional use of vector pathogens (diseases), parasites, and/or predators to reduce the population size of target vectors. Biological control is used as a method of protecting the public from mosquitoes and the diseases using mosquito parasites, pathogens, and predators. At present, mosquito parasites are not commercially available for mosquito control.

7.2.6.1 Mosquito Larvae Pathogens

As part of their Biological Control component, the District employs bacterial larvicides that are highly specific to mosquitoes. These biological controls include Bs, Bti, and spinosad. Because the potential environmental effects of Bs or Bti application are generally similar to those of chemical pesticide

applications, these materials and spinosad are evaluated below under Section 7.2.7, Chemical Control component. The environmental fate and toxicity of these control agents is discussed in Appendix B.

7.2.6.2 Mosquito Predators

Mosquitofish (*Gambusia affinis*) are presently the only commercially available mosquito predators. The District's rearing and stocking of these fish in mosquito habitats is the most commonly used biological control agent for mosquitoes in the world. Used correctly, this fish can provide safe, effective, and persistent suppression in various mosquito sources. However, due to concerns that mosquitofish may potentially affect red-legged frog and tiger salamander populations, the District limits the use of mosquitofish to ornamental fish ponds, water troughs, water gardens, fountains, and unused swimming pools.

7.2.6.3 Other Vectors

No effective natural predators exist to control high rodent populations. Currently, no commercial biological control agents or products are available for wasp and yellowjacket control.

7.2.7 Chemical Control Component

Chemical control involves the application of nonpersistent selective insecticides to directly reduce populations of mosquitoes and other invertebrate threats to public health and the use of rodenticides to control rats and mice. If and when inspections reveal that mosquitoes or other vector populations are present at levels that trigger the District's criteria for chemical control – based on the vector's abundance/density, species composition, proximity to human settlements, water temperature, or presence of predators – the District applies pesticides to the site in strict accordance with label instructions and federal and state guidelines.

Most of the chemical controls the Program uses are for mosquito abatement and are classified as larvicides or adulticides. Below is a discussion of the larvicides, adulticides, and rodenticides the District uses. The active ingredients that were identified as warranting further evaluation in Appendix B due to their potential toxicity and/or prevalent use/public concern are listed in Table 7-4.

Table 7-4 Active Ingredients Identified for Further Evaluation in Appendix B

Active Ingredient	Vector	Potential Issue
Methoprene	Mosquitoes	Prevalent use; toxicity to aquatics and insects
Etofenprox	Mosquitoes	Toxicity to aquatic organisms; no synergist required
Bti	Mosquitoes	Prevalent use; public concerns
Pyrethrins	Mosquitoes	Prevalent use; requires synergist (PBO)
Resmethrin	Mosquitoes	Requires synergist (e.g., PBO); potential endocrine disruptor
Vegetable Oil (coconut oil)/mix	Mosquitoes	Contains low percentage of petroleum distillate
Permethrin	Mosquitoes/yellowjackets	Toxicity to aquatic organisms; potential endocrine disruptor
Lambda-cyhalothrin	Yellowjackets	Toxicity to aquatic organisms; potential to bioaccumulate
Bromadiolone	Rats	Toxicity to nontarget organisms including mammals, birds, aquatics
Difethialone	Rats	Toxicity to nontarget organisms including mammals, birds, aquatics

7.2.7.1 Mosquito Larvicides

Larvicides are used to manage immature life stages of mosquitoes including larvae and pupae in aquatic habitats. Temporary aquatic habitats are usually targeted because permanent water bodies generally support natural mosquito predators such as fish. The larvicides are applied using ground application equipment, fixed wing aircraft, and rotary aircraft. The mosquito larvicides the District uses and where they are discussed in detail in Appendix B are listed in Table 7-5.

Table 7-5 Chemicals Employed for Larval Mosquito Abatement

Chemical Classification	Active Ingredient	Appendix B
Organophosphate	Temephos	Section 4.2.2
Bacterial larvicide	Bs	Section 4.3.1
Bacterial larvicide	Bti	Section 4.3.2
Bacterial larvicide	Spinosad	Section 4.3.3
Hydrocarbon ester	Methoprene	Section 4.3.4
Surfactant	Alcohol Ethoxylated Surfactant (monomolecular film)	Section 4.3.5

7.2.7.1.1 Bacterial Larvicides (Bs, Bti, and spinosad)

These bacterial larvicides are highly mosquito-specific bacteria that usually infect mosquito larvae when they are ingested. These pathogens are activated in the host, destroying internal organs and consuming nutrients. The pathogen can be spread to other mosquito larvae in some cases when larval tissue disintegrates and the pathogens are released into the water and are ingested by uninfected larvae. Bs and Bti, produce proteins that are toxic to most mosquito larvae, while the fermentation of *S. spinosa* produces spinosysns, which are highly effective mosquito neurotoxicants. All three bacteria are naturally occurring soil organisms and are commercially produced as mosquito larvicides. Bs can reproduce in natural settings for some time following release. Bs and Bti are applied on a variety of crops and standing and moving water bodies, Bti materials the District applies do not contain live organisms, only spores. The spores of Bs and Bti can persist in the environment for months, but the endotoxins are readily degraded by UV light and persist only for days. Bacterial spores of Bti are uniquely toxic to nematoceran Diptera (mosquitoes, midges, blackflies, psychodids, and ceratopogonids) (Lacey and Mulla 1990) and do not exhibit any human toxicity.

Spinosad alters nicotine acetylcholine receptors in insects, causing constant involuntary nervous system effects ultimately leading to paralysis and death. It is used on various crops, animal husbandry premises, recreation areas, rights-of-way, and local residences. The USEPA has classified spinosad as a “reduced risk” compound because it is an alternative to more toxic, OP insecticides (CDPR 2002). It exhibits very acute toxicity by all exposure routes and has not been shown to elicit chronic toxicity in humans.

7.2.7.1.2 Hydrocarbon Ester - Methoprene

Methoprene is an insect growth regulator and selective larvicide. It used in a variety of settings including indoors and outdoors at residences, animal husbandry premises, industrial sites, irrigation systems, and standing water bodies. It is applied either in response to observed high populations of mosquito larvae at a site, or as a sustained-release product that can persist for 4 months or longer if a site has limited accessibility and has regularly produced immature mosquitoes in the past. It is applied by hand, ground equipment or by low-flying helicopters (particularly for marshes and other highly vegetated areas) but never when winds exceed 10 mph to prevent drift. Methoprene has very low acute toxicity to humans and

mammals by all routes (USEPA 1991c). It is of public concern due to its potential ecological effects and widespread use (discussed in Chapter 6, Section 6.2.7.1.2).

7.2.7.1.3 Alcohol Ethoxylated Surfactant (monomolecular film)

The monomolecular film formulation used in California for mosquito larvae control is Agnique. Monomolecular films spread a thin film on the water surface that makes it difficult for mosquito larvae, pupae, and emerging adults to attach to the water's surface, causing them to drown (USEPA 2007a). The films also disrupt larval respiration of some other classes of air-breathing aquatic insects. They are used on an assortment of water bodies including ornamental ponds, pastures, irrigation systems, drainage systems, and drinking water systems (CDPR 2010a). No evidence supports that these surfactants are toxic to humans.

7.2.7.1.4 Temephos

Temephos is the only OP registered for larvicidal use and may be used to help prevent mosquitoes from developing resistance to the bacterial larvicides. It was used prevalently in California for mosquito abatement from 1965 into the mid-1980s; however, microbial pesticides (e.g., Bs, Bti, and spinosad), methoprene, and surface oils are used much more frequently now. It is used in various water bodies including lakes, marshes, drainage systems, irrigation systems, and polluted and stagnant water; it is not used on agricultural lands (CDPR 2010a). The District rarely uses this product, but applications typically target man-made sources such as tire piles, utility vaults, and cemetery urns. Temephos has extremely low water solubility and binds strongly to soils. It has low toxicity for vertebrates at the levels used for mosquito control (USEPA 2000). The USEPA (2000) states that people are likely not exposed to temephos in drinking water or from residential use.

7.2.7.2 Mosquito Adulticides

The District may use pesticides to control adult mosquitoes when no other tools are available and if specific criteria are met, including species composition, population density, proximity to human populations, and/or human disease risk. Adulticide materials are used infrequently and only when necessary to control mosquito populations. The adulticides the District uses to control mosquito and yellowjackets and where they are discussed in detail in Appendix B are listed in Table 7-6.

Table 7-6 Chemicals Employed for Adult Insect Abatement

Chemical Classification	Active Ingredient	Vector	Appendix B
Pyrethrin	Pyrethrins	Mosquito; yellowjacket	Section 4.1.1
Pyrethroid	Allethrins and d-*trans* allethrin	Mosquito; yellowjacket	Section 4.1.2
Pyrethroid	Phenothrin (sumithrin or d-phenothrin)	Mosquito; yellowjacket	Section 4.1.3
Pyrethroid	Prallethrin	Mosquito; yellowjacket	Section 4.1.4
Pyrethroid	Deltamethrin	Mosquito; yellowjacket	Section 4.1.5
Pyrethroid	Esfenvalerate	Mosquito	Section 4.1.6
Pyrethroid	Lambda-cyhalothrin	Yellowjacket	Section 4.1.7
Pyrethroid	Resmethrin	Mosquito	Section 4.1.8
Pyrethroid	Tetramethrin	Mosquito; yellowjacket	Section 4.1.9
Pyrethroid	Permethrin	Mosquito; yellowjacket	Section 4.1.10
Pyrethroid	Etofenprox	Mosquito	Section 4.1.11

Synergist	PBO	Mosquito; yellowjacket	Section 4.1.12
Potassium salt	Potassium salts	Yellowjacket	Section 4.4.1

7.2.7.2.1 Pyrethrins

Pyrethrins are naturally occurring compounds the flowers of the Chrysanthemum species produce. They effectively induce temporary paralysis in insects but are not acutely lethal by themselves; thus, they are used concomitantly with the synergist PBO, which inhibits metabolism of the pyrethrins so that a lethal dose is assured (USEPA 2006c). The District uses pyrethrins in residential, commercial or industrial zones to suppress nuisance or disease-transmitting mosquitoes. Indoor treatments may be applied to greenhouses and warehouses where invasive vector species have been discovered.

Pyrethrins have low to moderate acute mammalian toxicity via the oral, dermal, and inhalation routes (Categories III and IV). They are a moderate eye irritant (Category III), a mild dermal irritant (Category IV), and not a skin sensitizer. The effects of pyrethrins are (1) neurobehavioral effects following acute, short-term, and chronic exposure, with nervous system lesions observed in the rat and mouse following acute exposure; (2) thyroid effects, following chronic exposure in the rat and dog; and (3) liver effects, following short- and long-term exposure in the rat, dog, and mouse. The neurobehavioral effects are considered relevant to humans because the effects are observed in both the rat and mouse, and the mode of action affects a basic function of the nervous system that is common to all animals (USEPA 2006c).

They are of concern because they are prevalently used and are typically combined with the synergist PBO, a potential endocrine disruptor (USEPA 2009). However, the District uses pyrethrins only when absolutely necessary in ULV applications that are designed to break down rapidly, resulting in very low potential exposure to humans.

7.2.7.2.2 Pyrethroids, Pyrethroid-Like Compounds, and Synergists

Pyrethroids are synthetic compounds that are chemically similar to the pyrethrins but have been modified to increase stability and activity against insects. Pyrethroids bind to neuronal voltage-gated sodium channels, preventing them from closing; this persistent activation of the channels then leads to paralysis.

First generation or “Type I” pyrethroids include d-allethrin, phenothrin (sumithrin), prallethrin, resmethrin, and tetramethrin. These pyrethroids are used to control flying and crawling insects in a number of commercial and horticultural applications and are sold for residential use and application on pets to control fleas and ticks. They have effective insect knock-down capabilities but are unstable as they are highly photosensitive (i.e., easily degraded by light). The newer second-generation or “Type II” pyrethroids contain an α-cyano group, which reduces their photosensitivity, thereby increasing their persistence and toxicity. The active ingredients that fall into this group include deltamethrin, esfenvalerate, lambda-cyhalothrin, and permethrin.

Some synthetic insecticides are similar to pyrethroids, such as etofenprox, but have a slightly different chemical composition. The pyrethroids that were identified for further evaluation in Appendix B are discussed below.

7.2.7.2.3 Resmethrin

Resmethrin is the active ingredient in Scourge®. It is a restricted-use pesticide due to its toxicity to fish and is available for use only by certified pesticide applicators or persons under their direct supervision.

Resmethrin has low acute toxicity via the oral (Category III), dermal (Category III), and inhalation (Category IV) routes of exposure. Resmethrin is included in the final list of chemicals for screening under USEPA‘s Endocrine Disruptor Screening Program (USEPA 2009).

Though public concern regarding resmethrin exists because of its potential endocrine-disrupting properties and concomitant use of PBO, Scourge® has been phased out of the District's program and replaced with nonresmethrin alternatives.

7.2.7.2.4 Permethrin

Permethrin is also a pyrethroid. Dermal exposure in humans can cause tingling and pruritus with blotchy erythema on exposed skin (ATSDR 2003). In humans, acute effects observed subsequent to ingestion of permethrin included nausea, vomiting, abdominal pain, headache, dizziness, anorexia, and hypersalivation. Reports of severe poisoning are rare and usually follow ingestion of substantial, but poorly described, amounts of permethrin. Symptoms of severe poisoning include impaired consciousness, muscle fasciculation, convulsions, and noncardiogenic pulmonary edema (ATSDR 2003). Systemic effects are similar to those seen in acute and chronic ingestion with prolonged contact or contact with high concentrations of permethrin. Acute toxicity to permethrin via inhalation has been shown to be very small. The USEPA (2006c) has classified permethrin as Category III for acute oral and acute dermal toxicity, Category III for eye irritation potential, and Category IV for dermal irritation potential.

Because permethrin is included in the final list of chemicals for screening under USEPA's Endocrine Disruptor Screening Program (USEPA 2009), it is of concern to the public. However, the District only uses permethrin as a repellent against ticks and fleas by staff conducting field surveys.

7.2.7.2.5 Etofenprox

Etofenprox is a pyrethroid-like insecticide that is the active ingredient in Zenivex. It differs in structure from pyrethroids in that it lacks a carbonyl group and has an ether moiety, whereas pyrethroids contain ester moieties. It is used indoors, as a spot treatment for pets, and as an outdoor fogger to control flying and crawling insect pests. It is frequently applied to backyards and patios and sometimes directly to domestic pets. It has low acute toxicity to humans and mammals. The public's concerns regarding the ecological effects of etofenprox are discussed in Chapter 6, Section 6.2.7.2.5.

7.2.7.2.6 Piperonyl Butoxide

PBO is a pesticide synergist that enhances the effectiveness of pesticide active ingredients, such as pyrethrins and pyrethroids, by inhibiting microsomal enzymes and, thus, the breakdown of the other active ingredient(s) (USEPA 2006a). It is a registered active ingredient in products used to control flying and crawling insects and arthropods in agricultural, residential, commercial, industrial, and public health settings. No products contain only PBO. It degrades quickly in soil and water. PBO has a low acute toxicity by oral, inhalation, and dermal routes, but it is included in the final list of chemicals for screening under USEPA's Endocrine Disruptor Screening Program (USEPA 2009). As a synergist, PBO is applied using the same guidelines as those for pyrethroids and pyrethrins: ULV application with a backpack mister or handcan/duster, and it is not applied during high winds.

7.2.7.3 Yellowjacket Wasp Adulticides

The District selectively applies insecticides to control ground-nesting yellowjackets and tick populations that pose an imminent threat to people or pets. This activity is generally triggered by public requests for District assistance or action rather than as a result of regular surveillance of their populations. The District does not apply pesticides to yellowjacket populations that are located in or on a structure. Whenever the District learns that a hive is situated in or on a structure or is above ground, the resident(s) are encouraged to contact a private pest control company that is licensed to treat the infestation. Yellowjacket nests that are off the ground would be treated only under special circumstances to protect public health and safety of the District's residents. When a District technician encounters a honeybee swarm or unwanted hive, residents are referred to the Santa Clara Bee Guild, which maintains a referral list of beekeepers that can safely remove the bees. If a District technician deems it appropriate to treat stinging insects, they will apply the insecticide directly within the nest in accordance with the District's policies to avoid drift of the insecticide or

harm to other organisms. Alternatively, they will place tamper-resistant traps or bait stations, selective for the target insect in the immediate environment of the vector.

Pyrethroid-based chemicals are typically used against ground-nesting yellowjackets and are applied directly into the underground nest, which prevents drift and further reduces the potential for nontarget exposure to these compounds. In addition to the pyrethrins and pyrethroids discussed above, the District uses lambda-cyhalothrin to control yellowjacket wasps.

7.2.7.3.1 Lambda-cyhalothrin

Lambda-cyhalothrin is the active ingredient in Spectracide®, used to control yellowjacket wasps. It is moderately toxic to mammals via acute oral, dermal, and inhalation routes (National Pesticide Information Center 2001). Acute exposure to lambda-cyhalothrin has been linked with changes in neurological function when administered at high doses (USEPA 2002). Chronic studies of lambda-cyhalothrin and cyhalothrin have repeatedly and consistently documented decreased body weight gain and reduced food consumption. Signs of neurotoxicity and changes in organ weights are also common effects of chronic exposure to lambda-cyhalothrin and cyhalothrin (USEPA 2002, 2004b, 2007b, c). No genotoxicity data for cyhalothrin or lambda-cyhalothrin were identified in recent USEPA pesticide tolerance documents (USEPA 2002, 2004b, 2007b, c).

The potential for persistence of lambda-cyhalothrin and its toxicity to mammals is of concern from a potential human health perspective. However, the District rarely uses lambda-cyhalothrin and usually applies Drione (amorphous silica dust and pyrethrin). Lambda-cyhalothrin is not applied to vernal pools.

7.2.7.3.2 Potassium Salts

Potassium salts of fatty acids are used as insecticides and herbicides. They are used to control numerous insects and weeds, in/on crops, in residential yards, and on pets. The fatty acids disrupt the cell membranes of an insect, leading to dehydration. Soft-bodied insects, such as aphids, are more susceptible as are immature insects. These salts degrade quickly in soil by microbes and do not persist in the environment (USEPA 1992). They are classified as Category IV (lowest level of toxicity) for acute effects to humans, and the District use them very infrequently.

7.2.7.4 Rodenticides

The District employs limited use of rodenticides in response to District resident requests. The District may use two different groups of anticoagulant rodenticides, known as first generation and second generation rodenticides. First generation rodenticides require consecutive multiple doses or feedings over a number of days to be effective. Second-generation rodenticides require only one dose and are effective against rodents that have become resistant to first generation rodenticides; they are far more toxic than first generation baits.

The District may conduct rodent baiting at underground sites such as sewers, storm drains, or catch basins. Secure bait stations or other accepted methods of rodent baiting are conducted in areas with severe rodent infestations. In sewer baiting, bait blocks containing a rodenticide are suspended by wire above the water line to encourage rodent feeding. For rodent burrows, rodenticides may be blown into the burrows. The rodenticides the District uses and where they are discussed in detail in Appendix B are listed in Table 7-7.

Table 7-7 Chemicals Employed for Rodent Abatement

Chemical Classification	Active Ingredient	Appendix B
First-generation anticoagulant	Chlorophacinone	Section 4.5.1
First-generation anticoagulant	Diphacinone	Section 4.5.2
Second-generation anticoagulant	Brodifacoum	Section 4.5.3
Second-generation anticoagulant	Bromadiolone	Section 4.5.4
Neurotoxicant	Bromethalin	Section 4.5.5
Second-generation anticoagulant	Difethialone	Section 4.5.6
Sterol	Cholecalciferol	Section 4.5.7
Fumigant	Sulfur (fumigant)	Section 4.5.8
Fumigant	Sodium nitrate (fumigant)	Section 4.5.9

7.2.7.4.1 Anticoagulant Rodenticides

As their name suggests, anticoagulants function by inhibiting the production of blood-clotting factors. First-generation (e.g., chlorophacinone, diphacinone) anticoagulants require multiple doses to achieve lethality in rodent pests. Chlorophacinone is currently registered for the control of rodents in and around buildings and residences, industrial areas, and food processing, handling, and storage areas and facilities. Diphacinone baits are in/ around buildings and similar man-made structures. These compounds have very low water solubility and are moderately persistent in soils. First-generation rodenticides are classified as Category I (highly toxic) to mammals for oral, dermal, and inhalation toxicity (USEPA 1998c).

Second-generation (e.g., brodifacoum, bromadiolone, difethialone) compounds have the same mode of action as first-generation anticoagulants but are more acutely toxic than the first-generation anticoagulants because they are retained much longer in body tissues of primary consumers (Hartless and Jones 2011). Brodifacoum has the greatest acute toxicity of the Program rodenticides, but it is used very infrequently.

The anticoagulant rodenticides (bromadiolone and difethialone) that have been selected for further evaluation in Appendix B are discussed individually below.

7.2.7.4.2 Bromadiolone

Bromadiolone, the active ingredient in Contrac products, is a second-generation anticoagulant rodenticide that is used in and around buildings and in transport vehicles, alleys, and sewers. It is highly toxic to mammals, including humans, by acute oral, dermal, and inhalation exposure (USEPA 1998c). Bromadiolone is listed as Category III for eye irritation and Category IV for skin dermal irritation (USEPA 1998c).

Bromadiolone is a concern to the public due to its high mammalian toxicity. However, bromadiolone is usually wax-encased (e.g., Contrac Blox) in block form, which has exceptionally low water solubility and low leaching potential. Furthermore, when the District applies bromadiolone blocks in sewers, usually below manhole covers, it is suspended by a string. This method of bait deployment reduces the probability of exposure to humans and pets. When bromadiolone is used around residences, usually at a homeowner's request, the District places bromadiolone in tamper-proof bait stations, which are anchored at treatment locations (e.g., wires, stakes) to ensure that they cannot be dragged away by children or pets. The District educates citizens about the locations of bait blocks and potential risks to pets and children.

7.2.7.4.3 Difethialone

Difethialone is also a second-generation anticoagulant rodenticide that is the active ingredient in FirstStrike Soft Bait. It is very toxic to mammals, including humans, domestic pets, and nontarget mammalian wildlife, by all acute exposure routes. Difethialone is not known to cause skin or eye irritation. No genotoxic or carcinogenic effects have been noted (Annex I - Norway 2007).

Difethialone is also of public concern because of its high mammalian toxicity and because it is used in areas frequented by humans and domestic animals (parks, landscaped areas) during much of the year. As with bromadiolone, the District uses difethialone in tamper-proof bait stations, which are anchored at treatment locations (e.g., wires, stakes) to ensure that they cannot be dragged away by children or pets. The rodenticides are used at historical baiting sites when food competition occurs to increase the likelihood of exposure to only target rodents. The District educates citizens about the locations of bait blocks and potential risks to pets and children. If the District expands use in the future or additional issues arise regarding the use of this rodenticide, new, more protective rodenticide bait station alternatives the USEPA reports could be considered (http://www.epa.gov/pesticides/mice-and-rats/rodent-bait-station.html).

7.2.7.4.4 Neurotoxicant Rodenticide - Bromethalin

Bromethalin causes paralysis, neurological dysfunction, and death of rodent pests by uncoupling oxidative phosphorylation, which leads to decreased cellular ATP production and failure of Na+, K+-ATPase pumps, cellular swelling, and cerebral and spinal cord edema (Dunayer 2003). It is often used to exterminate rodents resistant to first generation anticoagulant rodenticides. It is highly toxic to mammals. However, many recent bromethalin products meet USEPA's new, more protective risk reduction standards because they present a lower risk of accidental exposure to children, pets, and wildlife. It is the active ingredient in many of the bait blocks the UESPA recommends as "New, more protective rodenticide bait stations" that may be used in place of the anticoagulants. Bromethalin is applied in tamper-resistant and weather-resistant bait stations (USEPA 2013a).

7.2.7.4.5 Sterol – Cholecalciferol

Cholecalciferol is used in and around homes, industrial buildings, and similar man-made structures, agricultural buildings, transport vehicles, port and terminal buildings; and in alleys. Formulation types include pellets and blocks (Clock-Rust and Sutton 2011). It is essentially insoluble in water and immobile in soils. Cholecalciferol is vitamin D3, and ingestion of high amounts results in hypercalcemia from mobilization of calcium from bone matrix into blood plasma leading to soft tissue mineralization resulting in loss of functionality of kidneys, cardiac muscle, etc. (Morrow 2001). It is not acutely toxic to humans at the doses used in bait stations and the District uses it infrequently. When the District does use it, residential treatments involve bait station deployment within 50 feet of home.

7.2.7.4.6 Fumigants

Sulfur

Sulfur is one of the active ingredients in four fumigant (gas-producing) cartridge products that are used for rodent control on lawns, on golf courses, and in gardens. Carbon, sodium and potassium nitrates, sawdust, and sulfur are used in the pyrotechnic fumigant gas-producing cartridge products. After the cartridges are ignited, they produce toxic gases that cause asphyxiation of the pests. The gases displace the oxygen in the burrows, creating an unbreathable atmosphere, causing asphyxiation of the target organisms (USEPA 2008a).

Elemental sulfur, when applied as a pesticide, will become incorporated into the natural sulfur cycle. The main processes and dissipation of elemental sulfur are oxidation into sulfate and reduction into sulfide. These processes are mainly mediated by microbes (USEPA 2008a). Sulfur is nontoxic to mammals.

Sodium Nitrate

Sodium nitrate fumigants work by the combustion of charcoal in the formulation of each product. Pyrolysis of these sodium nitrate products results in simple organic and inorganic compounds, mostly in the form of gases such as nitrous oxide and carbon monoxide, which eventually diffuse through burrow openings or into the soil causing organisms to die of asphyxiation (USEPA 1991a). The only people exposed to sodium nitrates should be pesticide applicators and only minimally (USEPA 1991b). The USEPA believes that sodium nitrates, when used as indicated, do not present any unreasonable adverse effects to humans.

7.2.8 Other Nonchemical Control/Trapping Component

The trapping of rodents and/or yellowjackets is conducted when these organisms pose a threat to public health and welfare. For both vector species, District staff place the tamper-resistant or baited trap(s) primarily at the request of the property owner or manager. The District does not remove rats or yellowjackets that are in or on structures. When these structural requests are made, residents are referred to a directory of private pest control companies. Trapping is also used for the removal of nuisance wildlife such as raccoon, skunk, and opossum when these animals pose a threat to public health and safety.

8 Public Services / Hazard Response

Chapter 8 evaluates the Program in relation to public services and hazard response. Results of the evaluation are provided at the programmatic level. Section 8.1, Environmental Background, presents an overview of the public services and hazard response in the Program Area, and contains state and local ordinances and regulations that are applicable to the Program. Section 8.2 provides an environmental assessment of the Program in terms of issues related to public services and hazard response

8.1 Environmental Background

8.1.1 Overview of Public Services and Hazard Response

The District operates according to its Emergency Response Plan, Employee Training Plan, an Emergency Response Plan-Spill Control and Clean Up Procedures, and Pesticide Safety Training Program. The plans provide BMPs for minimizing the impact of small spills of hazardous materials, storage of hazardous materials, and worker safety in the field conducting surveillance, physical control, vegetation management, and pesticide application protocols. In 2012, the District had only 0 incidents requiring spills management, only 1 incident involving worker safety, and no fire incidents. The Program would continue activities subject to these plans and BMPs in the future, similar to the existing Program.

A combination of county sheriffs' departments and municipal police departments provides law enforcement services in the Program Area. Sheriffs' departments typically provide law enforcement and jail services within their respective counties. In addition to law enforcement jurisdiction over unincorporated county areas, some sheriffs' departments, including Alameda and San Mateo county sheriffs' departments, also provide law enforcement services to certain cities within the county on a contract basis.

Additionally, the California Highway Patrol is the state police force for California. They have specific jurisdiction over all California state routes, US highways, interstate highways, and freeways in the state, and over all public roads in unincorporated parts of a county.

Fire protection services in the Program Area are provided by a number of agencies, including county fire departments, city fire departments, and fire districts. A number of counties also have volunteer fire departments.

California Department of Forestry and Fire Protection (CAL FIRE) oversees the fire protection and stewardship of over 31 million acres of California's privately owned wildlands. CAL FIRE's firefighters, fire engines, and aircraft respond to an average of more than 5,600 wildland fires each year. CAL FIRE also responds in other emergency situations such as medical aid, hazardous material spills, swift water rescues, search and rescue missions, civil disturbances, train wrecks, floods, earthquakes, and more. CAL FIRE provides varied emergency services in 36 of California's 58 counties via contracts with local governments.

8.1.2 Regulatory Setting

California state law and local ordinances and regulations pertaining to public services and hazard response are cited in this section. No federal regulations pertain to public services or hazard response. Regulations governing human health are discussed in Chapter 7, Human Health.

8.1.2.1 State

8.1.2.1.1 California Code of Regulations (CCR)

CCR Title 3 Division 6, Pesticides and Pest Control Operations, directs the safe use and transport of pesticides within the state. The following are some of the sections of particular relevance to the Program:

6670. Container Control

Pesticides, emptied containers or parts thereof, or equipment that holds or has held a pesticide, shall not be stored, handled, emptied, disposed of, or left unattended in such a manner or at any place where they may present a hazard to persons, animals (including bees), food, feed, crops or property. The [Agricultural] commissioner may take possession of such unattended pesticides or emptied containers to abate such hazard.

6672. Delivery of Pesticide Containers

(a) No person shall deliver a container that holds, or has held, a pesticide to a property unless he stores it in an enclosure or closure complying with the requirements of this Section or delivers it to a person in charge of the property or his agent, or a pest control operator or his employee. The person receiving the container shall control access to it in accordance with this Section.

(b) Each person who controls the use of any property or premises is responsible for all containers or equipment on the property that hold, or have held, a pesticide. Unless all such containers are under his personal control so as to avoid contact by unauthorized persons, he shall:

(1) Provide a person responsible to him to maintain such control over the containers at all times; or

(2) Store all such containers in a locked enclosure, or in the case of liquid pesticides in a container larger than 55 gallons in capacity, the container shall have a locked closure. Either shall be adequate to prevent unauthorized persons from gaining access to any of the material.

6682. Transportation

(a) Pesticides shall not be transported in the same compartment with persons, food or feed.

(b) Pesticide containers shall be secured to vehicles during transportation in a manner that will prevent spillage onto the vehicle or off the vehicle. Paper, cardboard, and similar containers shall be covered when necessary to protect them from moisture.

8.1.2.1.2 California Department of Forestry and Fire Protection

Public Resources Code 4201-4204 directs CAL FIRE to map fire hazards within State Responsibility Areas based on relevant factors such as fuels, terrain, and weather. These statutes were passed after significant wildland-urban interface fires occurred; consequently, these hazards are described according to their potential for causing ignitions to buildings. These zones, referred to as Fire Hazard Severity Zones (FHSZs), provide the basis for application of various mitigation strategies to reduce risks to buildings associated with wildland fires (CAL FIRE 2007).

Additionally, the Public Resources Code, beginning with Section 4427, includes fire safety regulations that restrict the use of equipment that may produce a spark, flame, or fire; require the use of spark arrestors on construction equipment with internal combustion engines; specify requirements for the safe use of gasoline-powered tools in fire hazard areas; and specify fire suppression equipment that must be provided on site for various types of work in fire-prone areas. These requirements would apply to Program activities within a “Very High Fire Hazard Severity Zone.”

8.1.2.2 Local

Local ordinances and regulations are usually contained within the general plans of cities and counties in the Program Area, and focus on providing adequate public services and hazard response with a reasonably

brief response time throughout the Service Area. Municipal and county ordinances establish police and fire departments and districts, and some establish emergency preparedness councils or committees.

8.2 Environmental Evaluation

The evaluation for public services and hazard response is provided below.

8.2.1 Evaluation Concerns

The following concerns were associated with public services and hazard response and are addressed in this section:

> Risk of spill of hazardous materials from equipment or applications of pesticides

> Risk of aerial equipment failure during applications of pesticides.

> Safe storage and disposal of chemical-related materials including pesticide containers.

Although activities proposed under the Program components could occur on or near sites included on a list of hazardous materials sites (e.g., landfills and manufacturing sites) compiled pursuant to Government Code Section 65962.5 (Cal/EPA 2013), most of these activities, with the exception of constructing new shallow ditches or minor water control features, would not involve excavation or other ground disturbance that could result in adverse effects related to the release of materials at these hazardous materials sites. However, the District maintains a list of these existing hazardous materials sites within their Service Area.

One of the Program components involves aerial application of chemical treatments and would, therefore, occur partially within areas covered by airport land use plans, within 2 miles of public airports or public use airports, or within the vicinity of private airstrips. However, no construction or other activities would occur that would conflict with airport land use plans or result in a safety hazard for people residing or working in proximity to these facilities. Therefore, this criterion is not applicable to the Program and is not discussed further.

None of the Program components would result in any road or lane closures or detours. The Program would not involve activities that could impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan. Therefore, this criterion is not applicable to the Program and is not discussed further.

Under some of the Program components, the District and its registered contractors would practice safe disposal of pesticide products. Properly rinsed empty containers can be safely and legally disposed of at landfills. Any unused portions of Program chemicals would be disposed of at permitted hazardous waste collection locations. Adequate landfill and hazardous waste collection capacity exists in locations throughout the Program Area. The Program would not exceed the existing capacity to safely dispose of these materials. Therefore, this criterion is not applicable to the Program and is not discussed further.

Based on public concerns and the relevant CEQA criteria above, the environmental issues topics addressed in the evaluation are:

(a) Increase Demand for Police, Fire, or Health-Care Services

(b) Create a Significant Hazard to the Public or Environment

(c) Expose People or Structures to Wildfire Risk

8.2.2 Evaluation Methods and Assumptions

The methodology and assumptions of this evaluation for the Program components are provided below.

8.2.2.1 Methodology

The methodology used to prepare this public services and hazard response evaluation is as follows:

> Reviewed transcripts from public scoping meetings in May and June 2011.

> Summarized federal, state, county, and select municipal regulations, ordinances, and guidelines for general public services and hazard response issues and as they related to the Program.

> Evaluated potential hazards requiring response and potential interference with public services and hazard response at the programmatic level.

> Evaluation potential issues associated with the Program components, as described in Chapter 2, Program Description.

8.2.2.2 Assumptions

For the analysis of potential effects to public services and hazard response, no assumptions were made beyond those explained in Chapter 2, Program Description, for the Program components.

8.2.3 Surveillance Component

The Surveillance component involves both ground surveillance and water surveillance. Surveillance activities include field investigations, trapping, sampling, and responding to public service requests. The number and type of vehicles and equipment required for surveillance would vary by District, but typically, ground surveillance would require the periodic use of light trucks, such as pickup trucks and jeeps, and low ground pressure ATVs, and would take place in all land use types. Water surveillance would require the use of ATVs and, occasionally, boats and most frequently would occur in agricultural and open-space areas. Most equipment would only be operated a few hours per day for varying periods of time throughout the year. Pesticide use is limited; only small amounts of chemicals are used for mosquito trapping purposes (i.e., dichlorvos-containing solid paper “fragments” that are used in mosquito collection jars).

8.2.3.1 Increase Demand for Police, Fire, or Health-Care Services

It is unlikely that the Surveillance component would result in a substantial increase in requests for services from emergency dispatchers, and the Program would not adversely affect the ability of 911 dispatchers to handle calls.

8.2.3.1.1 Create a Significant Hazard to the Public or Environment

Surveillance activities, including the use of vehicles and small amounts of pesticides in containers, would not create a significant hazard to the public or the environment. District staff would adhere to all applicable CCR requirements regarding pesticides and to trap label instructions. The District’s Hazard Assessment Process, Illness and Injury Prevention Program and ongoing safety program provide training for all employees who may be affected by any substance, process, procedure, or equipment that represents a potential hazard. Training programs are conducted for the safe use of equipment, machinery, or tools and the safe use and disposal of pesticides. Staff are also enrolled in a continuing education program in cooperation with the California Department of Public Health.

Adherence to CCR requirements reduces the potential for accident conditions; therefore, the Surveillance component does not result in significant hazards to the public or environment.

8.2.3.1.2 Expose People or Structures to Wildfire Risk

Surveillance vehicles could be used in moderate to very high FHSZs. Ground surveillance requires the periodic use of light trucks, such as pickup trucks and jeeps, and ATVs, but does not require the use of large-scale, offroad equipment. In addition, surveillance is conducted via existing roads and access routes except when existing routes are unavailable and offroad access is required. All vehicles used in wildland areas are equipped with a shovel and a fire extinguisher during the dry season. The District's Hazard Assessment Process, Illness and Injury Prevention Program and ongoing Driver Training, Offroad Training and District Safety Program provide training for all employees on the safe use of equipment and machinery, including vehicle operation. These measures reduce fire hazards; therefore, the Surveillance component does not likely increase wildfire hazards through the use of equipment that may produce a spark, flame, or fire and does not expose people or structures to a significant risk of loss, injury, or death involving wildland fires.

8.2.4 Physical Control Component

The Physical Control component involves managing vector habitat to reduce vector production or migration and typically reduces the need for pesticides. Vector management is accomplished primarily through direct habitat management and public education. Physical control for mosquitos consists of managing wetlands and water bodies through maintenance, new construction, and cultural practices such as the installation and maintenance of water control facilities, sediment and debris removal, vegetation maintenance and removal, and the construction of ditches or installation of culverts that eliminate mosquito-breeding habitat. The District also requires some landowners to conduct similar maintenance activities for mosquito abatement. Physical controls for mammal vectors include reducing food sources and reducing conditions that promote harborage.

The number and type of vehicles and equipment required for physical control varies by activity, but typically, terrestrial activities require the periodic use of light trucks, such as pickup trucks and jeeps, and ATVs. Wetland and aquatic activities require the use of ATVs and, occasionally, boats and sprayers.

8.2.4.1.1 Increase Demand for Police, Fire, or Health-Care Services

It is unlikely that the Physical Control component results in a substantial increase in requests for services from emergency dispatchers, and the Program does not adversely affect the ability of 911 dispatchers to handle calls.

8.2.4.1.2 Create a Significant Hazard to the Public or Environment

Physical control activities do not include the use of pesticides and are intended to reduce the need to use chemical control measures for mosquito and/or vector control; therefore, the Physical Control component does not create a significant hazard to the public or the environment.

8.2.4.1.3 Expose People or Structures to Wildfire Risk

Physical control requires the use of vehicles and equipment that could be used in moderate to very high FHSZs. Access to work sites requires the periodic use of light trucks, such as pickup trucks and jeeps, and ATVs. Physical control activities are conducted via existing roads and access routes except when existing routes are unavailable and offroad access is required. Construction of ditches, levees, or other features could also require the use of large-scale, offroad equipment. Power tools are also used for vegetation management. The District's Hazard Assessment Process, Illness and Injury Prevention Program and ongoing safety program provide training for all employees on the safe use of equipment, tools, and machinery, including vehicle operation. After completing the training, employees are enrolled in a continuing education program. All vehicles are equipped with a shovel and a fire extinguisher during the dry season. These measures reduce fire hazards; therefore, the Physical Control component is not likely

to increase wildfire hazards through the use of equipment that may produce a spark, flame, or fire and do not expose people or structures to a significant risk of loss, injury, or death involving wildland fires.

8.2.5 Vegetation Management Component

Vegetation management activities are conducted to reduce the value of mosquito habitat and to allow District access for inspections and treatment. The number and type of vehicles and equipment required would vary by activity, but typically, access to vegetation management areas would require the periodic use of light trucks, such as pickup trucks and jeeps, and ATVs. Access at or near aquatic areas requires the use of ATVs and, occasionally, boats and sprayers. Vegetation management activities require the use of hand tools or other mechanical means (i.e., heavy equipment) for vegetation removal or thinning. Vegetation removal or thinning primarily occurs in aquatic habitats to control mosquitoes and in terrestrial habitats to control other vectors. To reduce the potential for mosquito breeding associated with water retention and infiltration structures, District staff may systematically clear weeds and other obstructing vegetation in wetlands and retention basins (or request the structures' owners to perform this task). Tools ranging from shovels and pruners to chain saws and weed eaters up to heavy equipment can all be used at times to clear plant matter that either prevent access to mosquito-breeding sites or that prevent good water management practices which would minimize mosquito populations. Generally, however, District brushing activities rely almost entirely on hand tools. Trimmed vegetation is either removed and disposed of properly from the site or broadcast in such a way as to minimize visual degradation of the habitat. Trimming is also kept to a minimum to reduce the possibility of the invasion of exotic plant and animal species. Water control structures are also used to manage vegetation by manipulating hydroperiods.

8.2.5.1.1 Increase Demand for Police, Fire, or Health-Care Services

It is unlikely that the Vegetation Management component results in a substantial increase in requests for services from emergency dispatchers, and the Program does not adversely affect the ability of 911 dispatchers to handle calls.

8.2.5.1.2 Expose People or Structures to Wildfire Risk

Vehicles and power tools can be used in moderate to very high FHSZs during vegetation management activities. Power tools include leaf blowers, mowers, chain saws, and weed eaters. Access to sites and vegetation management requires the periodic use of light trucks, such as pickup trucks and jeeps, and ATVs, and could require the use of large-scale, offroad equipment such as tractors. Access will be via existing roads and access routes except when existing routes are unavailable and offroad access is required. The District's Hazard Assessment Process, Illness and Injury Prevention Program and ongoing safety program provide training for all employees on the safe use of tools, equipment, and machinery, including vehicle operation. After completing the training, employees are required to take a comprehensive examination and are enrolled in a continuing education program. All vehicles are equipped with a shovel and a fire extinguisher during the dry season. These measures reduce fire hazards; therefore, the Vegetation Management component is not likely to increase wildfire hazards through the use of equipment that may produce a spark, flame, or fire and would not expose people or structures to a significant risk of loss, injury, or death involving wildland fires.

8.2.6 Biological Control Component

The Biological Control component involves the use of pathogens and predators to reduce mosquito populations. Biological control is not utilized for controlling other vectors. Mosquito pathogens include bacteria and viruses specifically targeted to mosquitoes which do not pose a risk to public health. Insects, fish, birds, and bats are predators used for biological control of mosquitoes. Mosquitofish (*Gambusia affinis*) are the most commonly used biological control agent throughout the world and the primary means of control used by the District. Biological control requires the periodic use of light trucks, and occasionally, ATVs, boats, tractors, helicopters, and sprayers.

The use of biological control reduces the need to use pesticides, but the use of pathogens involves chemical treatment. Examples of bacteria pathogenic to mosquitoes are Bs, the several strains of Bti, and *Saacharopolyspora spinosa (*spinosad*)*. Because the potential environmental effects of Bs or Bti application are generally similar to those of chemical pesticide applications, these materials and spinosad are evaluated below under the Chemical Control component.

8.2.6.1.1 Increase Demand for Police, Fire, or Health-Care Services

It is unlikely that the Biological Control component results in a substantial increase in requests for services from emergency dispatchers, and the Program does not adversely affect the ability of 911 dispatchers to handle calls.

8.2.6.1.2 Create a Significant Hazard to the Public or Environment

Biological control activities do not include the use of pesticides or other hazardous materials, but rely on mosquitofish, and are intended to reduce the need to use chemical control measures. Mosquitofish are used in controlled environments to avoid their migration into habitats used by sensitive species. District policy is to limit their use to ornamental fish ponds, water troughs, water gardens, fountains, and unused swimming pools. Therefore, the Biological Control component does not create a significant hazard to the public or the environment.

8.2.6.1.3 Expose People or Structures to Wildfire Risk

Vehicles may be used to access areas or to release or apply mosquitofish in areas that are moderate to very high FHSZs. Access requires the periodic use of light trucks, such as pickup trucks and jeeps, and ATVs, but does not require the use of large-scale, offroad equipment. The application of Bs, Bti, and spinosad is performed by hand, from an ATV, or from a helicopter. Access for biological control is via existing roads and access routes except when existing routes are unavailable and offroad access is required. The District's Hazard Assessment Process, Illness and Injury Prevention Program and ongoing safety program provide training for all employees on the safe use of equipment and machinery, including vehicle operation. After completing the training, employees are required to take a comprehensive examination and are enrolled in a continuing education program. All vehicles are equipped with a shovel and a fire extinguisher during the dry season. These measures reduce fire hazards; therefore, the Biological Control component is not likely to increase wildfire hazards through the use of equipment that may produce a spark, flame, or fire and would not expose people or structures to a significant risk of loss, injury, or death involving wildland fires.

8.2.7 Chemical Control Component

Chemical control is a Program tool that consists of the application of nonpersistent selective insecticides to directly reduce populations of larval or adult mosquitoes and other invertebrate threats to public health (e.g., ticks, yellowjacket wasps), and the use of rodenticides to control rats and mice. Chemical control is implemented when inspections reveal that mosquitoes or other vector populations are present at levels that trigger the District's criteria for chemical control based on the vector's abundance, density, species composition, proximity to human settlements, water temperature, presence of predators and other factors.

The majority of chemical control tools are used for mosquito abatement and consist of larvicides and adulticides. Mosquito larvicides routinely used by the District include Bti, Bs, Methoprene (Altosid), CoCoBear Oil, BVA-2, Masterline Mosquito Larvicide, *Saacharopolyspora spinosa* (spinosad) (Natular) and Agnique. Adulticides potentially used by the District include Pyrethrins (Pyrocide®, Pyrenone 25-5®), Pyrenone Crop Spray® and the synthetic pyrethroids Resmethrin (Scourge®) and Permethrin (Kontrol 4-4). Mosquito adulticide materials are used infrequently and only when necessary to control mosquito populations.

Pyrethroid-based chemicals are typically used against ground-nesting yellowjackets and ticks, and this control measure is usually triggered by public requests. When the District treats stinging insects, staff will apply the insecticide directly within the nest in accordance with the District's policies to avoid drift of the insecticide or harm to other organisms. Alternatively, they will place tamper-resistant traps or bait stations, selective for the target insect in the immediate environment of the vector. The potential environmental effects of these materials is minimal due to two factors: (1) their active ingredients consist largely of pyrethrins (a photosensitive natural insecticide manufactured from a Chrysanthemum species), or allethrin and phenothrin (first generation synthetic pyrethroids with similar photosensitive, nonpersistent characteristics as pyrethrin); and (2) the mode of their application for yellowjacket population control (i.e., directly into the underground nest), which prevents drift and further reduces the potential for inadvertent exposure to these materials.

The District's Rodent Program implements the limited use of rodenticides usually in response to District resident requests of severe rodent infestations. Two different groups of anticoagulant rodenticides, known as first generation and second generation rodenticides, may be utilized by the District. First generation rodenticides require consecutive multiple doses or feedings over a number of days to be effective. Concentrations of active ingredient in the bait typically range from 0.005 to 0.1 percent. Second generation rodenticides are lethal after one dose and are effective against rodents that have become resistant to first generation rodenticides. Concentrations of active ingredient in the bait typically range from 0.001 to 0.005 percent, as these anticoagulant baits are far more toxic than first generation baits. These materials are also used in controlled conditions, such as in underground sewers, to minimize the potential for nontarget species to ingest either the bait or the contaminated dead rat.

8.2.7.1 Mosquito Ground Application

For ground larviciding the District uses a variety of techniques and equipment to apply larvicides, including hand held sprayers, backpack sprayers, and blowers, and truck- or ATV-mounted spray rigs. The District uses conventional pickup trucks, and ARGO and Polaris ATVs as ground larvicide vehicles. ATV safety and handling is provided to employees before operating these machines. Ground larviciding allows applications while in close proximity to the actual treatment area, and consequently treatments occur to only those micro habitats where larvae are actually present, reducing the pesticide load on the environment compared to aerial application. However, risk of chemical exposure is also greater for the applicators during ground larviciding than during aerial larviciding.

Adulticiding is the only known effective measure of reducing an adult mosquito population in a timely manner. The most common form of adulticide application is ground aduticiding via insecticide aerosols at very low dosages, which is referred to as the ULV method. This method employs specially designed ULV equipment mounted on trucks, ATVs, golf carts, and boats or hand-held for ground applications. Cold aerosol generators, cold foggers, and ULV aerosol machines are constructed by mounting a vortex nozzle on the forced air blower of a thermal fogger. Insecticide is applied as technical material or at moderately high concentrations (as is common with the pyrethroids) which translates to very small quantities per acre. In agriculture, this rate is assumed less than 36 ounces per acre, but mosquito control ground adulticiding operations rarely exceed 1 ounce per acre. The optimum sized droplet for mosquito control with cold aerosols applied at ground level has been determined to be in the range of 5 to 20 microns.

8.2.7.1.1 Increase Demand for Police, Fire, or Health-Care Services

Occasional calls to the District or to emergency personnel can occur from the public in the treatment area due to concerns about the potential for health effects and need to stay indoors (or not), especially when a large-scale application is planned for an imminent and severe threat to public health. In 2012, the District received about 10 calls of this type. (Most calls are for information on dealing with pest problems and requests for service.) Therefore, the Chemical Control component does not result in a substantial increase in requests for actual services from emergency dispatchers, and the Program does not adversely affect the ability of 911 dispatchers to handle calls.

8.2.7.1.2 Create a Significant Hazard to the Public or Environment

The District uses the Chemical Control method only when other alternatives are ruled out after certain criteria are met that require implementing Chemical Control component (ground larviciding and adulticiding). Ground larviciding allows applications while in close proximity to the actual treatment area and, consequently, treatments occur to only those microhabitats where larvae are actually present, reducing the pesticide load on the environment compared to aerial application. Ground adulticiding employs specialized equipment that provides targeted control and applications at small quantities per acre and ULVs, reducing potential drift and nontarget exposure.

Applicators adhere to all applicable CCR requirements regarding pesticides to ensure safety and strictly adhere to the specific label instructions for each pesticide (see Section 2.9.1 and Appendix B). The District's Illness and Injury Prevention Program and the Emergency Response Plan provide safety training for all employees who may be affected by any substance, process, procedure or equipment that represents a potential hazard. Training programs are conducted for the safe use of equipment, machinery, or tools and the safe use and disposal of pesticides. After completing the training, employees are required to take a comprehensive examination and are enrolled in a continuing education program.

All small pesticide spills are handled according to the District's procedures for cleanup of small spills of 5 gallons or less as follows:

> Adequate caution shall be exercised to prevent spillage of pesticides during storage, transportation, mixing or application of pesticides. All pesticide spills and cleanups (excepting cases where dry materials may be returned to the container or application equipment) shall be reported using the Vector Control Management System (VCMS) database application.

> A pesticide spill cleanup kit and proper protective equipment will be maintained at the Vector Control Service Yard and in each vehicle used for pesticide application or transport.

> The spill site should be managed to prevent entry by unauthorized personnel. The spill will be contained and controlled by stopping it from leaking or spreading to surrounding areas, and dry spills will be covered with polyethylene or plastic tarpaulin and liquid spills will be absorbed with appropriate absorbent materials.

> The spilled material will be properly secured and the bags will be labeled with service container labels identifying the pesticide and delivered to the Field Operations Support Specialist for disposal.

> Applicators must wear a P-95 disposable filtering face piece respirator for spill of Bs and Bti dry formulations.

Adherence to pesticide label instructions and the District's small spill cleanup procedure reduces the potential for accident conditions to affect the public or the environment; therefore, ground larviciding and adulticiding under the Chemical Control component do not result in significant hazards to the public or environment. See also Sections 6.2.7 and 7.2.7.

8.2.7.1.3 Expose People or Structures to Wildfire Risk

Chemical control vehicles and equipment used for ground larviciding and adulticiding could be used in moderate to very high FHSZs. The Districts would use a variety of vehicles and equipment for access to sites and to apply ground larvicides and adulticides, including conventional pickup trucks and ATVs, blowers, and truck- or ATV-mounted spray rigs. Access to sites is via existing roads and access routes except when existing routes are unavailable and offroad access is required. The District's Hazard Assessment Process, Illness and Injury Prevention Program and ongoing safety program provide training for all employees on the safe use of tools, equipment, and machinery, including vehicle operation. After completing the training, employees are enrolled in a continuing education program. All vehicles are equipped with a shovel and a fire extinguisher during the dry season. These measures reduce fire

hazards; therefore, the Chemical Control component does not likely increase wildfire hazards through the use of equipment that may produce a spark, flame, or fire and would not expose people or structures to a significant risk of loss, injury, or death involving wildland fires.

8.2.7.2 Mosquito Aerial Application

When large areas are simultaneously producing mosquito larvae at densities exceeding District treatment thresholds, then the District may use helicopters or other aircraft to apply any of the larvicides. Aerial application of larvicides is a relatively infrequent activity for the District, typically occurring only a few times each year, with each application covering around 200 to 1,200 acres. Aerial application can be more practical for remote or inaccessible areas than ground larviciding. However, risk of drift is greater with aerial applications, especially with liquid or ULV aerial larviciding and, consequently, potential risk of nontarget exposure is greater.

The aerial larvicides, excluding granular and pellet formulations, are typically combined with water and applied as a low volume wet spray mix at 2 gallons per acre and sometimes at 5 gallons per acre. Aerial application of liquid larvicides typically occurs during daylight hours and at an altitude above the treatment site of less than 40 feet. Granular and pellet formulations of larvicides are applied using a large mechanical spreader with a bucket that can hold several hundred pounds of payload beneath the aircraft. Granular applications occur during daylight hours and are at a less-than-50-foot altitude.

Aerial adulticiding is often the only means available to cover a very large area quickly in case of severe mosquito outbreaks or vector-borne disease epidemics, and aerial applications may be the only reliable means of gaining effective control in some areas. Two aerial adulticiding techniques are used in California: low volume spraying and ULV aerosols. Low volume (<2 gallons per acre) sprays are applied with the pesticide diluted in light petroleum oils or water and as a rather wet spray. The size of the droplets reduces drift, thus limiting swath widths, and may not be ideal under certain circumstances for impinging on mosquitoes. The technique is compatible with equipment commonly used for aerial liquid larviciding.

A common aerial adulticiding technique applies the insecticide in a technical concentrate or in a very high concentration formulation as an ULV cold aerosol. Lighter aircraft, including helicopters, can be used because the insecticide load is a fraction of the other techniques. If the aircraft is capable of >120 knots, fine droplets can be created by the high speed air stream impeding the flow from hydraulic nozzles. Slower aircraft and most helicopters typically use some variety of rotary atomizers to create the required droplet spectrum. ULV applications can be difficult to accurately place with any regularity. Without the visual cues, drift and settling characteristics can be difficult to assess.

The flight parameters for aerial adulticiding differ by technique. Some operations fly during hours of daylight. At these times, the pilots should be able to see towers and other obstructions as well as keep track of the spray plume. The aircraft can be flown at a less-than-200-foot altitude, which may make it easier to hit the target area. Other operations may be conducted in the dark of the night. The aircraft typically are flown between a 200-and 300-foot altitude. Swath widths vary from operation to operation but are normally set somewhere between 400 and 1,200 feet. Swaths are flown as close to perpendicular with the wind as is possible. A number of factors affect the spray-drift offset and settling such as wind speed, droplet size, aircraft wake turbulence, altitude, and even characteristics of the individual aircraft. Pilots rely somewhat on experience for determining this offset, and some use telltale smoke or paper markers for swath alignment.

One of the public concerns was regarding potential hazards from fuel dumping, which is a procedure used to lighten an aircraft's weight in certain emergency situations. For instance, if a flight takes off at a maximum takeoff weight and then faces a situation where it must return to the departure airport (due to certain mechanical problems or a passenger medical issue), not enough time is available to consume the fuel meant for getting to the original destination, and the aircraft may be over the maximum landing weight to land back at the departure point. Fuel would be released before landing. Once released, fuel would trail

behind the aircraft. Most aviation fuel is a derivative of kerosene, which evaporates rapidly in the atmosphere and rarely survives in liquid form to reach the earth's surface.

This issue does not apply to the District's use of helicopter or fixed-wing aircraft. These aircraft are not equipped to dump fuel. Only very large aircraft such as 727s and 747s are equipped to dump fuel prior to an emergency landing.

8.2.7.2.1 Increase Demand for Police, Fire, or Health-Care Services

Occasional calls to the District or to emergency personnel may occur from the public in the treatment area. However, it is unlikely that aerial application under the Chemical Control component results in a substantial increase in requests for services from emergency dispatchers, and the Program does not adversely affect the ability of 911 dispatchers to handle calls.

8.2.7.2.2 Create a Significant Hazard to the Public or Environment

The use, transport, and disposal of the pesticides would not create a significant hazard to the public or the environment. The District uses the Chemical Control method only when other alternatives are ruled out after certain criteria are met that require implementing the Chemical Control component. Aerial application of larvicides and adulticides is a relatively infrequent activity for the District. Applicators would adhere to all applicable CCR requirements regarding pesticides to ensure safety and strictly adhere to the specific label instructions for each pesticide (see Section 2.9.1 and Appendix B). The District's Hazard Assessment Process, Illness and Injury Prevention Program and ongoing safety program provide safety training for all employees who may be affected by any substance, process, procedure or equipment that represents a potential hazard. Training programs are conducted for the safe use of equipment, machinery or tools, and use and disposal of pesticides. After completing the training, employees are enrolled in a continuing education program.

All small pesticide spills are handled according to the District's procedures for cleanup of 5-gallon-or-less spills as follows:

> Adequate caution shall be exercised to prevent spillage of pesticides during storage, transportation, mixing or application of pesticides. All pesticide spills and cleanups (excepting cases where dry materials may be returned to the container or application equipment) shall be reported using the Vector Control Management System (VCMS) database application.

> A pesticide spill cleanup kit and proper protective equipment will be maintained at the Vector Control Service Yard and in each vehicle used for pesticide application or transport.

> The spill site should be managed to prevent entry by unauthorized personnel. The spill will be contained and controlled by stopping it from leaking or spreading to surrounding areas, and dry spills will be covered with polyethylene or plastic tarpaulin and liquid spills will be absorbed with appropriate absorbent materials.

> The spilled material will be properly secured and the bags will be labeled with service container labels identifying the pesticide and delivered to the Field Operations Support Specialist for disposal.

> Applicators must wear a P-95 disposable filtering face piece respirator for spill of Bs and Bti dry formulations.

Adherence to pesticide label instructions and the District's small spill cleanup procedure reduces the potential for accident conditions to affect the public or the environment; therefore, the Chemical Control component would not result in significant hazards to the public or environment.

8.2.7.2.3 Expose People or Structures to Wildfire Risk

Helicopters or other aircraft may be used in moderate to very high FHSZs for aerial application similar to existing conditions. However, continued flight operations do not pose increased fire risk in those zones,

and the Program does not substantially increase the risk of wildfire from accidents; therefore, the Chemical Control component (aerial application) does not likely to increase wildfire hazards through the use of equipment that may produce a spark, flame, or fire and does not expose people or structures to a significant risk of loss, injury, or death involving wildland fires.

8.2.7.3 Yellowjackets and Other Arthropods

8.2.7.3.1 Increase Demand for Police, Fire, or Health-Care Services

It is unlikely that the Chemical Control component (for yellowjackets and ticks) results in a substantial increase in requests for services from emergency dispatchers, and the Program does not adversely affect the ability of 911 dispatchers to handle calls.

8.2.7.3.2 Create a Significant Hazard to the Public or Environment

The District uses the Chemical Control method only when other alternatives are ruled out after certain criteria are met that require implementing the Chemical Control component. Applicators would adhere to all applicable CCR requirements regarding pesticides to ensure safety and strictly adhere to the specific label instructions for each pesticide (see Section 2.9.1 and Appendix B). The District's Hazard Assessment Process, Illness and Injury Prevention Program and ongoing safety program provide safety training for all employees who may be affected by any substance, process, procedure or equipment that represents a potential hazard. Training programs are conducted for the safe use of equipment, machinery, or tools and the safe use and disposal of pesticides. After completing the training, employees are required to take a comprehensive examination and are enrolled in a continuing education program.

All small pesticide spills are handled according to the District's procedures for cleanup of 5-gallon-or-less spills as follows:

> Adequate caution shall be exercised to prevent spillage of pesticides during storage, transportation, mixing or application of pesticides. All pesticide spills and cleanups (excepting cases where dry materials may be returned to the container or application equipment) shall be reported using the Vector Control Management System (VCMS) database application.

> A pesticide spill cleanup kit and proper protective equipment will be maintained at the Vector Control Service Yard and in each vehicle used for pesticide application or transport.

> The spill site should be managed to prevent entry by unauthorized personnel. The spill will be contained and controlled by stopping it from leaking or spreading to surrounding areas, and dry spills will be covered with polyethylene or plastic tarpaulin and liquid spills will be absorbed with appropriate absorbent materials.

> The spilled material will be properly secured and the bags will be labeled with service container labels identifying the pesticide and delivered to the Field Operations Support Specialist for disposal.

> Applicators must wear a P-95 disposable filtering face piece respirator for spill of Bs and Bti dry formulations.

Consistent with existing conditions, the District's adherence to pesticide label instructions and the small spill cleanup procedure reduces the potential for accident conditions to the public or the environment; therefore, the Chemical Control component does not result in significant hazards to the public or environment.

8.2.7.3.3 Expose People or Structures to Wildfire Risk

Vehicles may be used in moderate to very high FHSZs similar to existing conditions. Access to application sites could require the periodic use of light trucks, such as pickup trucks and jeeps, and ATVs, but does not require the use of large-scale, offroad equipment. Access is via existing roads and access

routes except when existing routes are unavailable and offroad access is required. The District's Illness and Injury Prevention Program and the Emergency Response Plan provide training for all employees on the safe use of tools, equipment, and machinery, including vehicle operation. After completing the training, employees are required to take a comprehensive examination and are enrolled in a continuing education program. All vehicles are equipped with a shovel and a fire extinguisher during the dry season. These measures will reduce fire hazards; therefore, the Chemical Control component does not likely increase wildfire hazards through the use of equipment that may produce a spark, flame, or fire and does not expose people or structures to a significant risk of loss, injury, or death involving wildland fires.

8.2.8 Other Nonchemical Control/Trapping Component

The Other Nonchemical Control/Trapping component includes the use of tamper-resistant or baited traps to trap rodents and/or yellowjackets that pose a threat to public health and welfare. Trapping is also used for the removal of nuisance wildlife such as raccoon, skunk, and opossum when these animals pose a threat to public health and safety.

8.2.8.1.1 Increase Demand for Police, Fire, or Health-Care Services

It is unlikely that the Other Nonchemical Control/Trapping component result in a substantial increase in requests for services from emergency dispatchers, and the Program does not adversely affect the ability of 911 dispatchers to handle calls.

8.2.8.1.2 Create a Significant Hazard to the Public or Environment

Other Nonchemical Control/Trapping component activities do not include the use or transport of pesticides that could spill or leak into the environment; therefore this component does not create a significant hazard to the public or the environment.

8.2.8.1.3 Expose People or Structures to Wildfire Risk

Other Nonchemical Control/Trapping component activities may require operating vehicles in moderate to very high FHSZs. Access to sites could require the periodic use of light trucks, such as pickup trucks and jeeps, and ATVs, but would not require the use of large-scale, offroad equipment. In addition, access would be via existing roads and access routes except when existing routes are unavailable and offroad access is required. The District's Illness and Injury Prevention Program and the Emergency Response Plan provide training for all employees on the safe use of equipment, and machinery, including vehicle operation. After completing the training, employees are required to take a comprehensive examination and are enrolled in a continuing education program. All vehicles are equipped with a shovel and a fire extinguisher during the dry season. These measures reduce fire hazards; therefore, the Other Nonchemical Control/Trapping component does not likely increase wildfire hazards through the use of equipment that may produce a spark, flame, or fire and does not expose people or structures to a significant risk of loss, injury, or death involving wildland fires.

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9 Water Resources

Chapter 9 evaluates the District's Program in relation to water resources. Results of the evaluation are provided at the programmatic level. Section 9.1, Environmental Background, presents an overview of the physical properties and Environmental Backgrounds; and contains federal regulations, state regulations, and local ordinances and regulations that are applicable to the Program. Section 9.2 provides an assessment in terms of environmental issues associated with protection of water resources.

9.1 Environmental Background

9.1.1 California's Hydrologic and Geomorphic Regions

The hydrologic resources of California can be divided into regions based on several hydrologic characteristics. The California Water Plan divides California into 10 hydrologic regions. These regions are delineated based upon the state's major drainage basins. Each region has distinct precipitation characteristics and water bodies.

Hydrologic regions over District Program Area include portions of San Francisco Bay San Joaquin River and Central Coast hydrologic regions. The District's Service Area and lands in adjacent counties comprise the District's Program Area, and the hydrologic regions with important water features for the District are shown on Figure 9-1. Description of surface water and groundwater characteristics for the differing hydrologic regions relied on *California Water Plan, Update 2009* and *California Water Plan, Update 2013, Advisory Committee Review Draft* (CDWR 2009a-c, 2013a-d

9.1.1.1 San Francisco Bay Hydrologic Region

The San Francisco Bay Hydrologic Region (Bay Region) occupies approximately 4,500 square miles, from Tomales Bay in Marin County to southern Santa Clara County, and inland to the confluence of the Sacramento and San Joaquin Rivers near Collinsville. The eastern boundary follows the crest of the Coast Range where the highest peaks are more than 4,000 feet above mean sea level (CDWR 2013b). This region includes portions of Marin, Sonoma, Napa, Solano, San Mateo, Santa Clara, Contra Costa, and Alameda counties.

Principle watersheds in the Bay Region include Tomales Bay, Corte Madera Creek, Novato Creek, Petaluma River, Sonoma Creek, Napa River, Wildcat Creek, San Pablo Creek, Green Valley Creek, Suisun Creek, Walnut Creek, San Mateo Creek, San Francisquito Creek, Guadalupe River, Coyote Creek, Alameda Creek, San Lorenzo Creek, and San Leandro Creek watersheds. These watersheds drain into Suisun, San Pablo, North San Francisco, and South San Francisco bays, or directly into the Pacific Ocean. For example, the Guadalupe River and Coyote and Alameda creeks drain from the Coast Range and flow northwest into San Francisco Bay. The Napa River originates in the Mayacamas Mountains at the northern end of Napa Valley and flows south into San Pablo Bay. Sonoma Creek begins in mountains within Sugarloaf State Park and flows south through Sonoma Valley into San Pablo Bay.

A large proportion of the nine counties that surround the San Francisco Bay is urbanized. As a result, many creeks have been confined to underground culverts beneath the developed regions. While many larger creeks remain open, they often have been heavily modified to run in concrete channels to optimize flood conveyance and provide flood protection. Ownership of Bay Area streams is a patchwork of public title, public easements, and private ownership that complicates policies and jurisdiction over, or maintenance responsibility for, urban streams. Many Bay Area stream reaches have, in fact, no established public jurisdiction or maintenance responsibility (RMC 2006).

Tidal marshes occur throughout much of the fringe of the San Francisco Bay, from the lowest extent of vascular vegetation to the top of the intertidal zone (at the maximum height of the tides). Tidal marsh also exists in the tidal reaches of local rivers and streams. Tidal marshland was once more extensive and was estimated to be 190,000 acres; however, development in the region has decreased the amount of tidal marshland to approximately 40,000 acres. A large effort has recently been undertaken to restore these ecosystems as high-quality wetlands have been shown to moderate the effect of floods, improve water quality, help maintain shipping channels, and provide habitat to numerous species (USEPA 1999).

Like most of Northern California, the climate in the Bay Region largely is governed by weather patterns originating in the Pacific Ocean. About 90 percent of the annual precipitation falls between November and April. The North Bay receives about 20 to 25 inches of precipitation annually. In the South Bay, east of the Santa Cruz Mountains, annual precipitation is only about 15 to 20 inches because of the rain shadow effect. Temperatures in the Bay Region generally are cool, and fog often resides along the coast. The inland valleys receive warmer, Mediterranean-like weather (average summer high temperatures are about 80 degrees Fahrenheit). The gap in the rolling hills at Carquinez Strait allows cool air to flow from the Pacific Ocean into the Sacramento Valley. Most of the interior North Bay and the northern parts of the South Bay are influenced by this marine effect. By contrast, the southern interior portions of the South Bay experience very little marine air movement (CDWR 2013b).

Land use in the Bay Region is diverse. Residents live in urban, suburban, and rural areas. Some of these areas are on natural floodplains, which historically were used for agriculture. Agriculture accounts for 21 percent of the Bay Region's land area, most of which is in the North and Northeast Bay in Napa, Marin, Sonoma, and Solano counties. Santa Clara and Alameda counties also have significant agricultural acreage at the edge of urban development (CDWR 2013b).

The region has many significant water management challenges: sustaining water supply, water quality, and the ecosystems in and around San Francisco Bay; reducing flood damages and adapting to effects from climate change. Numerous government agencies and water districts deliver, treat, and regulate water in the Bay Region. Many planning organizations identify present and future challenges in the region such as land use, housing, environmental quality, economic development, wetlands, water quality, water reliability, stormwater management, flood protection, watershed management, groundwater management, fisheries, and ecosystem restoration (CDWR 2013b).

Groundwater basins underlie approximately 1,400 square miles or 30 percent of the Bay Region and account for about 15 percent of the region's average annual water supply. The Bay Region has 25 identified groundwater basins, as shown on Figure SFB-3 (CDWR 2013b) The Santa Clara Valley, Livermore Valley, Westside, Niles Cone, Napa-Sonoma Valley, and Petaluma Valley are heavily used groundwater basins (CDWR 2013b).

Figure 9-1 Program Area and California Hydrologic Regions with Major Water Bodies Santa Clara County Vector Control District

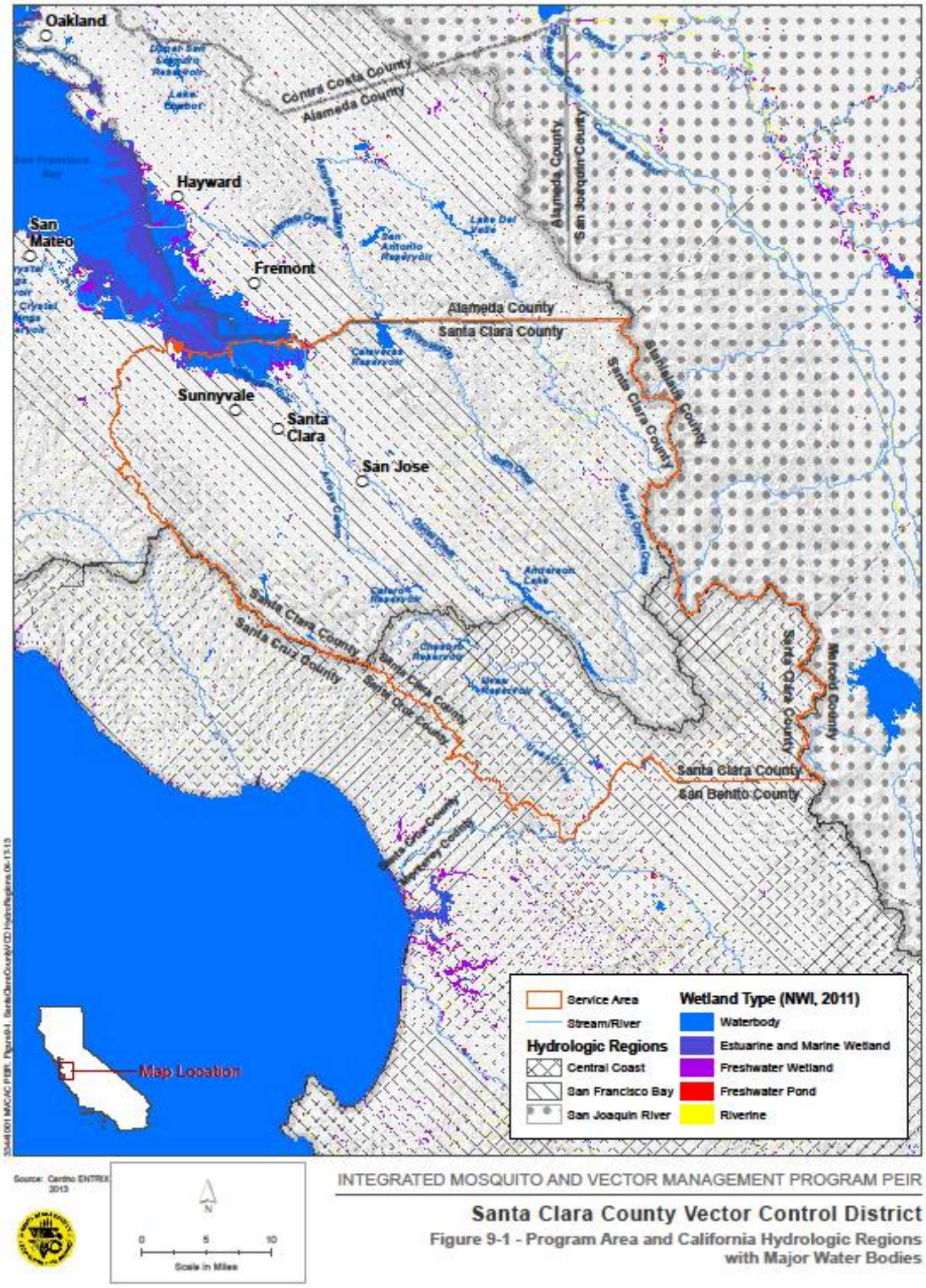

Figure 9-1 BACK

Ongoing surface water quality issues exist in the Bay Region. Pollutants from urban and rural runoff include pathogens, nutrients, sediments, and toxic residues. Some toxic residues are from past human activities such as mining; industrial production; and the manufacture, distribution, and use of agricultural pesticides. These residues include mercury, PCBs, selenium, and chlorinated pesticides. Emerging pollutants in the region include flame retardants and pharmaceuticals.

San Francisco Bay and a number of the streams, lakes, and reservoirs in the Bay Region have elevated mercury levels, as indicated by elevated mercury levels in fish tissue. The major source of the mercury is historic mercury mining and mining activities in the Sierra Nevada and coastal mountains. Large amounts of contaminated sediments were discharged into the Bay from Central Valley streams and local mines in the Bay Area. Significant impaired water bodies include the Bay, the Guadalupe River in Santa Clara County (from New Almaden Mine discharges), and Walker Creek in Marin County (from Gambonini Mine discharges). The SFBRWQCB has adopted total maximum daily loads (TMDLs) for mercury in the Bay, Guadalupe River, and Walker Creek (CDWR 2013b).

Water agencies in the region have relied on importing water from the Sierra Nevada for nearly a century to supply their customers. Water from the Mokelumne and Tuolumne rivers accounts for about 38 percent of the region's average annual water supply. Water from the Delta via the federal Central Valley Project and the State Water Project accounts for another 28 percent. Approximately 31 percent of the average annual water supply is from local groundwater and surface water, and 3 percent is from miscellaneous sources. Population growth and concerns over diminishing water quality have led to the development of local surface water supplies, recharge of groundwater basins, and incorporation of conservation guidelines (CDWR 2013b).

Drinking water in the Bay Region ranges from high-quality Mokelumne and Tuolumne river water to variable-quality Delta water, which constitutes about one-third of the domestic water supply. Purveyors that depend on the Delta for all or part of their domestic water supply can meet drinking water standards, but still need to be concerned about microbial contamination, salinity, and organic carbon.

The Bay Region generally receives very little snow, so floodwaters originate primarily from intense rainstorms. The northern portion of the region receives more precipitation and floods more often than the southern portion. Flooding occurs more frequently in winter and spring and can be intense with a short duration in small watersheds with steep terrain. Local flooding tends to occur when large, widespread storms fall on previously saturated watersheds that drain into local valleys. The greatest flood damages occur in the lower reaches of streams when floodwaters spill onto the floodplain and spread through urban neighborhoods (CDWR 2013b).

Drought, overdraft, and pollution have impaired portions of 28 groundwater basins in the Bay Region. The basins face a perpetual threat of contamination from spills, leaks, and discharges of solvents, fuels, and other pollutants. Contamination affects the supply of potable water and water for other beneficial uses. Some municipal, domestic, industrial, and agricultural supply wells have been removed from service due to the presence of pollution, mainly in shallow groundwater zones. Overdraft can result in land subsidence and saltwater intrusion, although active groundwater management has stopped or reversed the saltwater intrusion (CDWR 2013b).

A variety of historical and ongoing industrial, urban, and agricultural activities and their associated discharges have degraded groundwater quality, including industrial and agricultural chemical spills, underground and aboveground tank and sump leaks, landfill leachate, septic tank failures, and chemical seepage via shallow drainage wells and abandoned wells. The region has over 800 groundwater cleanup cases, about half of which are related fuel spills from leaking underground tanks. In many cases, the groundwater is treated and discharged to surface waters via storm drains (CDWR 2013b).

9.1.1.2 Central Coast Hydrologic Region

The Central Coast Hydrologic Region (Central Coast region) extends from southern San Mateo County in the north to Santa Barbara County in the south. This region includes Monterey County and portions of San Mateo and Santa Clara counties.

The Central Coast region has a temperate Mediterranean climate characterized by mild, wet winters and warm, dry summers. West of the Coast Range, the climate of the region is dominated by the Pacific Ocean, characterized by small daily and seasonal temperature changes, and high relative humidity. As distance from the ocean increases, the maritime influence decreases, resulting in a more continental type of climate that generates warmer summers, colder winters, greater daily and seasonal temperature ranges, and lower relative humidity. Average annual precipitation can range from 10 inches per year along the southern valley floors to 50 inches per year on northern coastal mountain peaks.

Geographically, the vegetation and topography of the Central Coast is highly variable and includes redwood forests, foggy coastal terraces, chaparral-covered hills, green cultivated valley floors, stands of oak, warm and cool vineyards, and semiarid grasslands. The lower portions of the northern watersheds, close to Monterey Bay, are more urbanized with residential, commercial, and light industrial land use. Upper watershed land use consists predominantly of rural residential, timber production, open space, some mining, and limited agriculture.

For the Central Coast region, surface water quality parameters of special concern include nitrate, water toxicity, pesticides, fecal coliform, sediment, temperature, and dissolved oxygen. Nitrate enters the waters of the region most commonly as runoff from agricultural fields or through percolation to groundwater. Fecal coliform is an indicator for pathogenic bacteria and enters the waters of the region through stormwater runoff, the presence of cattle and other animals in creeks, and from failing septic systems. Toxicity can be caused by metals, fertilizers, pesticides, petroleum products, and other organic compounds. Regionally, erosion and excessive sedimentation in rivers and streams have led to a decline in anadromous fish habitat for migration and spawning. Common causes of erosion and excessive sedimentation include clearing land for development without adequate stormwater controls, farming too close to creek banks or on steep slopes, and increased stormwater runoff from impervious surfaces (CDWR 2013d).

Among all of California's hydrologic regions, the Central Coast is the most reliant on groundwater for its water supply. Groundwater supplies are locally supplemented by stream diversions, timed releases from regional reservoirs, and some imported surface water. Factors that affect water availability in the region include precipitation, groundwater recharge capacity, groundwater quality degradation, groundwater pumping management styles or practices, surface water and reservoir storage capacity, and annually variable State Water Project and Central Valley Project water deliveries (CDWR 2013d). Seawater intrusion in the northern Salinas Valley has been an issue for decades and is likely associated with seasonal groundwater withdrawals for agriculture in Santa Cruz and Monterey counties (CDWR 2013d).

9.1.1.3 Existing Water Quality

Statewide and regional surface water monitoring has identified pesticides in surface waters and sediments throughout the Program Area and vicinity. A query of water quality data available through the California Environmental Data Exchange Network (CEDEN) water quality database revealed detectable quantities of several chemicals that the District will use and several additional chemicals of the same class (i.e., pyrethroids). See Tables 2-1 through 2-6 for a list of all chemicals the District uses.

The following is a summary of CEDEN data from 1993 to 2012 regarding the concentrations of these chemical constituents when detected and the water bodies in which they were discovered (CEDEN 2013). In addition to the CEDEN data, the list below includes Water Year 2012 Regional Monitoring Coalition pesticide results (BASMAA 2013). The Regional Monitoring Coalition was formed to implement the monitoring program required by the Municipal Regional Stormwater NPDES Permit (Order R2-2009-0074)

issued by the SFBRWQCB. In consideration of their more frequent usage and potentially greater toxicity compared with other commonly applied pesticides used in this geographic region, monitoring of the class of pesticides known as pyrethroids was conducted by the Regional Monitoring Coalition to explore potential causes of toxicity to *Hyalella azteca* in sediments. Based on monitoring results, BASMAA (2013) concluded that it is likely that pyrethroids caused toxicity in water year 2012.

> Allethrin was detected in sediments of various bays in the region including Central Bay, Grizzly Bay, San Pablo Bay (Pinole Point), San Francisco Bay (Yerba Buena Island), and Suisun Bay. Concentrations ranged from 0.238 to 5.61 micrograms per kilogram (µg/kg) in these bay sediments. Allethrin concentrations within Sacramento River and San Joaquin River sediments ranged from 0.33 to 2.13 µg/kg.

> Bifenthrin was detected in Central Bay, Grizzly Bay, Lower South Bay, San Pablo Bay (Pinole Point), San Francisco Bay (Yerba Buena Island), South Bay, and Suisun Bay sediments in concentrations ranging from 0.35 to 1.96 µg/kg. Alameda Creek, Agua Hedionda Creek, Coyote Creek, Guadalupe Creek, Kirker Creek, Pajaro River, Redwood Creek, Salinas River, San Leandro Creek, San Mateo Creek, Tembladero Slough, and Walker Creek Ranch sediments contained bifenthrin in concentrations ranging from 0.204 to 38.2 µg/kg. The Hayward Industrial Storm Drain, Sunnyvale East Channel, Guadalupe River, Lower Marsh Creek, and San Leandro Creek water columns contained detectable bifenthrin concentrations ranging from 0.18 to 272 nanograms per liter (ng/L).

> Chlorpyrifos was detected in the water columns of Coyote Creek, the Sacramento River, and the San Joaquin River in concentrations ranging from 0.004 to 2.054 ng/L. Chlorpyrifos was also detected in sediments from Redwood Creek and Sacramento River in concentrations ranging from 0.055 to 0.300 µg/kg. Detectable chlorpyrifos concentrations were also measured in Grizzly Bay, San Pablo Bay (Pinole Point), and San Francisco Bay (Yerba Buena Island) sediments. Chlorpyrifos concentrations within these Bay sediments ranged from 0.11 to 0.49 µg/kg.

> Cinerin, also a pyrethrin-based compound, was detected in the water column of the Hayward Industrial Storm Drain in detectable concentrations ranging from 3.76 to 79.9 ng/L.

> Lambda-cyhalothrin was detected in Central Bay, Lower South Bay, San Pablo Bay, and South bay sediments in concentrations ranging from 0.065 to 0.395 µg/kg. Guadalupe Creek, Kirker Creek, Laguna de Santa Rosa, Lagunitas Creek, and Tembladero Slough sediments contained lambda-cyhalothrin concentrations ranging from 1.14 to 6.03 µg/kg. Lambda-cyhalothrin concentrations in the water column of the Hayward Industrial Storm Drain ranged from 3.53 to 6.07 ng/L.

> Esfenvalerate / fenvalerate were detected in Central Bay, Grizzly Bay, and Lower South Bay sediments in concentrations ranging from 0.163 to 0.577 µg/kg. Tembladero Slough sediments also contained esfenvalerate/fenvalerate concentrations of up to 60.8 µg/kg.

> The concentration of all permethrin isomers detected in the water column of the Hayward Industrial Storm Drain ranged from 1.57 to 285 ng/L. Sunnyvale East Channel, Guadalupe River, and Lower Marsh Creek sediments contained concentrations ranging from 3.81 to 20.9 µg/kg. Cis- and trans-permethrin isomers were detected in Central Bay, Grizzly Bay, Lower South Bay, San Pablo Bay (Pinole Point), South Bay, and Suisun Bay sediments in concentrations ranging from 0.10 to 1.32 µg/kg. Cis- and trans- isomers were also detected in Coyote Creek, Redwood Creek, San Leandro Creek, and Tembladero Slough sediments in concentrations 0.12 to 25.6 µg/kg. Only the cis- isomer of permethrin was detected in Guadalupe Creek, Laurel Creek, Salinas River, and San Mateo Creek sediments in concentrations ranging from 3.22 to 11.1 µg/kg. Trans-permethrin was the only isomer detected in Lagunitas Creek and the Pajaro River sediments in concentrations ranging from 4.06 to 4.52 µg/kg.

> Phenothrin was detected in Central Bay and San Francisco Bay (Yerba Buena Island) sediments in concentrations ranging from 0.988 to 4.81 µg/kg.

Additional queries were made to the USEPA's ECOTOX database to compare regional water quality data to available ecological toxicity data (See Table 9-1). The toxicology data is expressed in LC50.[7] The LC50 value is used as a standard measure of toxicity for evaluation and comparison of chemicals. Chemicals with lower LC50 values are more toxic. The LC50 values in Table 9-1 are populated from the lowest available constituent concentrations in which a 50 percent die-off for the test species is observed (USEPA 2013b). LC50 values are not available for sediment. Freshwater and saltwater values are provided where available.

A 2010 study performed by the CDPR analyzed the presence of pyrethroid insecticides in California's surface waters from urban areas. The most frequently detected pyrethroids were bifenthrin followed by permethrin and cyfluthrin. These pyrethroids are found in many common household insecticides. Bifenthrin and cyfluthrin, which the District does not use, were detected with the highest concentrations in both water and sediment. Over 8 percent water samples of bifenthrin and cyfluthrin exceeded the acute toxicity benchmarks for fish and over 12 percent water samples of cyfluthrin and permethrin exceeded those for aquatic invertebrates (CDPR 2010b).

[7] LC50 refers to the lethal concentration of a chemical (amount of chemical in a volume of food, water or air) that that would kill 50 percent of a group of test animals exposed to the chemical for a defined exposure time.

Table 9-1 Pesticide Concentrations in Surface Water and Sediment throughout the Program Area and Vicinity (1993 to 2012)

Pesticide	Sediment		Water			
	Concentration (µg/kg)	LC50 (µg/kg)	Concentration (ng/L)	LC50 (ng/L)	Standard Test Species	Exposure Time
Allethrin	0.238 - 5.61	*	NA	1,800	Coho Salmon (*Oncorhynchus kisutch*)	96-hour exposure in Freshwater Medium
Bifenthrin	0.204 - 38.2	*	0.18 - 272	9	Scud (*Hyalella Azteca*)	96-hour exposure in Freshwater Medium
				3	Opossum Shrimp (*Americamysis bahia*)	96-hour exposure in Saltwater Medium
Chlorpyrifos	0.004 - 2.054	*	0.004 - 2.054	0.3	Scud (*Hyalella Azteca*)	96-hour exposure in Freshwater Medium
				29	Opossum Shrimp (*Americamysis bahia*)	96-hour exposure in Saltwater Medium
Cinerin (Pyrethrin)	NA	*	3.76 - 79.9	920	Scud (*Gammarus fasciatus*)	96-hour exposure to Pyrethrin in Freshwater Medium
				84	Opossum Shrimp (*Americamysis bahia*)	96-hour exposure to Pyrethrin in Saltwater Medium
Lambda-cyhalothrin	0.065 - 6.03	*	3.53 - 6.07	30	Zebra Danio (*Danio rerio*)	72-hour exposure in Freshwater Medium
				3	Opossum Shrimp (*Americamysis bahia*)	96-hour exposure in Saltwater Medium
Esfenvalerate / Fenvalerate	0.163 - 60.8	*	*	11	Water Flea (*Ceriodaphnia dubia)*	96-hour exposure to Esfenvalerate in Freshwater Medium
Permethrin	3.81 - 20.9	*	1.57 - 285	0.007 (umol/L)	Channel Catfish (*Ictalurus punctatus*)	96-hour exposure in Freshwater Medium
				4	Amphipod (*Eohaustorius estuarius*)	48-hour exposure in Saltwater Medium

Table 9-1 Pesticide Concentrations in Surface Water and Sediment throughout the Program Area and Vicinity (1993 to 2012)

Pesticide	Sediment		Water			
	Concentration (µg/kg)	**LC50 (µg/kg)**	**Concentration (ng/L)**	**LC50 (ng/L)**	**Standard Test Species**	**Exposure Time**
Cis- and Trans-Permethrin Isomers	0.10 - 25.6	*	*	465	Water Flea (*Ceriodaphnia dubia)*	96-hour exposure to Cis-Permethrin in Freshwater Medium
Phenothrin	0.988 - 4.81	*	*	140	Rainbow Trout (*Oncorhynchus mykiss*)	96-hour exposure in Freshwater Medium
				21	Opossum Shrimp (*Americamysis bahia)*	96-hour exposure in Saltwater Medium

*No Data Available

9.1.2 Regulatory Setting

The Program includes components under the jurisdiction of federal, state, and local agencies. Applicable regulations are summarized below and include aspects related to both surface water and groundwater. The primary focus of this regulatory summary is the water quality aspects related to the Program components. Because the Program will not cause changes to natural precipitation patterns, runoff, or groundwater infiltration, changes to water quantity are not anticipated.

9.1.2.1 Federal

Federal Clean Water Act (33 United States Code Section 1251 et seq.)

The USEPA is the federal agency responsible for water quality management and administers the federal Water Pollution Control Act Amendments of 1972 and 1987, collectively known as the Clean Water Act (CWA). The CWA establishes the principal federal statutes for water quality protection. It was established with the intent "to restore and maintain the chemical, physical, and biological integrity of the nation's water, to achieve a level of water quality which provides for recreation in and on the water, and for the propagation of fish and wildlife." Several key CWA sections guide the regulation of water pollution in the US:

> Section 208, Water Quality Control Plans. This section requires the preparation of local water quality control plans throughout the nation. Each water quality control plan covers a defined drainage area. The primary goal of each water quality control plan is to attain water quality standards established by the CWA and the state governments within the defined area of coverage. Minimum content requirements, preparation procedures, time constraints, and federal grant funding criteria pertaining to the water quality control plans are established in Section 208. The USEPA has delegated preparation of the water quality control plans to the individual states. More information is provided below in the state regulatory setting section.

> Section 303(d) Water Quality Limited Surface Waters. This section requires each state to provide a list of impaired waters that do not meet or are expected not to meet state water quality standards as defined by that section. It also requires the state to develop TMDLs from the pollution sources for such impaired water bodies. Table 9-2 lists pesticide-impaired surface waters and TMDL status in the Program Area. Because pyrethroids have been implicated in sediment toxicity, those impairments are also included in Table 9-2. See the state regulatory setting section (Section 9.1.2.2) for description of the Diazinon and Pesticide-Related Toxicity in Urban Creeks TMDL.

> Section 401, Water Quality Certifications. This CWA section requires that, prior to the issuance of a federal license or permit for an activity or activities that may result in a discharge of pollutants into waters of the US (see Section 404 discussion, below), the permit applicant must obtain a certification from the state in which the discharge would originate. A state certification indicates that the proposed activity or activities would not result in a violation of applicable water quality standards established by federal or state law, or that no water quality standards apply to the proposed activity. The SWRCB and/or the nine RWQCBs administer the certification program in California.

> Section 402, NPDES. The NPDES requires permits for pollution discharges (except dredge or fill material) into waters of the US, such that the permitted discharge does not cause a violation of federal and state water quality standards. Biological and residual pesticides discharged into surface waters constitute pollutants within the meaning of the CWA and require coverage under an NPDES permit. NPDES permits define quantitative and/or qualitative pollution limitations for the permitted source and control measures that must be implemented to achieve the pollution limitations. Pollution control measures are often referred to as BMPs. In California, NPDES permits are issued by the SWRCB or the RWQCBs.

Table 9-2 Section 303(d) Pesticide and Sediment Toxicity Limited Surface Waters

Water Body	Pollutants	Primary Stressors	TMDL Completion Dates
Santa Clara County Vector Control District			
Llagas Creek	Chloride, low dissolved oxygen, pH, fecal indicator bacteria, sodium and total dissolved solids.	Agricultural runoff, disturbed areas, livestock, stream bank erosion, loss of riparian vegetation and hydromodification	2006
Pajaro River	Boron and fecal indicator bacteria	Agricultural runoff, disturbed areas, livestock, stream bank erosion, loss of riparian vegetation and hydromodification	2006

Source: City of Gilroy, City of Morgan Hill and County of Santa Clara 2010

> Section 404, Discharge of Dredge and Fill Material. Section 404 assigns the USACE with permitting authority for proposed discharges of dredged and fill material into waters of the US, defined as "…waters which are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide; territorial seas and tributaries to such waters." The USACE typically considers all natural drainages with defined beds and banks to be waters of the US. Section 404 establishes procedures by which the permitting agency is to review, condition, approve, and deny permit requests. Per the regulations, permitting agencies are responsible to conduct public noticing and provide the opportunity for public hearings during the review of each permit request. This responsibility includes informing the USFWS and/or NMFS of each permit request. Consultation with the USFWS and/or NMFS is required for proposed discharges that could affect species protected by the federal Endangered Species Act. Measures that are required by the USFWS and/or NMFS to minimize effects to federally protected species must be included as conditions of the permit. The USACE also authorizes, with limited application requirements and associated delay, certain activities with minimal adverse effects on the environment, under nationwide permits. Currently, 50 nationwide permits exist, of which about half require preconstruction notification, which USACE reviews to verify the activity qualifies for the nationwide permit.

9.1.2.1.1 Federal Insecticide, Fungicide, and Rodenticide Act

The FIFRA was first passed in 1947 to establish labeling provisions and procedures for registering pesticides with the USDA. It was rewritten in 1972 and has since been amended several times. In its current form, FIFRA mandates that USEPA regulate the use and sale of pesticides to protect human health and preserve the environment. Registration with the USEPA assures that pesticides will be properly labeled and that, if used in accordance with specifications, they will not cause unreasonable harm to the environment. Pesticide use in California is also regulated by the CDPR and local County Agricultural Commissioners.

9.1.2.1.2 California Toxics Rule

The USEPA has developed water quality criteria for priority toxic pollutants and other provisions for water quality standards to be applied to inland surface waters, enclosed bays, and estuaries in California. This rule was developed to address a gap in California's water quality standards that was created when the state's water quality control plans containing water quality criteria for priority toxic pollutants were overturned in 1994. The established numerical standards were deemed necessary to protect human health and the environment. The rule includes ambient aquatic life criteria for 23 priority toxic pollutants, ambient human health criteria for 57 priority toxics, and a compliance schedule.

9.1.2.1.3 Safe Drinking Water Act of 1974

With the passage of the federal Safe Drinking Water Act of 1974, the USEPA established and enforced mandatory nationwide minimum standards. California adopted its own Safe Drinking Water Act in 1976 that gave California Department of Health Services (now CDPH) responsibility for the administration of the federal Safe Drinking Water Act in California. Under this program, the USEPA has delegated primary responsibility for setting and enforcing drinking water standards to the CDPH. CDPH has two approaches to standards for drinking water quality. The first approach is to safeguard public welfare by limiting the level of specific contaminants that can affect public health. These limits are identified as Primary MCLs and are specific concentrations that cannot be exceeded for a given constituent in surface water or groundwater.

9.1.2.1.4 Rivers and Harbors Act

The Rivers and Harbors Act (RHA) of 1899 prohibits the unauthorized alteration or obstruction of any navigable waters of the US. As defined by the RHA, navigable waters include all waters that are:

> Historically, presently, or potentially used for interstate or foreign commerce

> Subject to the ebb and flow of tides

Regulations implementing RHA Section 10 are coordinated with regulations implementing CWA Section 404. The RHA specifically regulates:

> Construction of structures in, under, or over navigable waters

> Deposition or excavation of material in navigable waters

> All work affecting the location, condition, course, or capacity of navigable waters

The USACE administers the RHA. If a proposed activity falls under the authority of RHA Section 10 and CWA Section 404, the USACE processes and issues a single permit. For activities regulated only under RHA Section 10, such as installation of a structure not requiring fill, permit conditions may be added to protect water quality during construction.

Program activities are not anticipated to affect any facilities that would be regulated under the RHA.

9.1.2.2 State

9.1.2.2.1 Porter-Cologne Act

The Porter-Cologne Act (California Water Code Section 13000) is the principal law governing water quality regulation in California. It establishes a comprehensive program to protect water quality and the beneficial uses of water. The Porter-Cologne Act applies to surface waters, wetlands, and groundwater, and to both point and nonpoint sources of pollution. Pursuant to the Porter-Cologne Act, it is the policy of the State of California that:

> The quality of all the waters of the state shall be protected.

> All activities and factors affecting the quality of water shall be regulated to attain the highest water quality within reason.

> The state must be prepared to exercise its full power and jurisdiction to protect the quality of water in the state from degradation.

Pursuant to the Porter-Cologne Act, the responsibility for protection of water quality in California rests with the SWRCB. The SWRCB administers federal and state water quality regulations for California's ocean waters and also oversees and funds the state's nine RWQCBs. The RWQCBs prepare water quality control plans, establish water quality objectives, and carry out federal and state water quality regulations and permitting duties for inland water bodies, enclosed bays, and estuaries within their respective regions. The Porter-Cologne Act gives the SWRCB and RWQCBs broad powers to protect water quality by regulating waste discharge to water and land and by requiring cleanup of hazardous wastes.

9.1.2.2.2 State Antidegradation Policy

The SWRCB adopted the Statement of Policy with Respect to Maintaining High Quality Water in California (Resolution No. 68-16) on October 28, 1968. This policy is generally referred to as the "Antidegradation Policy" and it protects surface water and groundwater where existing water quality is higher than the standards set by the Water Quality Control Plan (or Basin Plan) to protect beneficial use

of the waters. Under the Antidegradation Policy, any action that can adversely affect water quality in surface water or groundwater:

> Must be consistent with the maximum benefit to the people of the state.

> Must not unreasonably affect present and anticipated beneficial use of such water.

> Must not result in water quality less than that prescribed in water quality plans and policies.

9.1.2.2.3 Safe Drinking Water Act 1976

California adopted its own Safe Drinking Water Act in 1976 that gave California Department of Health Services the responsibility for the administration of the federal Safe Drinking Water Act in California. This responsibility was then moved to the CDPH. The first approach is to safeguard public welfare by limiting the level of specific contaminants that can affect public health. These limits are identified as Primary MCLs and are specific concentrations that cannot be exceeded for a given constituent. The second approach is a treatment technique that is based on distribution system sampling in comparison to an action level. If the action level is exceeded in more than 10 percent of the samples, then additional treatment is required of the water supplier. Currently, treatment technique limits apply only to copper and lead. CDPH also has established Secondary MCLs that regulate constituents that affect water quality aesthetics (such as taste, odor, or color). Generally, CDPH uses the Secondary MCLs as guidelines.

Another component of the California Safe Drinking Water Act is the requirement of Cal-EPA's Office of Environmental Health Hazard Assessment to develop PHGs for contaminants in California's publicly supplied drinking water. PHGs are concentrations of drinking water contaminants that pose no significant health risk if consumed for a lifetime, based on current risk assessment principles, practices, and methods. This office establishes PHGs pursuant to Health & Safety Code Section 116365© for contaminants with MCLs and for those for which CDPH will be adopting MDLs. Public water systems use PHGs to provide information about drinking water contaminants in their annual Consumer Confidence Reports. Certain public water systems must provide a report to their customers about health risks from a contaminant that exceeds its PHG and about the cost of treatment to meet the PHG, and hold a public hearing on the report.

9.1.2.2.4 Section 401 Water Quality Certification

CWA Section 401 certification is required for any permit or license issued by a federal agency for any activity that may result in a discharge into waters of the state to ensure that a proposed project will not violate state water quality standards. This water quality certification is part of the 1974 CWA, which allows each state to have input into projects that may affect its waters (USEPA 2013c).

9.1.2.2.5 Water Quality Control Plan

The Water Quality Control Plans (or Basin Plans) of all nine of the RWQCBs and the California Ocean Plan (prepared and implemented by the SWRCB) collectively constitute the State Water Quality Control Plan. These plans are the RWQCB's master water quality control planning documents. They designate beneficial uses and water quality objectives for waters of the state, including surface waters and groundwater and also include programs of implementation to achieve water quality objectives. According to the requirements of the CWA and the California Porter-Cologne Act, each Basin Plan has been designed to support the intentions of the CWA and the Porter-Cologne Act by (1) characterizing the water resources within a region, (2) identifying beneficial uses that exist or have the potential to exist in each water body, (3) establishing water quality objectives for each water body to protect beneficial uses or allow their restoration, and (4) providing an implementation program that achieves water quality objectives. Implementation program measures include monitoring, permitting, and enforcement activities. The Basin Plans include numeric site-specific water quality objectives and narrative objectives for toxicity, chemical constituents, and tastes and odors. The narrative toxicity objective states: "*All waters shall be*

maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life."

9.1.2.2.6 Diazinon and Pesticide-Related Toxicity in Urban Creeks TMDL

Resolution R2-2005-0063 amended the Basin Plan for the San Francisco Bay region to establish a Water Quality Attainment Strategy and TMDL for diazinon and pesticide-related toxicity in the Bay Area region creeks. As diazinon use was phased out in 2004, alternatives began to pose water quality concerns and pyrethroids in particular were identified as the likely cause of sediment toxicity in some Bay Area urban creeks. To account for pesticide use changes over time, the Basin Plan amendment includes generic pesticide-related toxicity targets to comply with the narrative toxicity objective. When pesticide-related toxicity occurs in urban creek water, creeks do not meet the narrative toxicity objective as stated above in *Water Quality Control Plan*. When pesticide-related toxicity occurs in sediment, the creeks also do not meet the narrative sediment objective, which states: "Controllable water quality factors shall not cause a detrimental increase in the concentrations of toxic pollutants in sediments or aquatic life." Management actions designed to reduce the effects of pesticide-related toxicity are outlined within the TMDL and Water Quality Attainment Strategy and are currently underway via Provision C.9 of the Municipal Regional NPDES Permit (BASMAA 2013).

9.1.2.2.7 California Pesticide Regulatory Program

CDPR regulates the sale and use of pesticides in California. CDPR is responsible for reviewing the toxic effects of pesticide formulations and determining whether a pesticide is suitable for use in California through a registration process. Although CDPR cannot require manufacturers to make changes in labels, it can refuse to register products in California unless manufacturers address unmitigated hazards by amending the pesticide label. Consequently, many pesticide labels that are already approved by USEPA also contain California-specific requirements. Pesticide labels are application requirements and include instructions informing users how to make sure the product is applied only to target pests including precautions the applicator should take to protect human health and the environment. For example, product labels may contain such measures as restrictions in applications to certain land uses and weather (i.e., wind speed) parameters.

9.1.2.2.8 Cooperative Agreement between the California Department of Public Health and Local Vector Control Agencies

Due to their public health mission, CDPR's Pesticide Regulatory Program provides special procedures for vector control agencies that operate under a Cooperative Agreement with CDPH. The application of pesticides by vector control agencies is regulated by a special and unique arrangement among the CDPH, CDPR, and County Agricultural Commissioners. CDPR does not directly regulate vector control agencies. CDPH provides regulatory oversight for vector control agencies that are signatory to the Cooperative Agreement. Signatories to the agreement use only pesticides listed by CDPH, maintain pesticide use reports, and ensure that pesticide use does not result in harmful residues on agricultural products.

9.1.2.2.9 Pesticide Permits

In response to a Sixth Circuit Court decision in 2009 that the application of pesticides at, near, or over waters of the US that results in discharges of pollutants requires coverage under a NPDES permit, the SWRCB adopted four Pesticide Permits. The following two are applicable to the Program. The Spray Applications Permit is also relevant to the regulatory setting when the District performs pesticide applications for the CDFA and/or USFS.

> Statewide NPDES Vector Control Permit. Users of specific larvicide and adulticide registered products are required to obtain coverage under the Statewide NPDES Permit for Biological and Residual Pesticide Discharges to waters of the US from Vector Control Applications (SWRCB Water Quality Order No. 2012-0003-DWQ; NPDES No. CAG 990004; Vector Control Permit). Permitted larvicide

active ingredients include monomolecular films, methoprene, Bti), Bs, temephos, petroleum distillates, and spinosad. Permitted adulticide active ingredients include malathion, naled, pyrethrin, permethrin, resmethrin, sumithrin, prallethrin, the synergist PBO, etofenprox, and N-octyl bicycloheptene dicarboximide (MGK-264). The permit contains a receiving water limitation for malathion and receiving water monitoring triggers for the other active ingredients. Receiving water monitoring triggers are conservatively based on one-tenth of the LC50 from USEPA's Ecotoxicity Database (LC50 is defined in Section 9.1.1.4). To obtain coverage under the permit, each discharger (typically a vector control district) must submit a Notice of Intent, application fee, and PAP, which is subject to approval by the SWRCB following a 30-day public comment period.

The PAP serves as a comprehensive plan developed by the discharger that describes the project, the need for the project, what will be done to reduce water quality impacts, and how those impacts will be monitored. The PAP must include a description of application and target areas, evaluation of available BMPs, and description of BMPs to be implemented. The PAP must include a discussion of the factors influencing the decision to select pesticide applications for vector control, what pesticide products or types expected to be used and any known degradation byproducts. The PAP also includes the methodology used to determine how much pesticide is needed and how this amount was determined, the methods in which pesticides are to be applied, and any adjuvants or surfactants that will be used.

Permittees must comply with the Vector Control Permit Monitoring and Reporting Program (MRP), which encourages formation of monitoring coalitions. Monitoring requirements include background, event, and post-event sampling for visual, physical, and chemical constituents for each type of aquatic pesticide used. Visual observations are required at 10 percent of all application sites, and physical measurements and chemical samples are required at six sites in each environmental setting (urban, agricultural/rural, and wetland). The District is a member of the MVCAC NPDES Permit Coalition, which is responsible for coordinating all physical measurements and conducting all chemical monitoring required under the Vector Control Permit MRP. Chemical monitoring results that exceed the receiving water limitation for malathion or the receiving water monitoring trigger for other active ingredients must be reported to the SWRCB and RWQCB within 24 hours of identification and again after 5 days. A description of actions to be taken to prevent recurrence of adverse incidents is included in those reports. Annual reports are required by the MVCAC NPDES Permit Coalition and each member district. Member district annual reports are typically limited to submittal of Pesticide Application Logs, which contain specific application details and review of their PAP. The MVCAC NPDES Permit Coalition annual report includes all physical and chemical monitoring data and makes recommendations for modifications to the MRP, if appropriate.

> Statewide NPDES Spray Applications Permit. The Statewide General NPDES Permit for Biological and Residual Pesticide Discharges to Waters of the US from Spray Applications (SWRCB Water Quality Order No. 2011-0004-DWQ; NPDES No. CAG 990007; Spray Applications Permit) addresses spray applications of insecticides by CDFA and USFS. Under the permit, CDFA is covered for applications of *Bacillus thuringiensis*, subspecies *kurstaki* (*Btk*), carbaryl, cyfluthrin, malathion, naled, nuclear polyhedrosis virus (NPV), pheromone, pyrethrins, Spinosad A and D. USFS is covered for applications of biological control agents, which is a subset of the CDFA active ingredients.

The permit contains a receiving water limitation for malathion and receiving water monitoring triggers for many of the other active ingredients. To obtain coverage under the permit, the discharger must submit a Notice of Intent, application fee, and a project- or program-specific PAP to the SWRCB. The PAP must describe the application area, appropriate BMPs for each pesticide project, an evaluation of possible alternatives to pesticide use, and a monitoring plan. The PAP must also include an Off-Target Drift Management Plan. Monitoring requirements include background and event monitoring for visual, physical, and chemical parameters at frequencies similar to the Vector Control Permit. Annual reports must summarize sampling results and recommend improvements to the monitoring program, BMPs, and PAP.

9.1.2.3 Local

A compilation of local ordinances and regulations (or chapters within which they can be found) for counties within the District Service Area is provided in Table 9-3. The counties include Alameda,[17] and Santa Clara counties.

Table 9-3 List of County General Plan Pesticide and Water Quality Policies

County	Name of Code/Plan	Element Title, Chapter and Section
Alameda	Castro Valley General Plan	Natural Hazards and Public Safety, Chapter 10
Alameda	East County Area Plan	Land Use, Public Services and Facilities, Environmental Health and Safety
Alameda	Eden Area General Plan	Land Use – Chapter 3, Public Facilities and Services – Chapter 6
Alameda	Countywide General Plan	Safety Element– Chapter 2, Hazardous Materials
San Mateo	San Mateo General Plan	Man Made Hazards 16-59, 16-64
Santa Clara	Santa Clara County General Plan	Resource Conservation, C-RC 18, C-RC 20, R-RC 14, R-RC 32

Sources: Alameda County Community Development Agency 2000, 2010, 2012; Santa Clara County 1994; San Mateo County 1986;

9.1.2.3.1 County Agricultural Commissioners

In addition to federal and state oversight, County Agricultural Commissioners in California also regulate the sale and use of pesticides and issue Use Permits for applications of pesticides that are deemed as restricted materials by CDPR. County Agricultural Commissioners collect pesticide use reports from the District and other users of pesticides, investigate incidents and illnesses, and conduct annual inspections.

9.2 Environmental Evaluation

The evaluation of the Program in terms of issues associated with water resources is provided below.

9.2.1 Methodology

The Human and Ecological Health Risk Assessment Report (Appendix B) reviews and evaluates 42 pesticide (insecticides) active ingredients and four adjuvants currently used or proposed for use by the nine Districts in MVCAC's coastal region. Application information, including the target organisms, number of treatments, total amount applied, and specific habitat types was obtained from the Districts. A comprehensive literature review was conducted to evaluate environmental fate and general toxicity characteristics for the active ingredients. The results of the assessment were used to rank the potential for adverse effects to human health and the environment. Chemical and application characteristics such as the likelihood for nontarget species and habitats, the potential for drift, and the possible transport and fate of the chemical in various media (i.e., air, surface water/groundwater, soil) were considered in the assessment. Those active ingredients that appear to exhibit a higher level of risk than others or that are in prevalent use in current Programs (even though they had lower toxicity) include the following products:

> Methoprene for mosquito control (toxicity to aquatic organisms and insects)

> Etofenprox for mosquito control (toxicity to aquatic organisms)

[17] In Alameda County, the cited area plans are for unincorporated communities.

> Bti for mosquito control (prevalent use; public concerns)

> Pyrethrins for mosquito control (prevalent use; includes PBO synergist)

> Resmethrin for mosquito control (prevalent use; includes PBO synergist)

> Vegetable oil (coconut oil)/mix for mosquito control (contains low percentage petroleum distillate)

> Permethrin for mosquito and wasp control (toxicity to aquatic organisms; potential endocrine disruptor)

> Lambda-cyhalothrin for yellowjacket wasp control (high toxicity to aquatic organisms; potential to bioaccumulate in fish; possible endocrine disruptor)

> Bromadiolone for rodent control (high toxicity to nontarget organisms)

> Difethialone for rodent control (high toxicity to nontarget organisms including mammals, birds, and aquatic organisms)

9.2.1.1 Assumptions

The following assumptions were used in the evaluation of water resources:

> Site-specific evaluation is not within the scope of this programmatic evaluation.

> The programmatic evaluation is based on the current mosquito and/or vector control methods.

> Existing baseline ambient water quality data related to Program chemicals are limited for most areas.

Assumptions related to the analysis of hazards, toxicity, and exposure for chemical treatment methods are explained below, including the definition of key terms.

9.2.1.1.1 Hazardous Material

A “hazardous material” is defined in California Health and Safety Code Section 25501 (p): as “any material that, because of its quantity, concentration, or physical or chemical characteristics, poses a significant present or potential hazard to human health and safety or to the environment if released into the workplace or the environment. "Hazardous materials" include, but are not limited to, “hazardous substances, hazardous waste, and any material that a handler or the administering agency has a reasonable basis for believing that it would be injurious to the health and safety of persons or harmful to the environment if released into the workplace or the environment.” Any liquid, solid, gas, sludge, synthetic product, or commodity that exhibits characteristics of toxicity, ignitability, corrosiveness, or reactivity has the potential to be considered a “hazardous material.”

9.2.1.2 Toxicity and Exposure

Toxicology is the study of a compound’s potential to elicit an adverse effect in an organism. The toxicity of a compound is dependent upon exposure, including the specific amount of the compound that reaches an organism’s tissues (i.e., the dose), the duration of time over which a dose is received, the potency of the chemical for eliciting a toxic effect (i.e., the response), and the sensitivity of the organism receiving the dose of the chemical. Toxicity effects are measured in controlled laboratory tests on a dose/response scale, whereby the probability of a toxic response increases as dose increases. Exposure to a compound is necessary for potential toxic effects to occur. However, exposure does not, in itself, imply that toxicity will occur. Thus, toxic hazards can be mitigated by limiting potential exposure to ensure that doses are less than the amount that may result in adverse health effects.

The toxicity data included in the numerous tables and charts in this document are generally derived from rigidly controlled laboratory animal studies designed to determine the potential adverse effects of the chemical under several possible routes of exposure. In these studies, the species of interest is exposed to 100 percent chemical at several doses to determine useful information such as the lowest concentration resulting in a predetermined adverse effect (LOAEL) on numerous selected physiological and behavioral

systems. The second component of these tests is to determine the highest concentration of chemical that results in no measurable adverse effect (NOAEL).

However, these, and other, coordinated and focused laboratory tests are designed to document the effects of the chemical when a continuous, controlled, exposure exists and do not realistically reflect the likely exposures or toxicity in the District field application scenarios. As such, the toxicity information is intended as an overview of potential issues and guidance for understanding the completely "safe" maximum exposure levels of applications that would not adversely affect humans or nontarget plant and animal species.

Although the regulatory community uses this basic information to provide a relative comparison of the potential for a chemical to result in unwanted adverse effects and this information is reflected in the approved usage labels and MSDSs, in actual practice, the amounts applied in the District's Program Area are substantially less than the amounts used in the toxicity studies. Because of the large safety factors used to develop recommended product label application rates, the amount of chemical resulting in demonstrated toxicity in the laboratory is much higher than the low exposure levels associated with an actual application. The application concentrations consistent with the labels or MSDSs are designed to be protective of the health of humans and other nontarget species (i.e., low enough to not kill them, weaken them, or cause them to fail to reproduce). However, adverse effects may still occur to some non-target organisms.

9.2.2 Surveillance Component

Surveillance activities involve monitoring the abundance of adult and larval mosquitoes, field inspection of mosquito habitat, testing for the presence of encephalitis virus-specific antibodies in sentinel chickens or wild birds, collection and testing of ticks, small rodent trapping, and/or response to public service requests regarding nuisance animals or insects. Mosquito populations are monitored through the use of traps, inspections, and sampling in mosquito habitats. Known and suspected habitats are anywhere that water can collect, be stored, or remain standing for more than a few days, including, but not limited to, catch basins, stormwater detention systems, residential communities, parks, ornamental ponds, unmaintained swimming pools, seeps, seasonal wetlands, tidal and diked marshes, wastewater ponds, sewer plants, winery waste/agricultural ponds, managed waterfowl ponds, canals, creeks, tree holes, and flooded basements. If preexisting roads and trails are not available, low ground pressure ATVs may be used to access sites. Offroad access is minimized and used only when roads and trails are not available. Ticks and rodents are collected along trails and sampled for disease. Rodents are collected during building inspections.

These activities do not involve chemical applications to water or soil and require very little interaction with water bodies to collect samples. With the exception of some adult mosquito traps, pesticides are not required for any of the surveillance techniques. Some adult mosquito traps use a Vapona strip infused with dichlorvos in the bottom of the collection jar; this chemical would be contained in the collection device and would not contact nor interact with the environment.

9.2.3 Physical Control Component

Physical control for mosquitoes consists of the management of mosquito-producing habitat (including freshwater marshes and lakes, saltwater marshes, temporary standing water, and wastewater treatment facilities) especially through water control and maintenance or improvement of channels, tide gates, levees, and other water control facilities, etc. Physical controls reduce or eliminate mosquito development sites by improving the habitat value for mosquito predators (i.e., providing deepwater sanctuary for larvivorous fish) or by reducing the habitat value for mosquitoes. Because mosquitoes breed in stagnant standing water, the District attempts to reduce these habitats through vegetation management, increased circulation, steepening banks, changes in water quality, or by reducing the duration that standing water is allowed to persist. The specific method employed is based on site- and project-specific considerations, including whether the activity is conducted to prevent mosquito-producing habitat from forming or in response to existing conditions. Characteristics of the site and water body are also considered in planning physical

control activities. Vegetation management is based on an IPM approach and is discussed in Section 9.2.5. The District conducts physical control activities, requests/requires landowners and stewards to implement maintenance activities, and advises landowners on source reduction for mosquito habitat.

Three types of physical control practices are implemented:

1. Maintenance activities include removal of sediments from existing water circulation ditches; repair of existing water control structures, removal of debris in natural channels, clearance of brush for access to streams tributary to wetland areas, and filling of existing, nonfunctional water circulation ditches to achieve required water circulation dynamics and restore ditched wetlands.
2. New construction typically involves the creation of new ditches to enhance tidal flow preventing stagnant water.
3. Cultural practices include vegetation and water management (i.e., irrigation practices), placement of culverts or other engineering works, and making other physical changes to the lands.

The District performs these physical control activities in accordance with all appropriate environmental regulations and in a manner that generally maintains or improves habitat values for desirable species. Physical control activities can be relatively minor, typically consisting of up to 10,000 to 20,000 linear feet of ditch maintenance per year, and are often covered by the District's 5-year USACE and BCDC regional wetlands permits (Section 2.8.1.3). Filling or periodically draining artificially ponded areas such as ornamental ponds and irrigation ponds can be cost-effective and environmentally acceptable; however, these methods are not appropriate strategies in natural areas, large permanent water bodies, or in areas set aside for stormwater or wastewater retention. Consequently, the District does not usually undertake physical control projects in freshwater bodies including marshes and ponds. In saline and brackish marsh habitat, physical control measures are typically designed to reduce salt-marsh mosquito production through enhancement of the frequency and duration of tidal inundation or through other water management strategies.

Physical control activities for other vectors such as rates, mice, raccoon, skunk, and opossum are based on the District's public service requests and surveillance activities. They may include education of property owners on sanitation, exclusion, and rodent proofing. The District may also remove the vector, typically by trapping methods.

Construction of water control facilities and changes in water management strategies can affect existing drainage patterns and water quality locally. However, physical control activities are designed to increase water circulation, which can increase dissolved oxygen and reduce water temperatures, improving these water quality conditions locally. Changing water circulation patterns can also increase localized areas of scour due to increased water velocities, particularly near structures. Water control facilities (e.g., tide gates, levees) are designed to minimize scour near the structure for long-term stability. Potential increases in turbidity in the water body are limited to during and immediately after the action and do not extend beyond the vicinity of the area being improved. Changes to groundwater conditions such as water quality or recharge do not occur.

Removal of sediments from existing water circulation ditches can temporarily approach or exceed turbidity water quality objectives in nearby downstream receiving waters. However, the physical control activities are short in duration (typically less than 1 day), are localized to site-specific areas, and are transitory in location.

9.2.4 Vegetation Management Component

District staff's direct vegetation management generally consists of activities to reduce the mosquito habitat value of sites by improving water circulation or access by fish and other predators, or to allow District staff's access to standing water for inspections and treatment. The District uses hand tools, other mechanical means to thin or remove vegetation. These activities primarily occur in aquatic habitats to assist with the control of mosquitoes but are also implemented in terrestrial habitats to help with the control of other vectors. The District may also perform vegetation management to assist other agencies and landowners with the management of invasive/nonnative weeds. These actions are typically performed under the direction of the concerned agency, which also maintains any required permits.

9.2.4.1 Mechanical Removal of Vegetation

Mechanical and hand removal of vegetation from aquatic habitats can temporarily approach or exceed turbidity water quality objectives in downstream receiving waters. However, the vegetation control activities are short in duration (typically less than 1 day), are localized to site-specific areas, and are transitory in location.

9.2.5 Biological Control Component

Biological control of mosquitoes involves the intentional use of vector pathogens, parasites, and predators to reduce the mosquito population. It is one of the principal components of the IPM approach followed in which the emphasis is on source reduction and control of mosquitoes in their immature stages. Mosquito pathogens include an assortment of viruses and bacteria. Mosquito parasites are not generally available commercially for mosquito control at present. Mosquito predators are represented by insects, fish, birds, and bats that consume larval or adult mosquitoes as prey. Although the District supports the presence of a variety of species, only mosquitofish (*Gambusia affinis*) are commercially available to use at present.

Mosquitofish are stocked and maintained at the District where wastewater discharge has the potential to convey nutrients, sediments, and other potential pollutants to storm drains, downstream receiving waters, and groundwater. The wastewater is discharged to a sanitary sewer; the potential pollutants may be removed by the wastewater treatment plant. Because the volume and frequency of discharges are relatively minor (20 gallons per day), the effect of this component to surface water and groundwater is minimal.

Because mosquitofish may potentially adversely affected-legged frog and tiger salamander populations, use of mosquitofish is limited to man-made water features such as ornamental fish ponds, water troughs, water gardens, fountains, and unused swimming pools where their migration into habitats used by special-status species is limited.

Currently, no commercial biological control agents or products are available for wasp and yellowjacket control, and the District does not employ predators for rodent control.

Because the potential environmental effects of mosquito pathogens the District applies are generally similar to those of chemical pesticide applications, these chemicals are evaluated under the Chemical Control component (Section 9.2.7).

High populations of mosquitofish in a water body can increase nutrient concentrations, causing algal blooms and a subsequent drop in dissolved oxygen. However, because mosquitofish use is limited to man-made water features that are hydrologically isolated from receiving waters, their effect on surface water is minimal, particularly since the connection between these man-made water bodies and natural surface waters or groundwater is limited or nonexistent.

9.2.6 Chemical Control Component

Chemical control consists of the application of chemicals to directly reduce populations of vectors that pose a risk to public health. The majority of chemical control tools are used for mosquito abatement. As part of their IPM program, the District prioritizes the least toxic materials available for control of the larval stages, focusing on bacterial larvicides, growth regulators, and surface films rather than OPs or pyrethroids. Control of adult mosquitoes may become necessary under some circumstances, such as in the event of a disease outbreak (documented presence of infectious virus in active host-seeking adult mosquitoes), or lack of access to larval sources and habitats leading to the emergence of large numbers of biting adult mosquitoes. OP insecticides may be used in rotation with pyrethrins or pyrethroids to avoid the development of resistance. The active ingredients currently used for control of adult mosquitoes have been deliberately selected for lack of persistence and minimal effects on nontarget organisms when applied in accordance with label guidelines for ULV mosquito control.

The District also uses insecticides to control populations of ground-nesting yellowjackets and ticks. This activity is generally triggered by public requests rather than as a result of regular surveillance activities. The District does not treat yellowjacket nests that are located inside or on a structure; instead, the resident is encouraged to contact a private pest control company. Likewise, residents complaining of honeybee swarms or hives are referred to the Santa Clara Bee Guild website for a referral list of beekeepers. If a District technician deems it appropriate to treat stinging insects, they will apply the insecticide directly within the nest to avoid drift or harm to other organisms. Alternatively, they will place tamper-resistant traps or bait stations, selective for the target insect in the immediate environment. Chemicals used in the traps are contained and do not interact with the environment.

The District's Rodent Management Program includes limited use of rodenticides in response to resident requests. Rodent baits containing first and second generation anticoagulants are typically placed in secure bait stations or at underground sites such as sewers, storm drains, or catch basins. In sewer baiting, bait blocks containing bromadiolone are often suspended by wire above the water line. For rodent burrows, fumigants or anticoagulant dust is blown into the burrows.

All chemicals are applied in strict conformance with label requirements, which have been approved by CDPR for use in California. Pesticide labels are application requirements and include instructions informing users how to apply the product and precautions the applicator should employ to protect human health and the environment. In addition, chemicals are applied in conformance with the PAP as required by the NPDES Vector Control Permit. All BMPs included in the PAP and product labels are followed and include such measures as restrictions in applications to certain land uses and weather (i.e., wind speed) parameters.

All chemical active ingredients and adjuvants the District currently uses are reviewed and evaluated in the Ecological and Human Health Risk Assessment (Appendix B). The following sections evaluate groups of chemicals based on their target organism or life stage.

9.2.6.1 Mosquito Larvicides

Larvicides are used to manage immature life stages of mosquitoes including larvae and pupae in aquatic habitats. Temporary aquatic habitats are usually targeted because permanent water bodies generally support natural mosquito predators such as fish. The larvicides are applied using ground application equipment and rotary aircraft. Applications may be repeated at any site at recurrence intervals ranging from annually to weekly.

9.2.6.1.1 Biological Agents

Bs is a bacterial larvicide that is applied to irrigation ditches, floodwater, standing ponds, woodland pools, pastures, tidal water, fresh- or saltwater marshes, and stormwater retention areas. It damages and paralyzes the gut of mosquito larvae that ingest the spores. Although dormant Bs spores may persist in the environment for several weeks to months and the δ-endotoxins generally persist for 2 to 4 weeks

following application, the δ-endotoxins degrade rapidly in sunlight and are degraded by soil microorganisms. Bs does not percolate through the soil and readily binds to sediments. It is highly selective for mosquitoes and is not toxic to nontarget species, including birds, mammals, fish, and invertebrates in amounts that effectively control mosquito larvae. For these reasons, Bs should not result in adverse effects to surface water or groundwater.

Bti is applied in a similar manner and often in combination with Bs. Bti toxins may persist in soil for several months, yet a half-life for typical Bti products on foliage is approximately 1 to 4 days due to rapid degradation in sunlight. Toxicity is minimal to nonexistent to nontarget avian, freshwater fish, freshwater aquatic invertebrates, estuarine and marine animals, arthropod predators/parasites, honeybees, annelids, and mammalian wildlife at the label use rates of registered Bti active ingredients. For these reasons, Bti should not result in adverse effects to surface water or groundwater.

Spinosad is a biologically derived insecticide produced from the fermentation of *Saacharopolyspora spinosa*, a naturally occurring soil organism. It activates the central nervous system of insects through interaction with neuroreceptors and causes mortality through continuous stimulation of the insect nervous system. Spinosad degrades quickly in sunlight in both aqueous and soil environments. It adsorbs strongly to soil particles where it is quickly metabolized by soil microorganisms under aerobic conditions and is therefore unlikely to leach into groundwater. Spinosad is practically nontoxic to birds and mammals but is slightly-to-moderately toxic to fish and most aquatic invertebrates. However, low amounts typically used for mosquito control would not likely pose a significant risk to potential ecological receptors. For these reasons, spinosad should not result in adverse effects to surface water or groundwater. The District applies all biological pathogen larvicides in strict conformance with their PAP and the label requirements, which have been approved by CDPR for use in California, avoiding adverse effects to surface water and groundwater resources. Hydrocarbon Esters

Methoprene is an insect growth regulator that is applied at very low concentrations for mosquito control in the form of briquettes, pellets, sand granules, and liquid. It consists of two enantiomers: S-methoprene and R-methoprene, with S-methoprene being the biologically active enantiomer. Fate and transport characteristics of the s-enantiomer and the mixture are similar, but toxicity differs. Methoprene readily binds to suspended solids in the water column and soils. It rapidly degrades by photolysis and is metabolized in soil under both aerobic and anaerobic conditions. Although it may exhibit toxicity to fish and aquatic invertebrates, as well as nontarget insects including moths, butterflies, and beetles, methoprene is considered the least toxic of all larvicide alternatives, these products have minimal effects to surface water and groundwater resources when applied in accordance with the recommended BMP application techniques described in their PAP and product label requirements.

9.2.6.1.2 Surfactants

The monomolecular film used in California for the control of mosquito larvae is alpha-isooctadecyl-omega-hydroxypoly (oxyethylene). Monomolecular films spread a thin film on the surface of the water that makes it difficult for mosquito larvae, pupae, and emerging adults to attach to the water's surface, causing them to drown. It also disrupts larval respiration. Reported half-lives of monomolecular films in water range from 5 to 22 days. It may temporarily affect nontarget surface-breathing insects but has no observable effects to amphibians, fish, or other aquatic organisms. These products should not result in adverse water quality conditions in surface water or groundwater when used in accordance with approved BMP application requirements and techniques.

Specially derived aliphatic solvents (e.g., mineral oils and aliphatic petroleum hydrocarbons) are used to form a coating on top of water to drown larvae, pupae, and emerging adult mosquitoes. Petroleum distillates can be more effective than monomolecular films but break down much more rapidly (2 to 3 days). They have low water solubility and high sorption to organic matter. They are practically nontoxic to most nontarget organisms. Using BMP application techniques, these products should not result in adverse effects to water quality conditions in surface water or groundwater.

The District applies all surfactant larvicides in strict conformance with their PAP and the label requirements, which have been approved by CDPR for use in California. Proper application using BMPs does not result in adverse effects on surface water or groundwater resources.

9.2.6.1.3 Temephos

Temephos is the only OP larvicide used and is sometimes used in rotation with bacterial pathogens to prevent resistance. Temephos is not labeled for use in agricultural lands or pasture and the District limits its use to man-made sources such as tire piles, utility vaults, and cemetery urns. It provides effective control in water with high levels of decaying organic matter. Temephos is extremely hydrophobic with low solubility and, therefore, is unlikely to leach to groundwater. It adsorbs rapidly to organic material in water and binds strongly to soils where it breaks down via photolysis and microbial degradation. It is slightly-to-moderately toxic to mammals and fish, but only when applied at rates much higher than needed for mosquito larval control.

However, it is highly toxic to nontarget aquatic invertebrates and therefore is rarely used. When applied in strict conformance with label requirements and the District's PAP, use of temephos has minimal effects on surface water or groundwater resources.

9.2.6.2 Mosquito Adulticides

The use of adulticides to control mosquitoes is the method of control of last resort in the District's IPM program. Adulticides are only applied when other tools are not available and when specific criteria are met, including species composition, population density, proximity to human populations, and/or human disease risk. The active ingredients currently in use have been deliberately selected for lack of persistence and minimal effects on nontarget organisms when applied in strict conformance to label instructions for ULV mosquito control. Adulticides are applied using ground application equipment or rotary aircraft and following strict conformance with label requirements and BMPs described in the District's PAP.

9.2.6.2.1 Pyrethrins and Pyrethroids

The District uses pyrethrins and pyrethroids to control adult mosquitoes and yellowjacket wasps. Pyrethrins are naturally occurring products distilled from the flowers of *Chrysanthemum* species. Pyrethroids are synthetic compounds that are chemically similar to the pyrethrins, but have been modified to increase their stability and activity against insects, while minimizing their effect on nontarget organisms. First generation or "Type I" photosensitive pyrethroids include d-allethrin, phenothrin (sumithrin), prallethrin, resmethrin, and tetramethrin. Typically, these pyrethroids are used indoors and around residential areas. The newer second-generation pyrethroids are mostly "Type II" pyrethroids. The active ingredients that fall into this group include deltamethrin, esfenvalerate, lambda-cyhalothrin, and permethrin. Type II pyrethroids are more toxic than Type I pyrethroids because they are less photosensitive and persist longer in the environment. Etofenprox is a synthetic pyrethroid-like chemical, differing in structure from pyrethroids in that it lacks a carbonyl group and has an ether moiety, whereas pyrethroids contain ester moieties. Pyrethrins and pyrethroids act by causing a persistent activation of the sodium channels on insect neurons.

Pyrethrins and pyrethroids quickly adsorb to suspended solids in the water column and partition into the sediment. They adsorb strongly to soil surfaces, and are generally considered immobile in soils and, therefore, are unlikely to leach to groundwater (USEPA 2006c). These materials are relatively nontoxic to mammals and birds, but are highly toxic to fish and invertebrates. The major route of degradation is through photolysis in both water and soil. Pyrethrins and pyrethroids may be persistent in environments free of light, and pyrethroids as a class have been implicated in 303(d) listings of sediment toxicity in urban creeks (BASMAA 2013). However, the ULV applications common to mosquito control and the limited use at yellowjacket nests encourage dissipation rather than persistence in the environment.

Insecticides containing pyrethrins and pyrethroids usually also contain PBO as a synergist. PBO interferes with the insect's ability to detoxify pyrethrins and pyrethroids, thus enhancing the product's effectiveness. PBO has low toxicity to mammals but is a possible endocrine disruptor and is included in the final list of chemicals for screening under USEPA's Endocrine Disruptor Screening Program. It is moderately to highly toxic to fish and is highly toxic to aquatic invertebrates. PBO is moderately mobile in soil and water but degrades rapidly in the environment by photolysis and through metabolism by soil microbes. Although it degrades rapidly, release of PBO to the environment may "activate" persistent pyrethroids that are already present in the sediment. However, adverse effects to surface water or groundwater from use of PBO are minimized when it is applied using ULV techniques, label requirements, and BMPs described in the District's PAP.

The District applies pyrethrins in terrestrial and aquatic environments for wide-area mosquito abatement using ULV techniques. They are also used locally to treat yellowjacket nests. Pyrethrins quickly adsorb to suspended solids in the water column and adsorb strongly to soil surfaces making them immobile in soils and unlikely to leach into groundwater. They degrade via photolysis and are likely to persist under anaerobic conditions. Pyrethrins have low to moderate acute toxicity to mammals but are practically nontoxic to birds. They are very highly toxic to freshwater fish and invertebrates. Several studies have shown that pyrethrins applied using ULV techniques do not accumulate in water or sediment following repeated applications. These studies also determined that no toxicity is associated when exposure is limited to the amounts used when following ULV protocols for mosquito control (Lawler et al. 2008; Amweg et al. 2006).

Allethrins are Type I synthetic pyrethroids that are usually combined with synergists such as PBO. They are typically released into the air through the use of mosquito coils and mats. Once in the air, they are) degraded by photolysis in less than 8 hours. The toxicity of allethrin varies depending on which of its four isomers are present. Allethrins are highly toxic to fish and invertebrates but degrade too quickly to result in adverse effects to surface water or groundwater when used according to label and PAP requirements.

Permethrin is a Type I synthetic pyrethroid that is usually combined with synergists such as PBO to control adult mosquitoes using ULV techniques and for yellowjacket control. It is hydrophobic and tends to partition to soil and sediment. Its primary degradation pathways include photolysis and aerobic metabolism and it may be persistent in environments free of light. Permethrin is slightly toxic to humans and has been included in the final list of chemicals for screening under USEPA's Endocrine Disruptor Screening Program. It has low toxicity to mammals and is practically nontoxic to birds, but is very highly toxic to fish, aquatic invertebrates, and honeybees. Because of its high toxicity and potential persistence, the application of permethrin is subject to the following Best Management Practices, which are also included in Section 2.8.3:

- Application of permethrin is applied only when other IPM options have been exhausted. Alternative mosquito adulticides shall be applied whenever possible.
- These chemicals are not be applied in locations where receiving waters are 303(d) listed for pyrethroids or sediment toxicity. Consistent with the District's current IPM plan, application of chemicals occur only when other IPM options have been exhausted. Because permethrin has relatively high toxicity and persistence in comparison to other pyrethroids, the District's current IPM plan is updated to give lower priority to the use of permethrin than other pyrethroids in instances requiring chemical control. Permethrin use is reserved for specific cases where alternative pesticides would not be as effective. Prior to chemical applications, the location of the application area is reviewed with respect to proximity to impaired water bodies. Application of permethrin is not conducted in locations where receiving waters are 303(d) listed for pyrethroids or sediment toxicity.

Phenothrin (or sumithrin) is a Type I synthetic pyrethroid that is usually combined with synergists such as PBO to control adult mosquitoes and yellowjacket wasps. Phenothrin has low solubility and a relatively

high affinity for binding to soil. It degrades through photolysis in water and aerobic metabolism in soil but is moderately persistent under aerobic conditions and persistent under anaerobic conditions. Phenothrin is not toxic to mammals or birds but is highly toxic to fish and freshwater invertebrates. When applied locally (for yellowjacket control) or in ULV applications (for mosquito control) according to the District's PAP, phenothrin does not result in adverse effects to surface water or groundwater.

Prallethrin is a Type I synthetic pyrethroid. The only prallethrin-containing product registered for mosquito control in California is Duet, which also contains phenothrin and PBO. Prallethrin is also intermittently used to target yellowjacket nests. Prallethrin readily sorbs to soils and sediments and degrades quickly via photolysis in both water and soil. It is not toxic to mammals or birds but is highly toxic to fish and nontarget aquatic invertebrates. When applied locally (for yellowjacket control) or in ULV applications (for mosquito control) according to the District's PAP, prallethrin does not result in adverse effects to surface water or groundwater.

Resmethrin is a Type I synthetic pyrethroid that is usually combined with synergists such as PBO to control adult mosquitoes in tree holes and using ULV techniques. Resmethrin has a high affinity to bind to soils, sediments, and organic carbon and it degrades rapidly when exposed to light. When not subject to photolysis, it may be environmentally persistent. Resmethrin has low toxicity to mammals but has been included in the final list of chemicals for screening under USEPA's Endocrine Disruptor Screening Program. It is moderately toxic to birds and highly toxic to fish and aquatic invertebrates. Due to its high toxicity and potential persistence, use of Resmethrin is subject to the following Best Management Practices, which are also included in Section 2.8.4:

- Resmethrin is applied only when other IPM options have been exhausted. Alternative mosquito adulticides are applied whenever possible.
- These chemicals are not be applied in locations where receiving waters are 303(d) listed for pyrethroids or sediment toxicity. Consistent with the District's current IPM plan, application of chemicals occurs only when other IPM options have been exhausted. Because resmethrin has relatively high toxicity and persistence in comparison to other pyrethroids, the District's current IPM plan has been updated to give lower priority to the use of resmethrin than other pyrethroids in areas requiring chemical control. Resmethrin use is reserved for specific cases where alternative pesticides are not as effective. Prior to chemical applications, the location of the application area is reviewed with respect to proximity to impaired water bodies. Resmethrin is not applied in locations where receiving waters are 303(d) listed for pyrethroids or sediment toxicity.

Tetramethrin is a Type I synthetic pyrethroid that the District uses in localized applications for the control of yellowjacket wasps. It is slightly mobile in soil but decomposes rapidly by photolysis and hydrolysis and is not considered persistent in the environment. Tetramethrin is practically nontoxic to birds and terrestrial mammals but meets the criteria for classification as a possible human carcinogen. It is highly toxic to fish, aquatic invertebrates, and honeybees. When used according to label requirements and BMP application techniques that limit its release to aquatic systems, tetramethrin does not result in adverse effects to surface water or groundwater.

Deltamethrin is a longer lasting Type II synthetic pyrethroid that kills adult mosquitoes, yellowjacket wasps, and ticks on contact and through ingestion. It is used as a barrier application in mosquito resting areas and migratory stops. These treatments do not use ULV techniques but are usually applied as large liquid droplets with a sprayer during daylight hours. The primary objective of barrier treatment is the temporary prevention of reinfestation. Deltamethrin is low to moderately toxic to humans and may cause prenatal damage. It is practically nontoxic to birds but is very highly toxic to fish and nontarget aquatic invertebrates. For this reason, it is not used in aquatic environments. It binds to soils and sediments and may be persistent in the environment. When applied locally to target yellowjacket nests, deltamethrin does not result in adverse effects to surface water or groundwater.

Esfenvalerate is a relatively new Type II synthetic pyrethroid that is deployed above ground in bait stations for yellowjacket wasp control. It is practically insoluble in water and has a strong tendency to bind to sediments and soil. It degrades via photolysis and aerobic metabolism and does not appear to persist in the environment. Esfenvalerate is considered moderately toxic to mammals and birds, highly toxic to fish, aquatic invertebrates, and honey-bees, and is bioaccumulative in fish. Additionally, esfenvalerate has been included in the final list of chemicals for screening under USEPA's Endocrine Disruptor Screening Program. However, when used according to label guidelines and BMP application techniques that limit its release to the soil surface and aquatic systems, esfenvalerate should not result in adverse effects to surface water or groundwater.

Lambda-cyhalothrin is a Type II synthetic pyrethroid that the District uses for yellowjacket wasp control in localized settings. It is extremely hydrophobic and rapidly adsorbs to soils and sediments. Its primary degradation pathways include photolysis and aerobic metabolism and it may be persistent in the absence of light. Lambda-cyhalothrin is moderately toxic to mammals, has low toxicity to birds, and is highly toxic to fish, aquatic invertebrates, and honeybees. It also has the potential to bioaccumulate in fish. However, when used according to label requirements and BMP application techniques that limit its release to the soil surface and aquatic systems, lambda-cyhalothrin does not result in adverse effects to surface water or groundwater.

Tetramethrin is a Type I synthetic pyrethroid that the District uses in localized applications for the control of yellowjacket wasps. It is slightly mobile in soil but decomposes rapidly by photolysis and hydrolysis and is not considered persistent in the environment. Tetramethrin is practically nontoxic to birds and terrestrial mammals but meets the criteria for classification as a possible human carcinogen. It is highly toxic to fish, aquatic invertebrates, and honeybees. When used according to label requirements and BMP application techniques that limit its release to aquatic systems, tetramethrin does not result in adverse effects to surface water or groundwater.

Etofenprox is a pyrethroid-like insecticide that is used as a mosquito adulticide and is available in formulations that do not contain PBO. It is virtually insoluble in water and stable to hydrolysis but is rapidly degraded by photolysis. Residues of etofenprox are not likely to persist in the environment. It has low toxicity to mammals but is highly toxic to fish and aquatic invertebrates. Based on toxicity and environmental fate, etofenprox does not result in adverse effects to surface water or groundwater when applied following label requirements and BMPs described in the District's PAP.

9.2.6.3 Yellowjacket Abatement

Pyrethrins and pyrethroids are applied direct to yellow jack wasp nest openings. The active ingredients the District uses are described under Mosquito Adulticides (Section 9.2.7.2).

9.2.6.3.1 Potassium Salts

Potassium salts of fatty acids are commonly referred to as "soap salts." They penetrate the insect's body covering and disrupt cell membranes causing the insect to die of dehydration. Potassium salts are not applied directly to water and degrade very quickly in soil. They are practically nontoxic to birds, slightly toxic to fish, and highly toxic to aquatic invertebrates.

9.2.6.4 Other Arthropod Abatement

Currently, deltamethrin may be used to control fleas, ticks and other arthropod vectors. It is described under Mosquito Adulticides (Section 9.2.7.2).

9.2.6.5 Rodenticides

The District's limited use of rodenticides is as a result of surveillance and/or in response to District resident requests.

9.2.6.5.1 Anticoagulants, Bromethalin, and Cholecalciferol

The District may use two different groups of anticoagulant rodenticides, known as first generation and second generation rodenticides. First generation rodenticides (e.g., chlorophacinone, diphacinone) require consecutive multiple doses or feedings over a number of days to be effective. Second generation rodenticides (e.g., brodifacoum, bromadiolone, difethialone) are lethal after one dose and are effective against rodents that have become resistant to first generation anticoagulant rodenticides. Secure, tamper-proof bait stations or other accepted methods of rodent baiting are conducted in areas with severe rodent infestations. Other poisons that act through ingestion include bromethalin and cholecalciferol.

Chlorophacinone is formulated as tracking powder, as loose-grain bait, paraffinized pellets, rat and mouse bait ready-to-use place packs, and paraffin blocks. It has low water solubility and is moderately persistent and immobile in soil. Chlorophacinone is highly toxic to wildlife, freshwater fish, and aquatic invertebrates, but application methods such as solid bait blocks minimize exposure pathways for nontarget species. For this reason, chlorophacinone products should not result in adverse effects when using BMP application techniques.

Diphacinone and diphacinone salt products are formulated as food baits, water baits, and a tracking powder. Diphacinone technical material has low water solubility and is generally applied as food bait blocks; however, diphacinone salt is highly soluble and is used to prepare water baits for indoor control of rodents. Diphacinone is highly toxic to mammals but only slightly-to-moderately toxic to fish and aquatic invertebrates. The District uses diphacinone in tree holes, burrows, parks, and/or urban creeks corridors and since it is generally applied as solid bait blocks, exposure to surface water and groundwater would be minimal.

Brodifacoum is formulated as meal bait, paraffinized pellets, ready-to-use place packs, and paraffin blocks. Brodifacoum has low solubility and is immobile and persistent in soil. Contamination of surface water and groundwater is expected to be minimal because of its use pattern and immobility in soil. Brodifacoum is highly toxic to mammals and highly toxic to freshwater fish and invertebrates, but due to its extremely low solubility, the USEPA does not believe the chemical poses a hazard to nontarget aquatic organisms.

Bromadiolone formulations include meal bait, pellets, ready-to-use place packs, and paraffinized blocks. It is moderately persistent in soils. Bromadiolone is moderately toxic to fish and moderately to highly toxic to freshwater invertebrates. The District uses bromadiolone in and around man-made and natural standing and moving water. When deployed in sewers, bromadiolone blocks are often attached to a string and hung below manhole covers and the bromadiolone is usually wax-encased in block form, which has exceptionally low water solubility and low leaching potential. This method of bait deployment reduces the probability of exposure to surface water and groundwater. Outside of sewers, bromadiolone is typically contained in tamper-proof bait stations, which are most frequently deployed at residential locations per homeowners' requests, and not near aquatic systems. When used properly, potential for adversely affecting aquatic systems is very limited.

Difethialone is formulated as meal, pellets, blocks, packs or pouches, paste, paraffin blocks, and bait stations. Difethialone adsorbs to suspended solids and sediment and is immobile in soil. Difethialone is highly toxic to mammals, birds, and aquatic organisms including fish. The District uses difethialone in around landscaping, in parks, and in urban creek corridors.

Bromethalin is an ingestion poison, which causes loss of osmotic control in cells, often used to exterminate rodents resistant to first generation anticoagulant rodenticides. Bromethalin is formulated as pelleted food bait. Bromethalin is very highly toxic to freshwater fish and aquatic invertebrates. However, some bromethalin products meet the USEPA's new, more protective risk reduction standards when applied in tamper-resistant and weather-resistant bait stations. Aquatic exposure is expected to be minor based on use patterns.

Cholecalciferol is a sterol and its ingestion by mice and rats results in hypercalcemia. Cholecalciferol is formulated as pellets and blocks. It is expected to be essentially insoluble in water and immobile in soil. Although it is highly toxic to target rodents, cholecalciferol is considered of low hazard to nontargets such as birds, dogs, and fish. The District uses cholecalciferol in one product along urban creek corridors, parks, and waterfronts.

Although many of these chemicals that have high toxicity to aquatic organisms (i.e., chlorophacinone, brodifacoum, bromadiolone, difethialone, bromethalin), these rodenticides generally have minimal exposure to surface water and groundwater due to paraffinization of these materials and the method of bait deployment. Furthermore, these materials often have low solubility.

9.2.6.5.2 Fumigants

Sulfur and sodium nitrate are two of the active ingredients in fumigant (gas-producing) cartridge products, which are used for rodent control. Carbon, sodium and potassium nitrates, sawdust, and sulfur are used in the fumigant gas-producing cartridge products. After the cartridges are ignited, these active ingredients produce toxic gases that cause asphyxiation of pests. The gases displace the oxygen in the burrows, creating an unbreathable atmosphere, causing asphyxiation of the target organisms (rats and mice). Sulfur fumigants are of low toxicity prior to activation of sulfur-containing cartridges. Elemental sulfur will become incorporated back into the natural sulfur cycle after deployment. Elemental sulfur is practically nontoxic to aquatic organisms. Sodium nitrates are naturally occurring substances and exposure to the aquatic environment is limited and localized when the products are used as fumigants in burrows.

9.2.7 Other Nonchemical Control/Trapping Component

This component includes the trapping of rodents and/or yellowjackets that pose a threat to public health and welfare. For both species, tamper-resistant or baited traps are used which limits the exposure of chemical-containing baits to the environment. Traps may also be used to remove nuisance wildlife such as raccoon, skunk, and opossum. This component has not effect on surface water or groundwater.

10 Air Quality

This chapter is based on Appendix C, Air Quality and Greenhouse Gas Emissions Technical Report. It presents the environmental setting for the District's Program and an analysis of the Program's emissions in relation to air quality in the District's Program Area.

10.1 Environmental Background

State and federal law defines criteria emissions to include the following: reactive or volatile organic compounds (ROCs or VOCs), nitrogen oxides (nitric oxide [NO] and nitrogen dioxide [NO_2]), carbon monoxide (CO), sulfur dioxide (SO_2), respirable particulate matter (PM_{10}), and fine particulate matter ($PM_{2.5}$). Elimination of tetraethyl lead in motor gasoline has eliminated lead (Pb) emissions from vehicles and portable equipment, although tetraethyl lead is still used in some types of aviation gasoline.

During applicable mosquito and/or vector control activities, the Program would generate criteria emissions from the combustion of fossil fuels (i.e., gasoline, diesel, jet fuel) used to operate portable equipment, vehicles, and aircraft across the District's service area. (Control activities would also cause greenhouse gas emissions, which are addressed in Chapter 11.)

10.1.1 Program Location

The Program Area is located in Santa Clara County and the adjacent counties, where control activities may be provided upon request. Adjacent counties include San Mateo, Merced, San Benito, Stanislaus, Santa Cruz, and Alameda. These counties are predominantly in the San Francisco Bay Area Air Basin (SFBAAB), under the jurisdiction of the Bay Area Air Quality Management District (BAAQMD). Other adjacent counties are in the San Joaquin Valley Air Pollution Control District (SJVAPCD) and the Monterey Bay Unified Air Pollution Control District. The bulk of criteria pollutant emissions resulting from Program activities would occur in the SFBAAB.

Air districts in California are required to monitor air pollutant levels to assure that National Ambient Air Quality Standards (NAAQS) and California Ambient Air Quality Standards (CAAQS) are met and, in the event that they are not, to develop strategies to meet these standards. If the standards are met, the local air basin is classified as being in "attainment;" if the standards are exceeded, it is classified as being in "nonattainment." Where insufficient data exist to make a determination, an area is deemed "unclassified."

The SFBAAB is designated as nonattainment for the state 1-hour, state 8-hour, and federal 8-hour ozone (O_3) standards, and nonattainment for all state PM_{10} and $PM_{2.5}$ standards. The SFBAAB is also designated unclassified for the 24-hour federal PM_{10} standard, and nonattainment and attainment for the federal 24-hour and annual $PM_{2.5}$ standards, respectively. For all other pollutants and standards, the SFBAAB is designated as either attainment or unclassified status (BAAQMD 2012a; CARB 2012a; USEPA 2012a; see Table 10-2).

10.1.2 Meteorology and Climate

The Program Area climate is characterized by moderately wet winters and dry summers. About 90 percent of the annual total rainfall is received in the November through April period. Between June and September, normal rainfall is typically less than 0.6 inch (1.5 centimeters). Temperatures in the Program Area average about 60 degrees Fahrenheit (°F) (15 degrees Celsius [°C]) annually, with average summer highs in the 70 to 80°F (21 to 27°C) range and average winter lows in the 40 to 50°F (4 to 10°C) range. Precipitation averages about 23 inches (58 centimeters) per year, although annual precipitation can vary significantly from year-to-year. Annual average wind speeds in the Program Area are about 8 miles per

hour (3.6 meters per second). The predominant direction of air pollution transport in the Program Area is inland from the coastal areas (BAAQMD 2010a; World Climate 2012; NOAA 2008).

10.1.3 Criteria Air Pollutants and Human Health

A criteria or regulated air pollutant is any air pollutant for which ambient air quality standards have been set by the USEPA or the California Air Resources Board (CARB). Primary air quality standards are established to protect human (public) health. Secondary air quality standards are designed to protect public welfare from effects such as diminished production and quality of agricultural crops, reduced visibility, degraded soils, materials and infrastructure damage, and damaged vegetation. Criteria pollutants include O_3, NO_2, CO, SO_2, PM_{10}, and $PM_{2.5}$. The six most prevalent criteria pollutants and their potential health effects are described below.

10.1.3.1 Ozone

Ground-level O_3 is a secondary pollutant formed in the atmosphere by a series of complex chemical reactions and transformations in the presence of sunlight above urban areas due to the mixing effects of temperature inversions. Nitrogen oxides (NO_X) and reactive organic gases (ROGs)[18] are the principal constituents in these reactions. NO_X and ROG emissions are predominantly attributed to mobile sources (onroad motor vehicles and other mobile sources). Thus, regulation and control of NO_X and ROGs from these sources is essential to reduce the formation of ground-level O_3.

O_3 is a strong irritating gas that can chemically burn and cause narrowing of airways, forcing the lungs and heart to work harder to provide oxygen to the body. A powerful oxidant, O_3 is capable of destroying organic matter, including human lung and airway tissue; it essentially burns through cell walls. O_3 damages cells in the lungs, making the passages inflamed and swollen. O_3 also causes shortness of breath, nasal congestion, coughing, eye irritation, sore throat, headache, chest discomfort, breathing pain, throat dryness, wheezing, fatigue, and nausea. It can damage alveoli, the individual air sacs in the lungs where oxygen and carbon dioxide are exchanged. O_3 has been associated with a decrease in resistance to infections. People most likely to be affected by O_3 include the elderly, the young, and athletes. O_3 may pose its worst health threat to people who already suffer from respiratory diseases such as asthma, emphysema, and chronic bronchitis (VCAPCD 2003).

10.1.3.2 Nitrogen Dioxide

NO_2 is formed in the atmosphere primarily by the rapid reaction of the colorless gas NO with atmospheric oxygen. It is a reddish brown gas with an odor similar to that of bleach. NO_2 participates in the photochemical reactions that result in O_3. The greatest source of NO, and subsequently NO_2, is the high-temperature combustion of fossil fuels such as in motor vehicle engines and power plant boilers. NO_2 and NO are referred to collectively as NO_X. NO_2 can irritate and damage the lungs, cause bronchitis and pneumonia, and lower resistance to respiratory infections such as influenza. Researchers have identified harmful effects, similar to those caused by O_3, with progressive changes over 4 hours of exposure causing impaired pulmonary function, increased incidence of acute respiratory disease, and difficult breathing for both bronchitis sufferers and healthy persons (VCAPCD 2003).

10.1.3.3 Carbon Monoxide

CO is a common, colorless, odorless, highly toxic gas. It is produced by natural and anthropogenic (caused by human activity) combustion processes. The major source of CO in urban areas is incomplete combustion of carbon-containing fuels (primarily gasoline, diesel fuel, and natural gas). However, it also results from combustion processes including forest fires and agricultural burning. Ambient CO concentrations are generally higher in the winter, usually on cold, clear days and nights with little or no

[18] Also referred to as ROCs or VOCs.

wind. Low wind speeds inhibit horizontal dispersion, and surface inversions inhibit vertical mixing. Traffic-congested intersections have the potential to result in localized high CO levels.

When inhaled, CO does not directly harm the lungs. The effect from CO is on oxygenation of the entire body. CO combines chemically with hemoglobin, the oxygen-transporting component of blood, which diminishes the ability of blood to carry oxygen to the brain, heart, and other vital organs. Red blood cells have 220 times the attraction for CO as for oxygen. This affinity interferes with movement of oxygen to the body's tissues. Effects from CO exposure include headaches, nausea, and death. People with heart ailments are at risk from low-level exposure to CO. Also sensitive are people with chronic respiratory disease, the elderly, infants and fetuses, and people suffering from anemia and other conditions that affect the oxygen-carrying capacity of blood. High CO levels in a concentrated area can result in asphyxiation. Studies show a synergistic effect when CO and O_3 are combined (VCAPCD 2003).

10.1.3.4 Sulfur Dioxide

SO_2 is a colorless gas with a sharp, irritating odor. It can react in the atmosphere to produce sulfuric acid and sulfates, which contribute to acid deposition and atmospheric visibility reduction. It also contributes to the formation of PM_{10}. Most of the SO_2 emitted into the atmosphere is from burning sulfur-containing fossil fuels by mobile sources such as marine vessels and farm equipment and stationary fuel combustion. SO_2 irritates the mucous membranes of the eyes and nose and may also affect the mouth, trachea, and lungs. Healthy people may experience sore throats, coughing, and breathing difficulties when exposed to high concentrations. SO_2 causes constriction of the airways and poses a health hazard to asthmatics, which are very sensitive to SO_2. Children often experience more respiratory tract infections when they are exposed to SO_2 (VCAPCD 2003).

10.1.3.5 Respirable Particulate Matter, 10 Microns

PM_{10} consists of particulate matter, fine dusts and aerosols, 10 microns or smaller in diameter. When inhaled, particles larger than 10 microns generally are caught in the nose and throat and do not enter the lungs. PM_{10} can enter the large upper branches of the lungs just below the throat, where they are caught and removed (by coughing, spitting, or swallowing).

The primary sources of PM_{10} include dust from paved and unpaved roads and construction and demolition operations. Lesser sources of PM_{10} include wind erosion, agricultural operations, residential wood combustion, smoke, tailpipe emissions, and industrial sources. These sources have different constituents, and, therefore, varying effects on health. Road dust is composed of many particles other than soil dust. It also includes engine exhaust, tire rubber, oil, and truck load spills. Diesel particulate matter (DPM) contains many toxic particle and elemental carbon (soot), and is considered a toxic air contaminant in California. Airborne particles absorb and adsorb toxic substances and can be inhaled and lodge in the lungs. Once in the lungs, the toxic substances can be absorbed into the bloodstream and carried throughout the body. PM_{10} concentrations tend to be lower during the winter months because weather greatly affects PM_{10} concentrations. During rain, concentrations are relatively low, and on windy days, PM_{10} levels can be high. Photochemical aerosols, formed by chemical reactions with man-made emissions, may also influence PM_{10} concentrations.

Elevated ambient particulate levels are associated with premature death, an increased number of asthma attacks, reduced lung function, aggravation of bronchitis, respiratory disease, cancer, and other serious health effects. Short-term exposure to particulates can lead to coughing, minor throat irritation, and a reduction in lung function. Long-term exposure can be more harmful. USEPA estimates that 8 percent of urban nonsmoker lung cancer risk is due to PM_{10} in soot from diesel trucks, buses, and cars. Additional studies by USEPA and the Harvard School of Public Health estimate that 50,000 to 60,000 deaths per year in the US are caused by particulates. PM_{10} particles collect in the upper portion of the respiratory system, affecting the bronchial tubes, nose, and throat. They contribute to aggravation of asthma, premature death, increased number of asthma attacks, bronchitis, reduced lung function, respiratory

disease, aggravation of respiratory and cardiovascular disease, alteration of lung tissue and structure, changes in respiratory defense mechanisms, and cancer (VCAPCD 2003).

10.1.3.6 Fine Particulate Matter, 2.5 Microns

$PM_{2.5}$ is a mixture of particulate matter, fine dusts, and aerosols 2.5 microns or smaller in aerodynamic diameter. $PM_{2.5}$ can enter the deepest portions of the lungs where gas exchange occurs between the air and the blood stream. They are the most dangerous particles because the lungs have no efficient mechanisms for removing them. If these particles are soluble in water, they pass directly into the blood stream within minutes. If they are not soluble in water, they are retained deep in the lungs and can remain there permanently. This tendency increases the risks of long-term disease including chronic respiratory disease, cancer, and increased and premature death. Other effects include increased respiratory stress and disease, decreased lung function, alterations in lung tissue and structure, and alterations in respiratory tract defense mechanisms.

$PM_{2.5}$ particles are emitted from activities such as industrial and residential combustion processes, wood burning, and from diesel- and gasoline-powered vehicles. They are also formed in the atmosphere from gases such as SO_2, NO_X, ammonia, and VOCs that are emitted from combustion activities and then become particles as a result of chemical transformations in the air (secondary particles) (VCAPCD 2003).

10.1.4 Relationship of Air Pollution to Asthma

10.1.4.1 Sensitive Receptors

Consistent with the health effects of air pollution described above, certain population groups are considered more sensitive to air pollution and odors than others; in particular, children, elderly, and acutely ill and chronically ill persons, especially those with cardiorespiratory diseases such as asthma and bronchitis. Sensitive receptors (land uses) indicate locations where such individuals are typically found, namely schools, daycare centers, hospitals, convalescent homes, residences of sensitive persons, and parks with active recreational uses, such as youth sports.

Persons engaged in strenuous work or physical exercise also have increased sensitivity to poor air quality. Residential areas are considered more sensitive to air quality conditions than commercial and industrial areas, because people generally spend longer periods of time at their residences, resulting in greater exposure to ambient air quality conditions. Recreational uses such as parks are also considered sensitive, due to the greater exposure to ambient air quality conditions and because the presence of pollution detracts from the recreational experience.

Due to the wide geographic dispersion of District activities and their short-term temporary nature at any particular location, no quantifiable risk to sensitive receptors or the general public would be posed by Program-related engine exhaust.

10.1.5 Existing Air Quality

Air quality is affected by a variety of sources in the vicinity of the Program Area. Large stationary sources such as oil refineries and power plants emit substantial amounts of NO_X and ROCs, along with PM_{10} and $PM_{2.5}$. Light motor vehicles, diesel-powered construction equipment, and commercial trucks used in the Program Area are another source of these pollutants. Noncombustion sources of PM_{10} and $PM_{2.5}$ include fugitive dust from roads, construction, demolition, and earthmoving. Finally, commercial and general aviation aircraft generate emissions that affect air quality.

O_3 is a secondary pollutant that is not emitted directly by sources, but rather is formed by a reaction between NO_X and ROCs in the presence of sunlight. Reductions in O_3 concentrations are dependent upon reducing emissions of these precursors. The major sources of O_3 precursors in the Bay Area are motor vehicles and other mobile equipment (including agricultural equipment), solvent use, petroleum industry activities, nonelectric agricultural water pumping, and electric utilities operation.

BAAQMD, NSCAPCD, and San Joaquin Valley Air Pollution Control District operate extensive regional air monitoring networks comprised of monitoring stations (sites) that collectively measure the ambient concentrations of six criteria air pollutants: O_3, NO_2, SO_2, CO, PM_{10}, and $PM_{2.5}$. Not all monitoring stations are fully instrumented for these pollutants, while some sites have not been operating for adequate periods of time to provide representative data for characterization of attainment status.

10.1.5.1 Sources of Air Pollutants

The most significant regional sources of O_3, NO_2, and CO in ambient air are automobiles, trucks, and other onroad vehicles, along with trains, vessels, and aircraft. O_3 is not directly emitted; rather, photochemical O_3 is formed by the atmospheric reaction of VOCs and NO_X in sunlight. Gasoline and diesel engines emit VOCs and NO_X as combustion products, as does natural gas-fired equipment such as pump engines, gas turbine generators, process heaters, and steam boilers.

Local PM_{10} emissions are primarily the result of fugitive dust from travel on unpaved roads, as well as construction and agricultural activities. Coarser particles also may be emitted from activities that disturb the topsoil. Other sources include wind-blown dust, pollen, salts, brake dust, and tire wear. Although $PM_{2.5}$ is a subset of PM_{10}, it differs from the rest of PM_{10}. While most of the ambient PM_{10} results from direct emissions of the pollutant, a significant amount of the ambient $PM_{2.5}$ results from transformation of precursors and condensing of gaseous pollutants in the atmosphere. Other than direct $PM_{2.5}$ emissions, the key pollutants contributing to $PM_{2.5}$ concentrations in the atmosphere are SO_2, NO_X, VOCs, and ammonia (CARB 2005).

Mobile sources used in mosquito and vector control activities include onroad fleet vehicles (light- and medium-duty trucks, vans, passenger cars), offroad ATVs, watercraft (motorboats, airboats), aircraft (helicopters and fixed-wing), portable equipment (pumps, sprayers, generators), and small equipment (handheld sprayers, foggers, dusters). Except for 2-stroke engines used in small lightweight equipment (spark ignition, 50:1 gas/oil mix), engines are 4-stroke gasoline (spark ignition) or diesel fuel (compression ignition). The dominant fuel used for these mobile sources is motor gasoline along with some diesel fuel (larger trucks), aviation gasoline (fixed-wing aircraft), and jet fuel (turbine-powered helicopters). Light trucks, vans, and passenger cars are normally used for responding to public service requests and disease surveillance.

10.1.6 Regulatory Framework

The following paragraphs summarize the federal, state, and local agencies and the laws and regulations governing air quality that are provided in Appendix C. *It is the practice of the District to work with Service Area jurisdictions and agencies during Program planning to reasonably consider the local environmental protection policies and to conform to the extent required.*

10.1.6.1 Standards and Attainment Status

The Clean Air Act of 1970 (CAA, amended 1977 and 1990, 42 United States Code 7401 et seq.) established NAAQS, and individual states retained the option to adopt more stringent standards and to include other pollution sources. CAAQS tend to be at least as protective as national standards and are often more stringent.

The ambient air quality standards shown in Table 10-1 are intended to protect the public health and welfare and specify the concentration of pollutants (with an adequate margin of safety) to which the public may be exposed without adverse health effects. The standards are designed to protect those segments of the public most susceptible to respiratory distress (known as sensitive receptors), including asthmatics, the very young, the elderly, people weak from other illness or disease, or persons engaged in strenuous work or exercise. Healthy adults can tolerate occasional exposure to air pollution levels somewhat above the ambient air quality standards before adverse health effects are observed.

Table 10-1 Ambient Air Quality Standards

Pollutant	Averaging Time	California Standards		Federal Standards	
		ppmv	µg/m³	ppmv	µg/m³
Ozone (O_3)	1-hour	0.09	177	—	—
	8-hour	0.07	137	0.075	147
Nitrogen Dioxide (NO_2)	1-hour	0.18	338	0.100	188
	Annual	0.03	56	0.053	100
Sulfur Dioxide (SO_2)	1-hour	0.25	655	0.075	196
	3-hour Secondary	—	—	0.50	1,309
	24-hour	0.04	105	—	—
Carbon Monoxide (CO)	1-hour	20	22,898	35	40,071
	8-hour	9	10,304	9	10,304
	Lake Tahoe (8-hr)	6	6,869	—	—
Particulates (as PM_{10})	24-hour	—	50	—	150
	Annual	—	20	—	—
Particulates (as $PM_{2.5}$)	24-hour	—	—	—	35
	Annual Primary	—	12	—	12
	Annual Secondary	—	—	—	15
Lead (Pb)	30-day	—	1.5	—	—
	3-month (rolling)	—	—	—	0.15
Sulfates (as SO_4)	24-hour	—	25	—	—
Hydrogen Sulfide (H_2S)	1-hour	0.03	42	—	—
Vinyl Chloride (C_2H_3Cl)	24-hour	0.01	26	—	—
Visibility Reducing Particles	8-hour	Extinction coefficient of 0.23 per kilometer; visibility of 10 miles or more (0.07 to 30 miles or more for Lake Tahoe) due to particles when relative humidity is less than 70 percent.		—	—

Sources: CARB 2012b; USEPA 2012b

ppmv = part(s) per million by volume
µg/m³ = microgram(s) per cubic meter

The 1.5 µg/m³ federal quarterly lead standard applied until 2008; 0.15 µg/m³ rolling 3-month average thereafter For gases, µg /m³ calculated from ppmv based on molecular weight and standard conditions. Standard Temperature 25°C. Standard Molar Volume 24.465 liter/g-mole

In general, the San Francisco Bay Area experiences low concentrations of most pollutants when compared to state and federal standards, except for O_3 and particulate matter, for which standards are periodically exceeded. Portions of Sonoma and Monterey counties also experience mildly elevated concentrations of O_3, resulting in state-level transitional and moderate nonattainment designations, respectively. Monterey County is also nonattainment for the state PM_{10} standard (MBUAPCD 2009; CARB 2012a). The attainment status of the main Bay Area region is shown in Table 10-2.

Table 10-2 Attainment Status Summary - Bay Area Region

Criteria Pollutant	State Designation	Federal Designation
Ozone (O_3) (1-hour)	Nonattainment	—

Table 10-2 Attainment Status Summary - Bay Area Region

Criteria Pollutant	State Designation	Federal Designation
Ozone (O_3) (8-hour)	Nonattainment	Nonattainment(1)
Nitrogen Dioxide (NO_2) (1-hour)	Attainment	Unclassified(2)
Nitrogen Dioxide (NO_2) (annual)	Attainment	Attainment
Sulfur Dioxide (SO_2)	Attainment	Attainment
Carbon Monoxide (CO)	Attainment	Attainment
Resp. Particulates (as PM_{10}) (24-hour)	Nonattainment	Unclassified(2)
Resp. Particulates (as PM_{10}) (annual)	Nonattainment	—
Fine Particulates (as $PM_{2.5}$) (24-hour)	—	Nonattainment
Fine Particulates (as $PM_{2.5}$) (annual)	Nonattainment	Attainment
Lead (Pb)	Attainment	Attainment
Sulfates (as SO_4)	Attainment	—
Hydrogen Sulfide (H_2S)	Unclassified(2)	—
Vinyl Chloride (C_2H_3Cl)	ND	—
Visibility	Unclassified(2)	—

Source: BAAQMD 2012a

ND = no data/information available

Notes:

(1) The 0.08 ppmv federal 8-hour O_3 standard applied until 2008; 0.075 ppmv thereafter

2) At the time of designation, if the available data do not support a designation of attainment or nonattainment, the area is designated as unclassified.

10.1.6.2 Federal Authority

The 1977 CAA amendments required that regional planning and air pollution control agencies prepare regional air quality plans to outline the measures by which both stationary and mobile sources of pollutants can be controlled to achieve all standards by the deadlines specified in the act.

For the SFBAAB, the Association of Bay Area Governments, the Metropolitan Transportation Commission, and BAAQMD jointly prepared the *2005 Bay Area Ozone Strategy,* which provided inputs to the most recent *2010 Clean Air Plan* issued by BAAQMD (2012a). These plans contain control strategies that demonstrate attainment with NAAQS by the deadlines established in the federal CAA and become part of the State Implementation Plan (SIP) administered by CARB and submitted to USEPA. Similarly, NSCAPCD and MBUAPCD are also required to prepare and submit tailored clean air implementation plans to state and federal regulators.

Under the 1990 CAA amendments, areas that did not meet the original federal 1-hour O_3 standard were classified according to the severity of each area's respective O_3 problem. The 1-hour classifications were Marginal, Moderate, Serious, Severe, and Extreme.

10.1.6.3 State Authority

In 1988, the California legislature passed the California CAA (California Health and Safety Code Section 39600 et seq.), which, like its federal counterpart, called for designations of areas as attainment or nonattainment based on state rather than federal standards.

Similar to the federal CAA, the California CAA also classifies areas according to pollution levels. Under the California CAA, the Bay Area is a "Serious" O_3 nonattainment area and state PM_{10} and $PM_{2.5}$ nonattainment areas. In addition, localized CO concentrations, also known as CO "hotspots," may occur at heavily traveled roadways, particularly at intersections or other locations where the traffic is congested and vehicles idle for prolonged periods. CO concentrations exceeding the existing standard may occur at intersections that operate at a Level of Service D or worse.

CARB is the state agency responsible for regulating air quality, and its responsibilities include establishing CAAQS, emissions standards, and regulations for mobile emissions sources (e.g., autos, trucks, etc.) as well as overseeing the efforts of countywide and multicounty air pollution control districts, which have primary responsibility over stationary sources. The emission standards most relevant to the Program are those related to automobiles, light- and medium-duty trucks, and California heavy-duty truck and construction equipment engines.

10.1.6.4 Local Authority

BAAQMD is the regional agency responsible for air quality regulation within the San Francisco Bay Area, along with SJVAPCD and MBUAPCD in their respective jurisdictions. These districts regulate air quality through planning, monitoring, rulemaking, permitting, and enforcement activities. Districts have permit authority over most types of stationary emission sources and can require stationary sources to obtain permits; they can also impose emission limits, set fuel or material specifications, or establish operational limits to reduce air emissions. BAAQMD also regulates new or expanding stationary sources of toxic air contaminants. For state air quality planning purposes, the Bay Area is classified by the California CAA as a nonattainment area for O_3. The "Serious" classification triggers various plan submittal requirements and transportation performance standards. One such requirement is that each district update its air quality attainment plan every 3 years (triennially) to reflect progress in meeting the air quality standards and to incorporate new information regarding the feasibility of control measures and new emission inventory data. Districts indirectly regulate construction projects that use mobile sources via the statewide Portable Equipment Registration Program (PERP) discussed below. Since the Program does not meet the definition of permanent stationary sources, no permits would be required from the BAAQMD, SJVAPCD, or MBUAPCD.

10.1.6.5 Source-Specific Regulations

10.1.6.5.1 Nonroad Engine Standards

CARB regulates mobile sources of air pollution in the State of California. Self-propelled nonroad construction equipment is considered a vehicle, as defined by the California Vehicle Code. A vehicle may have an engine that both propels the vehicle and powers equipment mounted on the vehicle. As such, vehicles are generally exempt from regulation by the air districts. However, not included in exemption provisions is any equipment mounted on a vehicle that would otherwise require a permit under air district rules and regulations.

Federal Tier 1 standards for offroad diesel engines were adopted as part of the California requirements for 1995. Federal Tier 2 and Tier 3 standards were adopted in 2000 and selectively apply to the full range of diesel offroad engine power categories. Both Tier 2 and Tier 3 standards include durability requirements to ensure compliance with the standards throughout the useful life of the engine (40 CFR 89.112, 13 CCR 2423).

On May 11, 2004, the USEPA signed the final rule implementing Tier 4 emission standards, which are to be phased-in over the period of 2008 to 2015 (69 Federal Register 38957-39273, 29 June 2004). The Tier 4 standards require that PM and NO_X emissions be further reduced by about 90 percent. Such emission reductions can be achieved through the use of advanced control technologies – including advanced exhaust gas after treatment similar to those required by the 2007–2010 standards for highway diesel engines.

10.1.6.5.2 Portable Equipment Registration Program

The statewide PERP establishes a uniform program to regulate portable engines and portable engine-driven equipment units. Once registered in PERP, engines and equipment units may operate throughout the California without the need to obtain individual permits from local air districts such as BAAQMD, SJVAPCD, and MBUAPCD. Owners or operators of portable engines and certain types of equipment can register their units under the PERP to operate their equipment anywhere in the state. (CARB 2012c)

BAAQMD operates stipulated enforcement programs for owners and operators of portable equipment, which does not comply with CARB's Portable Diesel Airborne Toxic Control Measure (ATCM) regulation. Under this rule, any portable diesel engine not registered in the PERP prior to January 1, 2006, is illegal, and may not be operated in California unless it meets the ATCM Tier requirements or has an operating permit issued by an air district.

BAAQMD Regulation 2, Sections 2-1-105 and 2-1-114 list types of portable equipment commonly used in construction as exempt from stationary source rule requirements provided that the equipment complies with all applicable requirements of the statewide PERP pursuant to 13 CCR, Division 3, Chapter 3, Article 5. The District's Program is not subject to BAAQMD permitting requirements because the Program would not involve any stationary air pollution sources that are subject to BAAQMD review, including engine-driven pumps, generators, and air compressors.

10.1.6.5.3 Air Toxics Control Measures

On July 26, 2007, CARB adopted a regulation to reduce DPM and NO_X emissions from in use (existing) offroad heavy-duty diesel vehicles in California. Such vehicles are used in construction, mining, and industrial operations. Not included in this category are locomotives, commercial marine vessels, marine engines over 50 horsepower, or recreational vehicles. The ATCM regulation supplements existing tiered emission standards for nonroad diesel engines in California (CARB 2012d).

10.1.6.5.4 Senate Bill 656

Senate Bill 656 is a planning requirement that calls for a plan and strategy for reducing $PM_{2.5}$ and PM_{10}. This bill requires CARB to identify, develop, and adopt a list of control measures to reduce the $PM_{2.5}$ and PM_{10} emissions from new and existing stationary, mobile, and area sources. BAAQMD has developed particulate matter control measures and submitted plans to CARB that include lists of measures to reduce particulate matter. Under the plans, air districts are required to continue to assess $PM_{2.5}$ and PM_{10} emissions and their impacts.

For construction emissions of fugitive PM_{10}, California air districts have adopted a number of feasible control measures that can be reasonably implemented to significantly reduce fugitive PM_{10} emissions from construction. In general, most districts' approach to CEQA analyses of construction impacts is to emphasize implementation of effective and comprehensive control measures rather than detailed quantification of emissions.

10.1.6.5.5 Nuisance (Odors)

Nuisance is a fundamental air pollution control rule across the state in all air districts, including and MBUAPCD Rule 402, and typically contain the same language as BAAQMD Regulation 1, Rule 301 which states that "No person shall discharge from any source whatsoever such quantities of air contaminants or other material which cause injury, detriment, nuisance or annoyance to any considerable number of persons or the public; or which endangers the comfort, repose, health or safety of any such persons or the public, or which causes, or has a natural tendency to cause, injury or damage to business or property."

BAAQMD Regulation 7, Rule 102 defines an objectionable odor problem as when the Air Pollution Control Officer "receives odor complaints from ten or more complainants within a 90-day period, alleging that a

person has caused odors perceived at or beyond the property line of such person and deemed to be objectionable by the complainants in the normal course of their work, travel, or residence." The assessment protocol includes projects that have the potential to cause odors or projects that may subject potential sensitive receptors to nearby existing or proposed land uses that emit objectionable odors.

10.1.6.5.6 Toxic Air Contaminants

A project with the potential to expose sensitive receptors (including residential areas) or the general public to substantial levels of toxic air contaminants, as designated by CARB under 17 CCR Section 93001, listed in BAAQMD's Toxic Air Contaminants Inventory (BAAQMD 2004), would be deemed to have a significant impact. Projects that would locate receptors near existing sources of toxic air contaminants are included, as well as projects that would place sources of toxic air contaminants near existing receptors.

DPM is considered a toxic air contaminant in California (BAAQMD 2004). Due to the limited use of diesel-powered vehicles and equipment and the Program's wide geographic scope, DPM emissions would not be sufficient to pose a significant risk to sensitive receptors from mosquito and/or vector control equipment operations.

10.1.6.5.7 General Conformity

A General Conformity determination is required for federally sponsored, permitted, or funded actions in NAAQS nonattainment areas or in certain maintenance areas when the total direct and indirect net emissions of nonattainment pollutants (or their precursors) exceed specified thresholds (CAA Amendments of 1990 Section 176[c]). This regulation ensures that federal actions conform to SIPs and agency NAAQS attainment plans.

As discussed in Section 10.1.6 and shown in Table 10-2, the Bay Area region is in federal nonattainment for $PM_{2.5}$ and O_3. Thus, the emissions of nonattainment pollutants NO_X, VOCs, PM_{10}, and $PM_{2.5}$ would be subject to the Rule if the Program were a federal action. However, since the Program is a local action and not federally sponsored, permitted, or funded actions, General Conformity does not apply.

10.2 Environmental Evaluation

The focus in this chapter is on the use of equipment to perform all Program activities and the resulting emissions. Concerning the chemical treatment methods, the effects of applications (including spraying) of those specific chemicals is addressed in Section 6.2 for ecological health and Section 7.2 for human health.

10.2.1 Evaluation Concerns

The environmental concerns are those identified from public scoping:

> Address impacts of spraying/fogging on air quality for humans and pets alike.

> Address impacts of emissions of air pollutants from control and treatment methods and combustion of fuels.

10.2.2 Evaluation Methods and Assumptions

As described in Section 10.1.5, operation of onroad fleet vehicles, offroad all-terrain vehicles, watercraft, aircraft, portable equipment, and small equipment would result in emissions of criteria pollutants (NO_X, VOCs, CO, SO_X, PM_{10}, $PM_{2.5}$) in engine exhaust. Detailed lists of equipment, estimated usage, and emission calculations are provided in Appendix C. Equipment lists and annual activity schedules were provided by the nine participating Districts. Emission calculations were performed using the most recent and applicable emission factors published by CARB (2008a), Hare and Springer 1973, and USEPA (1991, 2011a, 2011b, 2012c).

Table 10-4 shows the applicability by percentage of the Program components by District: surveillance, physical control, vegetation management, biological control, chemical control, or other nonchemical control. Table 10-5 shows land uses associated with selected alternatives: residential, commercial, industrial, agricultural, and open space. As shown in Tables 10-4 and 10-5, not all Program components or land uses are applicable in all Districts, nor are all options or activities under any applicable component.

Tables 10-6 through 10-11 show estimated ongoing annual criteria emissions by component. Table 10-12 shows estimated combined annual emissions across all nine Districts. Table 10-13 shows estimated peak daily criteria emissions for applicable components assuming simultaneous operations as a hypothetical and highly unlikely “worst-case” scenario. Table 10-14 shows estimated highest quarterly and average daily criteria emissions for applicable components assuming concurrent operations as “typical case,” which is a more likely and realistic scenario.

As shown in Table 10-12, no annual thresholds (Table 10-3) would be exceeded by the Program, either individually or collectively, based on existing activities. As shown in Table 10-13, no individual District would exceed “worst-case” daily thresholds. Estimated peak daily emissions (lbs/day) for the Santa Clara County Vector Control District would be 2.7 for VOCs, 26.9 for CO, 3.0 for NO_x, 0.0 for SO_x, 0.4 for PM_{10}, and 0.2 for $PM_{2.5}$. These emissions would all be below “worst-case” daily thresholds (80 lbs/day).

As shown in Table 10-14, no “typical case” daily thresholds would likely be exceeded by the Program, either individually or collectively. Due to the very wide spatial and temporal dispersion of the mobile emissions sources across the nine Service Area counties, no ambient air quality standards for any pollutant would be violated solely by mosquito and/or vector control activities.

Table 10-4 Districts' Selected Components Applicability

Districts	Surveillance	Physical Control	Vegetation Management	Biological Control	Chemical Control	Other Nonchemical
Alameda County MAD	12%	7%	—	1%	64%	16%
Alameda County VCSD	100%	—	—	—	—	—
Contra Costa County MVCD	16%	0.07%	0.13%	0.07%	61%	23%
Marin-Sonoma MVCD	20%	5%	13%	21%	25%	15%
Napa County MAD	11%	13%	7%	2%	64%	4%
Northern Salinas Valley MAD	3%	6%	29%	7%	39%	15%
San Mateo County MVCD	11%	0%	30%	21%	13%	24%
Santa Clara County VCD	47%	3%	—	13%	37%	—
Solano County MAD	24%	—	—	0.03%	46%	30%
Nine Districts Composite	**27%**	**4%**	**9%**	**7%**	**39%**	**14%**

Sources: Nine Districts

Table 10-5 Land Uses Associated with Selected Components

Districts	Residential	Commercial	Industrial	Agricultural	Open Space
Alameda County MAD	●	●	●	●	●
Alameda County VCSD	●	●			
Contra Costa MVCD	●	●	●	●	●
Marin-Sonoma Counties MVCD	●	●	●	●	●
Napa County MAD	●	●	●	●	●
Northern Salinas Valley MAD	●	●	●	●	●
San Mateo County MVCD	●	●	●		●
Santa Clara County VCD	●	●	●	●	●
Solano County MAD	●	●	●	●	●

Sources: Nine Districts

Table 10-6 Estimated Annual Criteria Emissions for Surveillance Component

Districts	VOCs lbs/year	CO lbs/year	NO_X lbs/year	SO_X lbs/year	PM_{10} lbs/year	$PM_{2.5}$ lbs/year
Alameda County MAD	44	1,051	44	1.4	4.1	2.7
Alameda County VCSD	148	1,392	138	2.3	19.4	12.5
Contra Costa MVCD	38	521	35	0.7	4.8	3.1
Marin-Sonoma MVCD	132	2,515	298	3.5	19.5	13.9
Napa County MAD	21	718	40	0.8	2.6	1.7
Northern Salinas Valley MAD	3	57	18	0.1	0.8	0.6
San Mateo County MVCD	365	7,550	321	10.2	38.5	24.9
Santa Clara County VCD	240	2,300	226	3.7	31.3	20.3
Solano County MAD	73	1,710	225	2.6	9.0	5.9
Nine Districts Totals	**1,065**	**17,813**	**1,345**	**25.2**	**130.1**	**85.6**

Sources: CARB 2008a; Hare and Springer 1973; USEPA 1991d, 2011a, 2011b, 2012c

SCCVCD = Emissions for equipment use associated with rodent and wildlife trapping are reported under Surveillance.

Table 10-7 Estimated Annual Criteria Emissions for Physical Control Component

Districts	VOCs lbs/year	CO lbs/year	NO_X lbs/year	SO_X lbs/year	PM_{10} lbs/year	$PM_{2.5}$ lbs/year
Alameda County MAD	25	606	25	0.8	2.4	1.5
Alameda County VCSD	0	0	0	0.0	0.0	0.0
Contra Costa MVCD	0	2	0	0.0	0.0	0.0
Marin-Sonoma MVCD	36	689	82	1.0	5.3	3.8

Napa County MAD	25	841	47	1.0	3.1	2.0
Northern Salinas Valley MAD	7	120	38	0.2	1.7	1.3
San Mateo County MVCD	8	170	7	0.2	0.9	0.6
Santa Clara County VCD	16	149	15	0.2	2.0	1.3
Solano County MAD	0	0	0	0.0	0.0	0.0
Nine Districts Totals	**117**	**2,577**	**214**	**3.4**	**15.4**	**10.5**

Sources: CARB 2008a; Hare and Springer 1973; USEPA 1991d, 2011a, 2011b, 2012c

Table 10-8 Estimated Annual Criteria Emissions for Vegetation Management Component

Districts	VOCs lbs/year	CO lbs/year	NO_X lbs/year	SO_X lbs/year	PM_{10} lbs/year	$PM_{2.5}$ lbs/year
Alameda County MAD	0	0	0	0.0	0.0	0.0
Alameda County VCSD	0	0	0	0.0	0.0	0.0
Contra Costa MVCD	0	4	0	0.0	0.0	0.0
Marin-Sonoma Counties MVCD	89	1,700	201	2.4	13.2	9.4
Napa County MAD	14	456	26	0.5	1.7	1.1
Northern Salinas Valley MAD	30	540	173	0.7	7.4	5.9
San Mateo County MVCD	973	20,105	855	27.0	102.6	66.4
Santa Clara County VCD	0	0	0	0.0	0.0	0.0
Solano County MAD	0	0	0	0.0	0.0	0.0
Nine Districts Totals	**1,106**	**22,805**	**1,255**	**30.7**	**124.9**	**82.9**

Sources: CARB 2008a; Hare and Springer 1973; USEPA 1991d, 2011a, 2011b, 2012c

Table 10-9 Estimated Annual Criteria Emissions for Biological Control Component

Districts	VOCs lbs/year	CO lbs/year	NO_X lbs/year	SO_X lbs/year	PM_{10} lbs/year	$PM_{2.5}$ lbs/year
Alameda County MAD	3	67	3	0.1	0.3	0.2
Alameda County VCSD	0	0	0	0.0	0.0	0.0
Contra Costa County MVCD	0	2	0	0.0	0.0	0.0
Marin-Sonoma MVCD	141	2,683	318	3.7	20.8	14.8
Napa County MAD	3	109	6	0.1	0.4	0.3
Northern Salinas Valley MAD	7	130	42	0.2	1.8	1.4
San Mateo County MVCD	669	13,828	588	18.6	70.5	45.7
Santa Clara County VCD	66	636	62	1.0	8.7	5.6
Solano County MAD	0	2	0	0.0	0.0	0.0
Nine Districts Totals	**890**	**17,458**	**1,019**	**23.7**	**102.5**	**68.0**

Sources: CARB 2008a; Hare and Springer 1973; USEPA 1991d, 2011a, 2011b, 2012c

Table 10-10 Estimated Annual Criteria Emissions for Chemical Control Component

Districts	VOCs lbs/year	CO lbs/year	NO_X lbs/year	SO_X lbs/year	PM_{10} lbs/year	$PM_{2.5}$ lbs/year
Alameda County MAD	231	5,523	229	7.4	21.6	14.0
Alameda County VCSD	0	0	0	0.0	0.0	0.0
Contra Costa County MVCD	146	2,013	136	2.9	18.6	12.1
Marin-Sonoma MVCD	167	3,168	375	4.4	24.5	17.5
Napa County MAD	127	4,244	238	4.9	15.6	10.1
Northern Salinas Valley MAD	41	737	236	1.0	10.2	8.1
San Mateo County MVCD	431	8,907	379	12.0	45.4	29.4
Santa Clara County VCD	186	1,786	175	2.9	24.3	15.7
Solano County MAD	138	3,235	426	4.8	17.1	11.1
Nine Districts Totals	**1,467**	**29,613**	**2,194**	**40.2**	**177.4**	**118.0**

Sources: CARB 2008a; Hare and Springer 1973; USEPA 1991d, 2011a, 2011b, 2012c

Table 10-11 Estimated Annual Criteria Emissions for Other Nonchemical Control/Trapping Component

Districts	VOCs lbs/year	CO lbs/year	NO_X lbs/year	SO_X lbs/year	PM_{10} lbs/year	$PM_{2.5}$ lbs/year
Alameda County MAD	58	1,374	57	1.8	5.4	3.5
Alameda County VCSD	0	0	0	0.0	0.0	0.0
Contra Costa MVCD	56	774	52	1.1	7.2	4.6
Marin-Sonoma MVCD	99	1,873	222	2.6	14.5	10.3
Napa County MAD	7	236	13	0.3	0.9	0.6
Northern Salinas Valley MAD	16	284	91	0.4	3.9	3.1
San Mateo County MVCD	755	15,609	664	21.0	79.6	51.6
Santa Clara County VCD	0	0	0	0.0	0.0	0.0
Solano County MAD	92	2,151	283	3.2	11.4	7.4
Nine Districts Totals	**1,082**	**22,300**	**1,382**	**30.4**	**122.8**	**81.1**

Sources: CARB 2008a; Hare and Springer 1973; USEPA 1991d, 2011a, 2011b, 2012c

ACMAD = Emissions associated with ongoing District office administration and grounds maintenance activities are reported under this component.

SCCVCD = Emissions for equipment use associated with rodent and wildlife trapping are reported under Surveillance.

SCMAD = Emissions referenced in the "Other Nonchemical" category emanate from vehicles and equipment used in connection with district activities not directly related to mosquito control, such as transportation to various meetings and facilities maintenance.

Table 10-12 Estimated Combined Annual Criteria Emissions Across Nine Districts

Components	VOCs tons/yr	CO tons/yr	NO_X tons/yr	SO_X tons/yr	PM_{10} tons/yr	$PM_{2.5}$ tons/yr
Surveillance	0.53	8.91	0.67	0.01	0.07	0.04
Physical Control	0.06	1.29	0.11	0.00	0.01	0.01
Vegetation Management	0.55	11.40	0.63	0.02	0.06	0.04
Biological Control	0.45	8.73	0.51	0.01	0.05	0.03
Chemical Control	0.73	14.81	1.10	0.02	0.09	0.06
Other Nonchemical Control/Trapping	0.54	11.15	0.69	0.02	0.06	0.04
All Components Totals	**2.86**	**56.28**	**3.70**	**0.08**	**0.34**	**0.22**

Sources: CARB 2008a; Hare and Springer 1973; USEPA 1991d, 2011a, 2011b, 2012c

Table 10-13 Estimated Peak Daily Criteria Emissions for Applicable Components - Simultaneous Operations

Districts	VOCs lbs/day	CO lbs/day	NO_X lbs/day	SO_X lbs/day	PM_{10} lbs/day	$PM_{2.5}$ lbs/day
Alameda County MAD	5.8	177.5	39.9	0.3	0.9	0.6
Alameda County VCSD	0.6	5.5	0.6	0.0	0.1	0.0
Contra Costa MVCD	7.8	152.7	23.7	0.2	1.2	0.8
Marin-Sonoma MVCD	15.3	394.0	44.1	0.5	2.1	1.5
Napa County MAD	6.6	255.0	31.2	0.3	0.9	0.6
Northern Salinas Valley MAD	1.7	31.1	10.0	0.0	0.4	0.3
San Mateo County MVCD	25.3	810.2	31.8	1.0	2.1	1.4
Santa Clara County VCD	2.7	26.9	3.0	0.0	0.4	0.2
Solano County MAD	9.2	283.7	43.8	0.4	1.2	0.8
Peak Total Daily Emissions	**75**	**2,137**	**228**	**3**	**9**	**6**

Sources: CARB 2008a; Hare and Springer 1973; USEPA 1991d, 2011a, 2011b, 2012c

Table 10-14 Estimated Highest Quarterly Criteria Emissions for Applicable Components - Concurrent Operations

Districts	VOCs lbs/qtr	CO lbs/qtr	NO_X lbs/qtr	SO_X lbs/qtr	PM_{10} lbs/qtr	$PM_{2.5}$ lbs/qtr
Alameda County MAD	184	5,215	197	7	15	10
Alameda County VCSD	38	355	35	1	5	3
Contra Costa MVCD	105	1,627	105	2	13	9
Marin-Sonoma MVCD	223	4,369	485	6	33	23
Napa County MAD	79	3,114	168	3	10	6
Northern Salinas Valley MAD	30	493	177	1	8	6
San Mateo County MVCD	1,329	28,290	1,125	38	140	91
Santa Clara County VCD	145	1,383	136	2	19	12
Solano County MAD	136	3,702	413	5	15	10
Nine Districts Totals	**2,268**	**48,549**	**2,841**	**65**	**258**	**170**
Average Total Daily Emissions	**35**	**747**	**44**	**1**	**4**	**3**

Sources: CARB 2008a; Hare and Springer 1973; USEPA 1991d, 2011a, 2011b, 2012c

10.2.3 Surveillance Component

The Surveillance component would be a continuation of existing activities the District currently practices using applicable techniques, equipment, vehicles, and watercraft. Surveillance involves monitoring mosquito and/or vector populations and habitat, their disease pathogens, and the human/vector interactions. Field counting/sampling and trapping are common mechanisms for surveillance.

Air Quality Attainment or Congestion Management Plans

The emission source categories associated with the Surveillance component include offroad vehicles, onroad vehicles, and watercraft, all of which are mobile sources of nonattainment pollutants NO_X, VOCs, PM_{10}, and $PM_{2.5}$. As discussed in Section 10.1.6, these types of emission sources are included in the SIP emission inventory and required to meet CARB and USEPA nonroad and onroad emission standards applicable on the date of manufacture. Taken together, these conditions establish that the Surveillance component do not conflict with applicable air quality attainment plans.

Air Quality Standards

Activities associated with the Surveillance component may emit regulated criteria pollutants, including O_3 precursors NO_X and VOCs, CO, SO_2, PM_{10}, and $PM_{2.5}$. Estimated peak daily emissions of each of these pollutants from all components combined for the Santa Clara County Vector Control District are shown in Table 10-13 and are less than the daily thresholds shown in Table 10-3. Annual thresholds do not apply to estimated emissions shown in Tables 10-6 and 10-12 because mosquito and vector control activities do not comprise a stationary source of air contaminants. Since mosquito and vector control activities are widely dispersed across a broad geographic area, there are no violations of CAAQS for CO. Based on estimated peak daily emissions for each criteria pollutant and geographic dispersion, the Surveillance component would not be the sole cause of a violation of either NAAQS or CAAQS.

Criteria Pollutants and Ambient Air Quality Standards

As discussed in Section 10.1.6, the focus of this assessment is on regulated criteria pollutants for which the local air basin is in nonattainment. Nonattainment pollutants include O_3 precursors NO_X and VOCs, PM_{10}, and $PM_{2.5}$. Estimated peak daily emissions of each of these pollutants from all components combined are shown in Table 10-13 and are less than the daily thresholds shown in Table 10-3. Annual thresholds do not apply to estimated emissions shown in Tables 10-6 and 10-12 because mosquito and vector control activities do not comprise a stationary source of air contaminants.

Sensitive Receptors

The Surveillance component has the potential to emit regulated criteria pollutants, including O_3 precursors NO_X and VOCs, CO, SO_2, PM_{10}, and $PM_{2.5}$. Estimated peak daily emissions of each of these pollutants from all components combined are shown in Table 10-13 and are less than the daily thresholds shown in Table 10-3. Annual thresholds do not apply to estimated emissions shown in Tables 10-6 and 10-12 because mosquito and vector control activities do not comprise a stationary source of air contaminants. Since mosquito and vector control activities use relatively small amounts of diesel fuel (most equipment and vehicles are gasoline-powered), potential DPM emissions would be small, transient in nature, and dispersed over a wide geographic area. Thus, no significant risk to sensitive receptors would occur from DPM emissions (as PM_{10}). Based on estimated peak daily emissions for each criteria pollutant, the Surveillance component would not be the sole cause of a violation of either NAAQS or CAAQS.

Objectionable Odors

Certain VOCs, sulfur compounds, and chlorine compounds found in some pesticides such as OPs, fumigants, and organochlorines emit characteristic odors when they evaporate (volatilize) into air, even at very low concentrations well within safety limits. The human sense of smell (olfactory system) is sensitive to these types of compounds as a warning mechanism, and some individuals are more sensitive than others. The Surveillance component would not apply these types of odorous treatments, because it involves mostly field sampling and trapping activities. Thus, people would not be affected by objectionable odors.

10.2.4 Physical Control Component

The Physical Control component involves managing vector habitat using source control and permanent control methods that do not use biological agents or chemical pesticides, such as ditch maintenance, debris removal in natural channels, and blockage of access points.

Air Quality Attainment or Congestion Management Plans

The emission source categories associated with the Physical Control component include small equipment, portable equipment, offroad vehicles, onroad vehicles, and watercraft, all of which are mobile sources of nonattainment pollutants NO_X, VOCs, PM_{10}, and $PM_{2.5}$. As discussed in Section 10.1.6, these types of emission sources are included in the SIP emission inventory, required to meet CARB and USEPA nonroad and onroad emission standards applicable on the date of manufacture, and subject to PERP and ATCM as applicable. Taken together, these conditions establish that the Physical Control component would not conflict with applicable air quality attainment plans.

Air Quality Standards

The Physical Control component has the potential to emit regulated criteria pollutants, including O_3 precursors NO_X and VOCs, CO, SO_2, PM_{10}, and $PM_{2.5}$. Estimated peak daily emissions of each of these pollutants from the Physical Control component in the individual District are shown in Table 10-13 and are less than the daily thresholds shown in Table 10-3. Annual thresholds do not apply to estimated emissions shown in Tables 10-7 and 10-12 because mosquito and vector control activities do not comprise a stationary source of air contaminants. Since mosquito and vector control activities are widely dispersed across a broad geographic area, no violation of CAAQS for CO would occur. Based on

estimated peak daily emissions for each criteria pollutant and geographic dispersion, the Physical Control component would not be the sole cause of a violation of either NAAQS or CAAQS.

Criteria Pollutants and Ambient Air Quality Standards

As discussed in Section 10.1.6, the focus of this assessment is on regulated criteria pollutants for which the local air basin is in nonattainment. Nonattainment pollutants include O_3 precursors NO_X and VOCs, PM_{10}, and $PM_{2.5}$. Estimated peak daily emissions of each of these pollutants from the Physical Control component in the individual District are shown in Table 10-13 and are less than the daily thresholds shown in Table 10-3. Annual thresholds do not apply to estimated emissions shown in Tables 10-7 and 10-12 because mosquito and vector control activities do not comprise a stationary source of air contaminants. Based on estimated peak daily emissions for each criteria pollutant and geographic dispersion, the Physical Control component would not result in a cumulatively considerable increase of nonattainment pollutants.

Sensitive Receptors

The Physical Control component has the potential to emit regulated criteria pollutants, including O_3 precursors NO_X and VOCs, CO, SO_2, PM_{10}, and $PM_{2.5}$. Estimated peak daily emissions of each of these pollutants from the Physical Control component in the individual District are shown in Table 10-13 and are less than the daily thresholds shown in Table 10-3. Annual thresholds do not apply to estimated emissions shown in Tables 10-7 and 10-12 because mosquito and vector control activities do not comprise a stationary source of air contaminants. Since mosquito and vector control activities use relatively small amounts of diesel fuel (most equipment and vehicles are gasoline-powered), potential DPM emissions would be small, transient in nature, and dispersed over a wide geographic area. Thus, no significant risk to sensitive receptors would occur from DPM emissions (as PM_{10}). Based on estimated peak daily emissions for each criteria pollutant, the Physical Control component would not be the sole cause of a violation of either NAAQS or CAAQS.

Objectionable Odors

Certain VOCs, sulfur compounds, and chlorine compounds found in some pesticides such as OPs, fumigants, and organochlorines emit characteristic odors when they evaporate (volatilize) into air, even at very low concentrations well within safety limits. The human sense of smell (olfactory system) is sensitive to these types of compounds as a warning mechanism, and some individuals are more sensitive than others. The Physical Control component would not apply these types of odorous chemical treatments.

10.2.5 Vegetation Management Component

The Vegetation Management component uses applicable techniques, equipment, vehicles, and watercraft to reduce the habitat value for mosquitoes and other vectors. The District uses hand tools and sometimes heavy equipment to remove vegetation primarily in aquatic habitats.

Air Quality Attainment or Congestion Management Plans

The emission source categories associated with the Vegetation Management component include small equipment, portable equipment, offroad vehicles, onroad vehicles, and watercraft, all of which are mobile sources of nonattainment pollutants NO_X, VOCs, PM_{10}, and $PM_{2.5}$. As discussed in Section 10.1.6, these types of emission sources are included in the SIP emission inventory, required to meet CARB and USEPA nonroad and onroad emission standards applicable on the date of manufacture, and subject to PERP and ATCM as applicable. Taken together, these conditions establish that the Vegetation Management component would not conflict with applicable air quality attainment plans.

Air Quality Standards

The Vegetation Management component has the potential to emit regulated criteria pollutants, including O_3 precursors NO_X and VOCs, CO, SO_2, PM_{10}, and $PM_{2.5}$. Estimated peak daily emissions of each of

these pollutants from the Vegetation Management component in the individual District are shown in Table 10-13 and are less than the daily thresholds shown in Table 10-3. Annual thresholds do not apply to estimated emissions shown in Tables 10-8 and 10-12 because mosquito and vector control activities do not comprise a stationary source of air contaminants. Since mosquito and vector control activities are widely dispersed across a broad geographic area, no violation of CAAQS for CO would occur. Based on estimated peak daily emissions for each criteria pollutant and geographic dispersion, the Vegetation Management component would not be the sole cause of a violation of either NAAQS or CAAQS.

Criteria Pollutants and Ambient Air Quality Standards

As discussed in Section 10.1.6, the focus of this assessment is on regulated criteria pollutants for which the local air basin is in nonattainment. Nonattainment pollutants include O_3 precursors NO_X and VOCs, PM_{10}, and $PM_{2.5}$. Estimated peak daily emissions of each of these pollutants from the Vegetation Management component in the individual District are shown in Table 10-13 and are less than the daily thresholds shown in Table 10-3. Annual thresholds do not apply to estimated emissions shown in Tables 10-8 and 10-12 because mosquito and vector control activities do not comprise a stationary source of air contaminants. Based on estimated peak daily emissions for each criteria pollutant and geographic dispersion, the Vegetation Management component would not result in a cumulatively considerable increase of nonattainment pollutants.

Sensitive Receptors

The Vegetation Management component has the potential to emit regulated criteria pollutants, including O_3 precursors NO_X and VOCs, CO, SO_2, PM_{10}, and $PM_{2.5}$. Estimated peak daily emissions of each of these pollutants from the Vegetation Management component in the individual District are shown in Table 10-13 and are less than the daily thresholds shown in Table 10-3. Annual thresholds do not apply to estimated emissions shown in Tables 10-8 and 10-12 because mosquito and vector control activities do not comprise a stationary source of air contaminants. Since mosquito and vector control activities use relatively small amounts of diesel fuel (most equipment and vehicles are gasoline-powered), potential DPM emissions would be small, transient in nature, and dispersed over a wide geographic area. Thus, no significant risk to sensitive receptors would occur from DPM emissions (as PM_{10}). Based on estimated peak daily emissions for each criteria pollutant, the Vegetation Management component would not be the sole cause of a violation of either NAAQS or CAAQS.

Objectionable Odors

Certain VOCs, sulfur compounds, and chlorine compounds found in some pesticides such as OPs, fumigants, and organochlorines emit characteristic odors when they evaporate (volatilize) into air, even at very low concentrations well within safety limits. The human sense of smell (olfactory system) is sensitive to these types of compounds as a warning mechanism, and some individuals are more sensitive than others.

10.2.6 Biological Control Component

The Biological Control component uses applicable techniques, equipment, vehicles, watercraft, and aircraft. It also involves the use of mosquito predators, i.e., mosquitofish (*Gambusia affinis*).

Air Quality Attainment or Congestion Management Plans

The emission source categories associated with the Biological Control component include small equipment, portable equipment, offroad vehicles, onroad vehicles, watercraft, and aircraft, all of which are mobile sources of nonattainment pollutants NO_X, VOCs, PM_{10}, and $PM_{2.5}$. As discussed in Section 10.1.6, these types of emission sources are included in the SIP emission inventory, required to meet CARB and USEPA nonroad and onroad emission standards applicable on the date of manufacture, and subject to PERP and ATCM as applicable. Taken together, these conditions establish that the Biological Control component would not conflict with applicable air quality attainment plans.

Air Quality Standards

The Biological Control component has the potential to emit regulated criteria pollutants, including O_3 precursors NO_X and VOCs, CO, SO_2, PM_{10}, and $PM_{2.5}$. Estimated peak daily emissions of each of these pollutants from the Biological Control component in the individual District are shown in Table 10-13 and are less than the daily thresholds shown in Table 10-3. Annual thresholds do not apply to estimated emissions shown in Tables 10-9 and 10-12 because mosquito and vector control activities do not comprise a stationary source of air contaminants. Since mosquito and vector control activities are widely dispersed across a broad geographic area, no violation of CAAQS for CO would occur. Based on estimated peak daily emissions for each criteria pollutant and geographic dispersion, the Biological Control component would not be the sole cause of a violation of either NAAQS or CAAQS.

Criteria Pollutants and Ambient Air Quality Standards

As discussed in Section 10.1.6, the focus of this assessment is on regulated criteria pollutants for which the local air basin is in nonattainment. Nonattainment pollutants include O_3 precursors NO_X and VOCs, PM_{10}, and $PM_{2.5}$. Estimated peak daily emissions of each of these pollutants from the Biological Control component in the individual District are shown in Table 10-13 and are less than the daily thresholds shown in Table 10-3. Annual thresholds do not apply to estimated emissions shown in Tables 10-9 and 10-12 because mosquito and vector control activities do not comprise a stationary source of air contaminants. Based on estimated peak daily emissions for each criteria pollutant and geographic dispersion, the Biological Control component would not result in a cumulatively considerable increase of nonattainment pollutants.

Sensitive Receptors

The Biological Control component has the potential to emit regulated criteria pollutants, including O_3 precursors NO_X and VOCs, CO, SO_2, PM_{10}, and $PM_{2.5}$. Estimated peak daily emissions of each of these pollutants from the Biological Control component in the individual District are shown in Table 10-13 and are less than the daily thresholds shown in Table 10-3. Annual thresholds do not apply to estimated emissions shown in Tables 10-9 and 10-12 because mosquito and vector control activities do not comprise a stationary source of air contaminants. Since mosquito and vector control activities use relatively small amounts of diesel fuel (most equipment and vehicles are gasoline-powered), potential DPM emissions would be small, transient in nature, and dispersed over a wide geographic area. Thus, no significant risk to sensitive receptors occurs from DPM emissions (as PM_{10}). Based on estimated peak daily emissions for each criteria pollutant, the Biological Control component would not be the sole cause of a violation of either NAAQS or CAAQS.

Objectionable Odors

Certain VOCs, sulfur compounds, and chlorine compounds found in some pesticides such as OPs, fumigants, and organochlorines emit characteristic odors when they evaporate (volatilize) into air, even at very low concentrations well within safety limits. The human sense of smell (olfactory system) is sensitive to these types of compounds as a warning mechanism, and some individuals are more sensitive than others. The Biological Control component does not apply these types of odorous treatments.

10.2.7 Chemical Control Component

The Chemical Control component uses applicable techniques, equipment, vehicles, watercraft, and aircraft. It also involves the application of insecticides and rodenticides to reduce populations of pest species.

Air Quality Attainment and Congestion Management Plans

The emission source categories associated with the Chemical Control component include small equipment, portable equipment, offroad vehicles, onroad vehicles, watercraft, and aircraft all of which are

mobile sources of nonattainment pollutants NO_X, VOCs, PM_{10}, and $PM_{2.5}$. As discussed in Section 10.1.6, these types of emission sources are included in the SIP emission inventory, required to meet CARB and USEPA nonroad and onroad emission standards applicable on the date of manufacture, and subject to PERP and ATCM as applicable. Taken together, these conditions establish that the Chemical Control component would not conflict with applicable air quality attainment plans.

Air Quality Standards

The Chemical Control component has the potential to emit regulated criteria pollutants, including O_3 precursors NO_X and VOCs, CO, SO_2, PM_{10}, and $PM_{2.5}$. Estimated peak daily emissions of each of these pollutants from the Chemical Control component in the individual District are shown in Table 10-13 and are less than the daily thresholds shown in Table 10-3. Annual thresholds do not apply to estimated emissions shown in Tables 10-10 and 10-12 because mosquito and vector control activities do not comprise a stationary source of air contaminants. Since mosquito and vector control activities are widely dispersed across a broad geographic area, no violation of CAAQS for CO would occur. Based on estimated peak daily emissions for each criteria pollutant and geographic dispersion, the Chemical Control component would not be the sole cause of a violation of either NAAQS or CAAQS.

Criteria Pollutants

As discussed in Section 10.1.6, the focus of this assessment is on regulated criteria pollutants for which the local air basin is in nonattainment. Nonattainment pollutants include O_3 precursors NO_X and VOCs, PM_{10}, and $PM_{2.5}$. Estimated peak daily emissions of each of these pollutants from the Chemical Control component in the individual District are shown in Table 10-13 and are less than the daily thresholds shown in Table 10-3. Annual thresholds do not apply to estimated emissions shown in Tables 10-10 and 10-12 because mosquito and vector control activities do not comprise a stationary source of air contaminants. Based on estimated peak daily emissions for each criteria pollutant and geographic dispersion, the Chemical Control component would not result in a cumulatively considerable increase of nonattainment pollutants.

Sensitive Receptors

The Chemical Control component has the potential to emit regulated criteria pollutants, including O_3 precursors NO_X and VOCs, CO, SO_2, PM_{10}, and $PM_{2.5}$. Estimated peak daily emissions of each of these pollutants from the Chemical Control component in the individual District are shown in Table 10-13 and are less than the daily thresholds shown in Table 10-3. Annual thresholds do not apply to estimated emissions shown in Tables 10-10 and 10-12 because mosquito and vector control activities do not comprise a stationary source of air contaminants. Since mosquito and vector control activities use relatively small amounts of diesel fuel (most equipment and vehicles are gasoline-powered), potential DPM emissions would be small, transient in nature, and dispersed over a wide geographic area. Thus, no significant risk to sensitive receptors would occur from DPM emissions (as PM_{10}). Based on estimated peak daily emissions for each criteria pollutant, the Chemical Control component would not be the sole cause of a violation of either NAAQS or CAAQS.

Objectionable Odors

Certain VOCs, sulfur compounds, and chlorine compounds found in some pesticides such as OPs, fumigants, and organochlorines emit characteristic odors when they evaporate (volatilize) into air, even at very low concentrations well within safety limits. Pesticides currently used in some Districts, and proposed for future use in other Districts, emit phenols (e.g., bifenthrin, cyhalothrin, lambda-cyhalothrin, deltamethrin, etofenprox, permethrin, or resmethrin). Due to limited applicability, small quantities of these types of substances are typically used.

The human sense of smell (olfactory system) is sensitive to these types of compounds as a warning mechanism, and some individuals are more sensitive than others. The Chemical Control component

applies certain types of odorous treatments using hydraulic spraying and atomizing (fogging), which could result in drift of small droplets and gaseous vapors. Depending on atmospheric conditions (i.e., wind direction, wind speed, stability class), this drift may subject people to objectionable odors near a treatment area. Without site-specific information, it cannot be determined whether an objectionable odor may persist downwind of a particular treatment area; therefore, an application containing an odorous compound may adversely affect an undefined number people for an undefined period of time. The materials have been used in the current Program, and people have not complained about odors. However, it is possible that complaints could occur in the future. To minimize this possibility, the District employs the following BMPs (as described in Section 2.8.8) as applicable to the specific application situation to reduce drift towards human populations/residences from the ground and aerial applications of odorous treatment compounds:

:

- Maintain appropriate buffer zones between spray areas and sensitive receptor locations whenever possible and practicable for the application of the treatment compounds, especially true for aerial applications.
- Whenever possible and practicable, defer application of treatment compounds until such time that favorable wind conditions would reduce or avoid the risk of drift into populated areas.
- Use global positioning system (GPS) dataloggers that document site-specific compliance with all label requirements for drift mitigation.
- Use precision application technology to reduce drift and the total amount of material applied. This measure can include (1) Precision guidance systems that minimize ground or aerial spray overlap (e.g., GPS and Real Time Kinetics – GPS/RTK) and (2) Computer-guided application systems that integrate real-time meteorological data and computer model guidance to reduce drift from aerial application (e.g., trade names “AIMMS,” “Wingman™ GX,” and “NextStar™ Flow Control”).

10.2.8 Other Nonchemical Control/Trapping Component

As applicable, the Other Nonchemical Control/Trapping component uses techniques, equipment, and vehicles for trapping rodents and/or yellowjackets.

Air Quality Attainment and Congestion Management Plans

The emission source categories associated with this component include small equipment, portable equipment, offroad vehicles, onroad vehicles, watercraft, and aircraft, all of which are mobile sources of nonattainment pollutants NO_X, VOCs, PM_{10}, and $PM_{2.5}$. As discussed in Section 10.1.6, these types of emission sources are included in the SIP emission inventory, required to meet CARB and USEPA nonroad and onroad emission standards applicable on the date of manufacture, and subject to PERP and ATCM as applicable. Taken together, these conditions establish that the Other Nonchemical Control/Trapping component would not conflict with applicable air quality attainment plans.

Air Quality Standards

The Other Nonchemical Control/Trapping component has the potential to emit regulated criteria pollutants, including O_3 precursors NO_X and VOCs, CO, SO_2, PM_{10}, and $PM_{2.5}$. Estimated peak daily emissions of each of these pollutants from the Other Nonchemical Control/Trapping component in the individual District are shown in Table 10-13 and are less than the daily thresholds shown in Table 10-3. Annual thresholds do not apply to estimated emissions shown in Tables 10-11 and 10-12 because mosquito and vector control activities do not comprise a stationary source of air contaminants. Since mosquito and vector control activities are widely dispersed across a broad geographic area, no violation of CAAQS for CO would occur. Based on estimated peak daily emissions for each criteria pollutant and

geographic dispersion, the Other Nonchemical Control/Trapping component would not be the sole cause of a violation of either NAAQS or CAAQS.

Criteria Pollutants and Ambient Air Quality Standards

As discussed in Section 10.1.6, the focus of this assessment is on regulated criteria pollutants for which the local air basin is in nonattainment. Nonattainment pollutants include O_3 precursors NO_X and VOCs, PM_{10}, and $PM_{2.5}$. Estimated peak daily emissions of each of these pollutants from the Other Nonchemical Control/Trapping component in the individual District are shown in Table 10-13 and are less than the daily thresholds shown in Table 10-3. Annual thresholds do not apply to estimated emissions shown in Tables 10-11 and 10-12 because mosquito and vector control activities do not comprise a stationary source of air contaminants. Based on estimated peak daily emissions for each criteria pollutant and geographic dispersion, the Other Nonchemical Control/Trapping component would not result in a cumulatively considerable increase of nonattainment pollutants.

Sensitive Receptors

The Other Nonchemical Control/Trapping component has the potential to emit regulated criteria pollutants, including O_3 precursors NO_X and VOCs, CO, SO_2, PM_{10}, and $PM_{2.5}$. Estimated peak daily emissions of each of these pollutants from the Other Nonchemical Control/Trapping component in the individual District are shown in Table 10-13 and are less than the daily thresholds shown in Table 10-3. Annual thresholds do not apply to estimated emissions shown in Tables 10-11 and 10-12 because mosquito and vector control activities do not comprise a stationary source of air contaminants. Since mosquito and vector control activities use relatively small amounts of diesel fuel (most equipment and vehicles are gasoline-powered), potential DPM emissions would be small, transient in nature, and dispersed over a wide geographic area. Thus, no significant risk to sensitive receptors would occur from DPM emissions (as PM_{10}). Based on estimated peak daily emissions for each criteria pollutant, the Other Nonchemical Control/Trapping component would not be the sole cause of a violation of either NAAQS or CAAQS.

Objectionable Odors

Certain VOCs, sulfur compounds, and chlorine compounds found in some pesticides emit characteristic odors when they evaporate (volatilize) into air, even at very low concentrations well within safety limits. The human sense of smell (olfactory system) is sensitive to these types of compounds as a warning mechanism, and some individuals are more sensitive than others. The Other Nonchemical Control/Trapping component would not apply these types of odorous treatments. Thus, people would not be subjected to objectionable odors.

11 Greenhouse Gases

This chapter provides an overview of the affected environment for greenhouse gases (GHGs) and climate change, based on Appendix C. The American Meteorological Society refers to climate change as any systematic change in the long-term statistics of climate elements (such as temperature, pressure, or winds) sustained over several decades or longer. The Society also indicates that climate change may be due to natural external forcings, such as changes in solar emission or slow changes in the Earth's orbital elements; natural internal processes of the climate system; or anthropogenic forcing (AMS 2012). The climate system can be influenced by changes in the concentration of various GHGs in the atmosphere that affect the Earth's absorption of radiation. This chapter concludes with an evaluation of the Program's contribution to GHG emissions.

11.1 Environmental Background

11.1.1 Global Climate Change

Climate change refers to any measurable alteration of climate lasting for an extended period of time – several decades or longer – and includes recordable changes in temperature, precipitation, or wind patterns. The average temperature of the Earth has increased about 0.7 to 1.5°F (0.4 to 0.8°C) over the past century, and is projected to rise another 2 to 11.5°F (1.1 to 6.4°C) over the next 100 years (IPCC 2001; USEPA 2012d). Seemingly, small changes in the average temperature of the planet can translate to large and potentially hazardous shifts in climate and weather. Climate change is suspected as the cause of changes in rainfall amounts and distribution that can result in flooding, droughts, or more frequent and severe heat waves. Also, oceans are warming and becoming more acidic, polar ice caps are melting, glaciers are receding, and sea levels are rising due to thermal expansion and ice loss. Long-term studies indicate that ocean surface temperatures have been rising at an average rate of 0.13°F (0.07°C) per decade and since 1901, average sea level has increased by about 8 inches (20 centimeters) during the same period, and average pH has decreased (acidified) by about 0.05 pH units since the mid-1980s. Late summer Arctic Ocean sea ice coverage has decreased by half since 1979, and glaciers have receded and lost significant mass since the 1970s (USEPA 2012d). As climate change progresses in the coming decades, it will likely present challenges to society and the environment.

11.1.1.1 Local Climate

The Program Area climate is characterized by moderately wet winters and dry summers. About 90 percent of the annual total rainfall is received in the November through April period. Between June and September, normal rainfall is typically less than 0.6 inch (1.5 centimeters). Temperatures in the Program Area average about 60°F (15°C) annually, with average summer highs in the 70 to 80°F (21 to 27°C) range and average winter lows in the 40 to 50°F (4 to 10°C) range. Precipitation averages about 23 inches (58 centimeters) per year, although annual precipitation can vary significantly from year to year. Annual average wind speeds in the Program Area are about 8 miles per hour (3.6 meters per second). The predominant direction of air pollution transport in the Program Area is inland from the coastal areas (BAAQMD 2010a; World Climate 2012; NOAA 2008).

11.1.2 The Greenhouse Effect

Over the past century, human activities have released large amounts of carbon dioxide (CO_2) and other GHGs into the atmosphere. The majority of GHGs are the by-product of burning fossil fuels to release energy in the form of heat, although deforestation, industrial processes, and some agricultural practices also emit GHGs into the atmosphere. GHGs trap solar energy in the atmosphere and cause it to warm. This phenomenon is called the greenhouse effect and is necessary to support life on Earth; however,

excessive buildup of GHGs can change Earth's climate and result in undesirable effects on ecosystems, which affect human health and welfare. (USEPA 2012d)

In its *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2011* (USEPA 2012e), the USEPA provides summary information on the work of the United Nations Framework Convention on Climate Change (UNFCCC 2009) and the Intergovernmental Panel on Climate Control (IPCC 1990-2007); key information from that report is summarized below – more details may be found in the cited source documents.

The UNFCCC defines climate change as “a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods” (UNFCCC 2009). In its *Second Assessment Report* of the science of climate change, the IPCC concluded “human activities are changing the atmospheric concentrations and distributions of greenhouse gases and aerosols” (IPCC 1995). These changes can produce a radiative forcing by changing either the reflection or absorption of solar radiation, or the emission and absorption of terrestrial radiation.” Building on this conclusion, the IPCC *Third Assessment Report* (IPCC 2001) asserted “concentrations of atmospheric greenhouse gases and their radiative forcing have continued to increase as a result of human activities.”

The IPCC reports the global average surface temperature of the Earth has increased by 1.1 ± 0.4°F (0.6 ± 0.2°C) over the 20th century. This value is about 0.27°F (0.15°C) larger than that estimated by the Second Assessment Report, which reported for the period up to 1994, “owing to the relatively high temperatures of the additional years (1995 to 2000) and improved methods of processing the data.”

While the *Second Assessment Report* concluded, “the balance of evidence suggests there is a discernible human influence on global climate,” the *Third Assessment Report* more directly connects the influence of human activities on climate. IPCC concluded, “In light of new evidence and taking into account the remaining uncertainties, most of the observed warming over the last 50 years is likely to have been due to the increase in greenhouse gas concentrations.”

In its most recent *Fourth Assessment Report*, IPCC stated warming of Earth’s climate is unequivocal, and that warming is very likely attributable to increases in atmospheric GHGs caused by human activities (IPCC 2007). IPCC further stated changes in many physical and biological systems, such as increases in global temperatures, more frequent heat waves, rising sea levels, coastal flooding, loss of wildlife habitat, spread of infectious disease, and other potential environmental effects, are linked to changes in the climate system, and some changes might be irreversible.

The mobile sources used in mosquito and vector control activities emit GHGs and, therefore, contribute incrementally to climate change; however, as described in Section 11.2.2, these emissions comprise a very small fraction of the Bay Area, California, and national GHG inventories. This fact precludes any meaningful analysis of quantitative effects that mosquito and vector control operations may specifically have on climate, although taken together with regional, national, and worldwide GHG emissions, global effects are as described above.

11.1.3 Greenhouse Gases and Their Emissions

11.1.3.1 The Atmosphere

Air is a mixture of constituent gases and its composition varies slightly with location and altitude. For 20th century scientific and engineering purposes, it became necessary to define a standard composition known as the US Standard Atmosphere. In addition to the common gases (nitrogen, oxygen, CO_2, methane [CH_4], hydrogen, nitrous oxide [N_2O]), the atmosphere contains noble or inert gases (argon, neon, helium, krypton, xenon). Radon is also present in low concentrations near ground level in limited geographic areas where it is naturally emitted from certain types of rock and soil. Table 11-1 shows the typical composition of dry

standard air, which is over 99 percent nitrogen and oxygen (UIG 2008; USEPA 2012e). The apparent molecular weight of dry standard air is 28.966 grams per mole (Jennings 1970; du Pont 1971).

Table 11-1 Standard Composition of Dry Air

Principal Gas	Chemical Symbol	Gas MW g/mole	Concentration ppmv	Fraction Percent	Fraction MW g/mole
Nitrogen	N_2	28.014	780,805.00	78.080500	21.873471
Oxygen	O_2	31.998	209,440.00	20.944000	6.701661
Argon	Ar	39.948	9,340.00	0.934000	0.373114
Carbon Dioxide	CO_2	44.009	387.69	0.038769	0.017062
Neon	Ne	20.183	18.21	0.001821	0.000368
Helium	He	4.003	5.24	0.000524	0.000021
Methane	CH_4	16.043	1.81	0.000181	0.000029
Krypton	Kr	83.800	1.14	0.000114	0.000096
Hydrogen	H_2	2.016	0.50	0.000050	0.000001
Nitrous Oxide	N_2O	44.013	0.32	0.000032	0.000014
Xenon	Xe	31.300	0.09	0.000009	0.000003
Totals			**1,000,000.00**	**100.000**	**28.966**

Sources: UIG 2008 ; USEPA 2012e ; du Pont 1971 ; Jennings 1970

Notes:

MW = molecular weight, g/mole

ppmv = parts per million by volume (10^{-6})

The atmosphere consists of five basic altitude zones: troposphere (sea level to 8 miles), stratosphere (8 to 32 miles), mesosphere (32 to 50 miles), thermosphere (50 to 350 miles), and exosphere (350 to 500 miles). Within the stratosphere is the ozone layer (9 to 22 miles), which absorbs ultraviolet wavelengths; and within the mesosphere is the ionosphere (62 to 190 miles), which reflects shortwave radio signals and produces auroras. These approximate altitude ranges vary with latitude, season, solar activity, and turbulence. GHGs persist mainly in the troposphere and stratosphere – some in the mesosphere – for different lengths of time, ranging from less than 5 years to over 50,000 years, long enough to become well-mixed, meaning that atmospheric concentrations are about the same all over the world, regardless of source locations (USEPA 2012f). Thus, the homogeneous composition of the lower atmosphere is the global setting for climate change.

11.1.3.2 Greenhouse Gases

Gases that trap heat in the atmosphere are called GHGs. Principal GHGs include CO_2, CH_4, N_2O, hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride (SF_6), and other fluorinated gases including nitrogen trifluoride and hydrofluorinated ethers. GHGs occur naturally because of volcanoes, forest fires, and biological processes such as enteric fermentation and aerobic decomposition. They are also produced by combustion of fuels, industrial processes, agricultural operations, waste management, and land use changes such as loss of farmland to urbanization. The most common GHG from human activity (fuel combustion) is CO_2, followed by CH_4 and N_2O. (USEPA 2012f)

Concentration, or abundance, is the amount of a particular gas in the air. Larger GHG emissions lead to higher concentrations in the atmosphere. GHG concentrations are measured in units of parts per million (ppm), parts per billion (ppb), and parts per trillion (ppt). One ppm is equivalent to 1 cubic

centimeter (cc) of pure gas diluted in 1 cubic meter of air. Similarly, 1 ppb is 1 cc diluted in 1,000 cubic meters, and 1 ppt is 1 cc diluted in 1,000,000 cubic meters. (USEPA 2012f)

11.1.3.2.1 Carbon Dioxide

CO_2 enters the atmosphere through burning fossil fuels (coal, natural gas, and petroleum products), decomposition of solid waste, trees and wood products, fermentation, and also as a result of certain chemical reactions, such as manufacture of cement. CO_2 is removed from the atmosphere (or "sequestered") when it is absorbed by plants as part of the biologic carbon cycle. In the carbon cycle, carbon in various molecular forms is cycled among atmospheric, oceanic, land biotic, marine biotic, and mineral reservoirs. Atmospheric CO_2 is part of this global carbon cycle. CO_2 concentrations in the atmosphere have increased from about 280 ppm in preindustrial times to about 390 ppm today, a 39 percent increase. The IPCC notes that “this concentration has not been exceeded during the past 420,000 years, and likely not during the past 20 million years. The rate of increase over the past century is unprecedented, at least during the past 20,000 years.” The IPCC definitively states that “the present atmospheric CO_2 increase is caused by anthropogenic emissions of CO_2.” (USEPA 2012f; IPCC 2007)

Global Warming Potential (GWP) is a quantified measure of the globally averaged relative radiative forcing impacts of a particular GHG. It is defined as the cumulative radiative forcing both direct and indirect effects integrated over a period of time from the emission of a unit mass of gas relative to a reference gas. CO_2 is the reference gas with a GWP of unity (1). Carbon dioxide equivalents (CO_2e) are calculated by summing the products of mass GHG emissions by species times their respective USEPA official GWP coefficients. The persistence of CO_2 in the atmosphere is estimated to be in the range of 50 to 200 years, depending on variations in the carbon cycle. (USEPA 2012e, f)

11.1.3.2.2 Methane

CH_4 is primarily produced through anaerobic decomposition of organic matter in biological systems. Agricultural processes such as wetland rice cultivation, enteric fermentation in ruminant animals (e.g., cows), and the decomposition of animal wastes emit CH_4, as does the decomposition of municipal solid wastes. CH_4 is also fugitively emitted during the production and distribution of natural gas and petroleum, and is released as a by-product of coal mining and incomplete fossil fuel combustion. Pipeline-quality natural gas is over 90 percent CH_4 by volume and is considered a “clean fuel” by industry with CO_2 and water vapor as its main combustion by-products. Atmospheric concentrations of CH_4 have increased by about 160 percent since preindustrial times, although the rate of increase has been declining. The IPCC has estimated that slightly more than half of the current CH_4 flux to the atmosphere is anthropogenic, from human activities such as agriculture, fossil fuel use, and waste disposal. The USEPA’s official GWP coefficient of CH_4 is 21, and its persistence in the atmosphere is estimated to be about 9 to 15 years. (USEPA 2012e, f)

11.1.3.2.3 Nitrous Oxide

N_2O is emitted during agricultural and industrial activities, as well as during combustion of fossil fuels and solid waste. Anthropogenic sources of N_2O emissions include agricultural soils, especially the use of synthetic and manure fertilizers; fossil fuel combustion, especially from mobile combustion; adipic (nylon) and nitric acid production; wastewater treatment and waste combustion; and biomass burning. The atmospheric concentration of N_2O has increased by about 19 percent since 1750, from a preindustrial value of about 270 to about 320 ppb today, a concentration that has not been exceeded during the last thousand years. The USEPA’s official GWP coefficient of N_2O is 310, and its persistence in the atmosphere is estimated to be about 110 to 120 years. (USEPA 2012e, f)

11.1.3.2.4 Fluorinated Gases

Hydrofluorocarbons, perfluorocarbons, and SF_6 are synthetic, powerful GHGs that are emitted from a variety of industrial processes. Fluorinated gases are sometimes used as substitutes for ozone-depleting substances (e.g., chlorofluorocarbons, hydrochlorofluorocarbons, and halons). In the electric utility industry, SF_6 is used as a dielectric gas in high-voltage equipment, such as switchgear and circuit breakers. As man-made gas, SF_6 in the atmosphere has increased from 0 to about 7 ppt in modern times. Due to their expense, all of these fluorinated gases are typically emitted (lost) in small quantities relative to combustion by-products, but because they are potent GHGs, they are sometimes referred to as “High GWP gases” with estimated persistence in the atmosphere ranging from 1.5 to 50,000 years. Of these, SF_6 is the most potent, with an USEPA official GWP of 23,900 and an estimated persistence of about 3,200 years. (USEPA 2012e, f)

11.1.3.3 Emission Sources

The USEPA tracks GHG emissions in the US and publishes the *Inventory of U.S. Greenhouse Gas Emissions and Sinks*, which is updated annually (USEPA 2012e). This detailed report contains estimates of the total national GHG emissions and removals associated with human activities in all 50 states. From the current report, the main sources of GHG emissions in the US are identified below (USEPA 2012f):

> Electric power generation

> Transportation

> Industry

> Commercial and residential

> Agriculture

Land Use and Forestry offsets (absorbs or sequesters) about 15 percent of GHG emissions nationwide. Land areas can act as GHG sinks (absorbing CO_2 from the atmosphere) or GHG sources. Since 1990, well-managed forests and other lands have absorbed more CO_2 from the atmosphere than they emit.

11.1.3.4 Mobile Sources

While stationary sources such as power plants and oil refineries emit large quantities of GHGs, mobile sources, due to their sheer numbers nationwide, also emit significant amounts. Mobile sources include onroad vehicles (e.g., automobiles, trucks, motorcycles), offroad equipment (e.g., earthmovers, cranes, portable pumps, and generators), trains (e.g., freight, passenger, light rail), vessels (e.g., boats, ships, watercraft), and aircraft (e.g., general aviation, commercial, military). Mobile source fuels include gasoline, diesel, heavy fuel oil (large marine vessels), and jet fuel, all of which emit GHGs when combusted.

Mobile sources used in mosquito and/or vector control activities include onroad fleet vehicles (light- and medium-duty trucks, vans, passenger cars), offroad ATVs, watercraft (motorboats, airboats), aircraft (helicopters and fixed-wing), portable equipment (pumps, sprayers, generators), and small equipment (handheld sprayers, foggers, dusters). Except for 2-stroke engines used in small lightweight equipment (spark ignition, 50:1 gas/oil mix), engines are 4-stroke gasoline (spark ignition) or diesel fuel (compression ignition). The dominant fuel used for these mobile sources is motor gasoline along with some diesel fuel (larger trucks) , aviation gasoline (fixed-wing aircraft), and jet fuel (turbine-powered helicopters). Light trucks, vans, and passenger cars are normally used for responding to public service requests and disease surveillance. Typical GHG contents of common fuels are presented in Table 11-2.

Table 11-2 Typical GHG Contents of Common Fuels

Fuel	CO_2 kg/mmBTU	CH_4 kg/mmBTU	N_2O kg/mmBTU	CO_2e lb/mmBTU	Energy BTU/gal	CO_2e lb/gal
Diesel Fuel No. 2	73.96	0.0105	0.0006	163.97	138,300	22.68
Kerosene	73.19	0.0105	0.0006	162.27	138,700	22.51
Jet Fuel	72.23	0.0105	0.0006	160.17	135,000	21.62
Motor Gasoline	71.35	0.0105	0.0006	158.23	122,600	19.40
Aviation Gasoline	69.15	0.0105	0.0006	153.38	120,200	18.44
Propane	62.22	0.0053	0.0001	137.49	91,300	12.55
Pipeline Natural Gas	53.02	0.0053	0.0001	117.20	—	—

Sources: USEPA 2012e, 2011a

Notes:

kg/mmBTU = kilogram(s) per million British Thermal Units

lb/mmBTU = pound(s) per million British Thermal Units

BTU = the amount of energy (heat) required to raise 1 pound of liquid water 1 degree Fahrenheit from 39 to 40°F

11.1.3.5 Sensitive Receptors

Certain population groups are considered more sensitive to air pollution and odors than others; in particular, children, elderly, and acutely ill and chronically ill persons, especially those with cardiorespiratory diseases such as asthma and bronchitis. Sensitive receptors (land uses) indicate locations where such individuals are typically found, namely schools, daycare centers, hospitals, convalescent homes, residences of sensitive persons, and parks with active recreational uses, such as youth sports.

None of the GHGs described in Section 11.2.2 are considered toxic; however, all are classified as asphyxiants. Thus, in high enough concentrations in confined spaces they can displace the oxygen in air and present hazards to industrial workers, however, GHG concentrations in ambient air (see Table 11-1) are far below any danger levels. Therefore, no risk to sensitive receptors or the general public is posed by GHGs emitted to outdoor air, either from stationary or mobile sources.

11.1.4 California Climate

Climate change is already affecting California. Average temperatures have increased, leading to more extreme hot days and fewer cold nights. Shifts in the water cycle have been observed, with less winter precipitation falling as snow, and both snowmelt and rainwater running off earlier in the year. Sea levels have risen. Wildland fires are becoming more frequent and intense due to dry seasons that start earlier and end later. These climate-driven changes affect resources critical to the health and prosperity of California. (CEC 2010)

If the state takes no action to reduce or minimize expected impacts from future climate change, the costs could be severe. In November 2008, the Governor directed the California Natural Resources Agency to develop a climate adaptation strategy for California. The Natural Resources Agency coordinated with ten state agencies, multiple scientists, a consulting team, and stakeholders to develop the first statewide, multisector adaptation strategy in the country. The resulting report, *2009 California Climate Adaptation Strategy*, summarizes the best-known science to assess the vulnerability of the state to climate change impacts, and outlines possible solutions that can be implemented within and across state agencies to promote resiliency. This strategy is the first step in an evolving process to reduce California's vulnerability to climate change impacts. (CEC 2010)

11.1.4.1 State Policies

The Global Warming Solutions Act of 2006 (Assembly Bill [AB] 32) (see Appendix C) required CARB to prepare a Scoping Plan to achieve substantial GHG emissions reductions, both from within the state and from "exported" emissions, such as importing electric power generated at coal-fired power plants located in neighboring western states. The 2008 Scoping Plan outlines a wide range of strategies for reducing statewide GHG emissions to 1990 levels by 2020. This goal will be achieved by cutting about 30 percent from business-as-usual emission levels projected for 2020, or about 15 percent from 2008 levels. Allowing for population growth, the goal is to reduce annual per capita emissions from 14 metric tonnes (MT) CO_2e down to about 10 MT CO_2e per capita by 2020. (CARB 2008b)

11.1.5 Emissions Inventories

The bulk of mosquito and vector control activity emissions would occur in the Bay Area, and only minor amounts would occur in northern Sonoma and northern Monterey counties. Therefore, the comprehensive 2007 Bay Area GHG inventory is used as the regional benchmark for comparison purposes.

Table 11-3 shows aggregated national, state, and regional GHG emissions for all sources on a gross basis (i.e., CO_2e emissions only, not including CO_2 sinks such as forestry and agriculture). As shown, California accounts for about 7 percent of gross CO_2e emissions in the US annually, and the Bay Area accounts for about 20 percent of gross CO_2e emissions in California.

Table 11-3 Greenhouse Gas Emissions Inventories - Gross Basis

Summary Year	National MMT CO_2e	California MMT CO_2e	Bay Area MMT CO_2e
2005	7,204	482.5	—
2006	7,159	481.9	—
2007	7,253	488.8	95.8
2008	7,048	484.7	—
2009	6,608	456.8	—
5-Year Average	**7,054**	**478.9**	—
Average Annual Variation	**2.6%**	**1.8%**	—

Sources: USEPA 2012e; CARB 2011; BAAQMD 2010b

Notes:

MMT = million metric tonnes (annual)

1 metric tonne = 1,000 kilograms or 2,204.6 pounds

2009 is most recent CARB published data; Bay Area for 2007 only

Tables 11-4, 11-5, 11-6, and 11-7 present progressively focused Bay Area GHG emissions inventory data for 2007 broken down by sectors, counties, and applicable subsectors. This information will be used as a basis for comparisons with estimated mosquito and vector control activity emissions for the nine Districts presented in Section 11.2.2.

Table 11-4 Bay Area GHG Emissions by Sector

End-Use Sector	District Emissions Percent	District Emissions MMT CO_2e
Industrial / Commercial	36.4%	34.9
Residential Fuel Use	7.1%	6.8
Local Electric Power Generation	8.5%	8.1
Imported Electric Power Generation	7.4%	7.1
Offroad Equipment	3.0%	2.9
Transportation	36.4%	34.9
Agriculture / Farming	1.2%	1.1
Totals	**100.0%**	**95.8**

Source: BAAQMD 2010b

Notes:

MMT = million metric tonnes (annual)

1 metric tonne = 1,000 kilograms or 2,204.6 pounds

Table 11-5 Bay Area GHG Emissions by County

County	District Emissions Percent	District Emissions MMT CO_2e
Alameda	16.4%	15.7
Contra Costa	32.9%	31.5
Marin	2.8%	2.7
Napa	1.8%	1.7
San Francisco	7.4%	7.1
San Mateo	8.9%	8.5
Santa Clara	19.6%	18.8
Solano (within BAAQMD)	5.9%	5.7
Sonoma (within BAAQMD)	4.3%	4.1
Totals	**100.0%**	**95.8**

Source: BAAQMD 2010b

Notes:

MMT = million metric tonnes (annual)

1 metric tonne = 1,000 kilograms or 2,204.6 pounds

Table 11-6 Mobile Sectors GHG Emissions by County

County	Offroad MT CO_2e	Transportation MT CO_2e
Alameda	569,000	8,351,000
Contra Costa	406,000	4,998,000
Marin	99,000	1,286,000
Napa	50,000	917,000
San Francisco	415,000	2,673,000
San Mateo	270,000	4,850,000
Santa Clara	790,000	7,859,000
Solano (within BAAQMD)	147,000	1,834,000
Sonoma (within BAAQMD)	175,000	2,103,000
Totals	**2,921,000**	**34,871,000**

Source: BAAQMD 2010b

Notes:

MMT = million metric tonnes (annual)

1 metric tonne = 1,000 kilograms or 2,204.6 pounds

Values rounded to nearest 1,000 tonnes

"Offroad" is offroad equipment category

Table 11-7 Offroad Subsectors GHG Emissions by County

County	Utility MT CO_2e	Commercial MT CO_2e	Combined MT CO_2e
Alameda	29,800	49,900	79,700
Contra Costa	20,300	26,900	47,200
Marin	7,900	12,300	20,200
Napa	2,900	4,300	7,200
San Francisco	14,200	43,900	58,100
San Mateo	14,200	27,200	41,400
Santa Clara	32,900	56,500	89,400
Solano (within BAAQMD)	3,900	6,800	10,700
Sonoma (within BAAQMD)	7,800	13,500	21,300
Totals	**133,900**	**241,300**	**375,200**

Source: BAAQMD 2010b

Notes:

MMT = million metric tonnes (annual)

1 metric tonne = 1,000 kilograms or 2,204.6 pounds

Values rounded to nearest 100 tonnes

"Utility" is small landscaping equipment selected for comparisons to Districts' activities

"Commercial" is light commercial equipment selected for comparisons to Districts' activities

11.1.6 Regulatory Setting

Currently, no local, state, or federal regulatory standards directly apply to GHG emissions from temporary or intermittent mobile sources such as mosquito and vector control activities. However, in the context of the Scoping Plan discussed in Section 11.1.4.1, implementation of Low Carbon Fuel Standard (Executive Order S-1-7, below) would indirectly apply to mosquito and vector control activities via fuel usage. Summaries of principal federal, state, and local GHG statutes, regulations, and programs that affect other types of sources are presented in Appendix C and below:

11.1.6.1 Federal

> 40 CFR Part 98 – Greenhouse Gas Reporting

> General Conformity

11.1.6.2 State

> Global Warming Solutions Act

> Cap and Trade

> Assembly Bill 939

> Senate Bill 1368

> Senate Bill 97

> Senate Bill 375

> Senate Bills 1078 and 10

> Executive Order S-20-04

> Executive Order S-3-05

> Executive Order S-1-07

> Executive Order S-13-08

11.2 Environmental Evaluation

11.2.1 Evaluation Concerns

The public identified the following issues:

> Address GHG emissions and climate change

The focus in this chapter is on the use of equipment to perform all Program activities and the resulting emissions of GHGs. Program emissions are compared against existing GHG inventories for context.

11.2.2 Evaluation Methods and Assumptions

As described in Section 11.1.3, operation of onroad fleet vehicles, offroad all-terrain vehicles, watercraft, aircraft, portable equipment, and small equipment would result in GHG emissions in engine exhaust. Detailed lists of equipment, estimated usage, and emission calculations are provided in Appendix C. Equipment lists and annual activity schedules were provided by the nine Districts, including the Santa Clara County Vector Control District. Emission calculations were performed using the most recent and applicable emission factors published by CARB (2008a) and USEPA (2011a, 2012e).

Table 11-8 shows Program components applicability by percentage as selected by the nine Districts: surveillance, physical control, vegetation management, biological control, chemical control, or other nonchemical control. Table 11-9 shows land uses associated with selected components: residential,

commercial, industrial, agricultural, and open space. As shown in Tables 11-8 and 11-9, not all components or land uses are applicable in all Districts, nor are all options or activities under any applicable component.

Table 11-8 Districts' Selected Components Applicability

Districts	Surveillance	Physical Control	Vegetation Management	Biological Control	Chemical Control	Other Nonchemical
Alameda County MAD	12%	7%	—	1%	64%	16%
Alameda County VCSD	100%	—	—	—	—	—
Contra Costa MVCD	16%	0.07%	0.13%	0.07%	61%	23%
Marin-Sonoma MVCD	20%	5%	13%	21%	25%	15%
Napa County MAD	11%	13%	7%	2%	64%	4%
Northern Salinas Valley MAD	3%	6%	29%	7%	39%	15%
San Mateo County MVCD	11%	0%	30%	21%	13%	24%
Santa Clara County VCD	47%	3%	—	13%	37%	—
Solano County MAD	24%	—	—	0.03%	46%	30%
Nine Districts Composite	**27%**	**4%**	**9%**	**7%**	**39%**	**14%**

Sources: Nine Districts

Table 11-9 Land Uses Associated with Selected Components

Districts	Residential	Commercial	Industrial	Agricultural	Open Space
Alameda County MAD	•	•	•	•	•
Alameda County VCSD	•	•			
Contra Costa MVCD	•	•	•	•	•
Marin-Sonoma MVCD	•	•	•	•	•
Napa County MAD	•	•	•	•	•
Northern Salinas Valley MAD	•	•	•	•	•
San Mateo County MVCD	•	•	•		•
Santa Clara County VCD	•	•	•	•	•
Solano County MAD	•	•	•	•	•

Sources: Nine Districts

Tables 11-10 through 11-15 show estimated ongoing annual GHG emissions as CO_2e by component and district. Table 11-16 shows estimated combined annual emissions across all nine Districts. On the local level, the combined "grand total" of 2,600 MT CO_2e per year comprises only 0.7 percent of the 375,200 MT CO_2e per year in the utility and commercial offroad subsectors (see Table 11-7); this amount is within USEPA limits of precision of -2 to +5 percent for fossil fuel combustion (USEPA 2012e). On the regional level, this is less than 0.003 percent of aggregate GHG emissions from the Bay Area (see Table 11-4). At the state and national levels, these emissions are negligible: 0.0005 and 0.00004 percent, respectively (see Table 11-3). Since the combined emissions of the nine Districts would not be cumulatively considerable, neither would the incremental contribution of each District.

Table 11-10 Estimated Annual GHG Emissions for Surveillance Component

Districts	CO_2 MT/year	CH_4 MT/year	N_2O MT/year	CO_2e MT/year
Alameda County MAD	16.3	0.0009	0.0004	16.4
Alameda County VCSD	105.4	0.0060	0.0024	106.3
Contra Costa MVCD	21.1	0.0012	0.0005	21.3
Marin-Sonoma MVCD	51.0	0.0024	0.0016	51.6
Napa County MAD	8.9	0.0004	0.0002	8.9
Northern Salinas Valley MAD	1.6	0.0001	0.0001	1.6
San Mateo County MVCD	147.6	0.0084	0.0034	148.9
Santa Clara County VCD	169.7	0.0097	0.0039	171.2
Solano County MAD	35.5	0.0016	0.0009	35.8
Nine Districts Totals	**557.2**	**0.0309**	**0.0135**	**562.0**

Sources: CARB 2008a; USEPA 2011a, 2012e

Table 11-11 Estimated Annual GHG Emissions for Physical Control Component

Districts	CO_2 MT/year	CH_4 MT/year	N_2O MT/year	CO_2e MT/year
Alameda County MAD	9.4	0.0005	0.0002	9.5
Alameda County VCSD	0.0	0.0000	0.0000	0.0
Contra Costa MVCD	0.1	0.0000	0.0000	0.1
Marin-Sonoma MVCD	14.0	0.0007	0.0004	14.1
Napa County MAD	10.4	0.0005	0.0003	10.5
Northern Salinas Valley MAD	3.4	0.0002	0.0001	3.4
San Mateo County MVCD	3.3	0.0002	0.0001	3.3
Santa Clara County VCD	11.0	0.0006	0.0003	11.1
Solano County MAD	0.0	0.0000	0.0000	0.0
Nine Districts Totals	**51.5**	**0.0027**	**0.0014**	**52.0**

Sources: CARB 2008a; USEPA 2011a, 2012e

Table 11-12 Estimated Annual GHG Emissions for Vegetation Management Component

Districts	CO_2 MT/year	CH_4 MT/year	N_2O MT/year	CO_2e MT/year
Alameda County MAD	0.0	0.0000	0.0000	0.0
Alameda County VCSD	0.0	0.0000	0.0000	0.0
Contra Costa MVCD	0.2	0.0000	0.0000	0.2
Marin-Sonoma MVCD	34.5	0.0016	0.0011	34.8
Napa County MAD	5.6	0.0003	0.0001	5.7
Northern Salinas Valley MAD	15.3	0.0007	0.0005	15.5
San Mateo County MVCD	393.2	0.0224	0.0092	396.5
Santa Clara County VCD	0.0	0.0000	0.0000	0.0
Solano County MAD	0.0	0.0000	0.0000	0.0
Nine Districts Totals	**448.8**	**0.0251**	**0.0109**	**452.7**

Sources: CARB 2008a; USEPA 2011a, 2012e

Table 11-13 Estimated Annual GHG Emissions for Biological Control Component

Districts	CO_2 MT/year	CH_4 MT/year	N_2O MT/year	CO_2e MT/year
Alameda County MAD	1.0	0.0001	0.0000	1.1
Alameda County VCSD	0.0	0.0000	0.0000	0.0
Contra Costa MVCD	0.1	0.0000	0.0000	0.1
Marin-Sonoma MVCD	54.4	0.0026	0.0017	55.0
Napa County MAD	1.3	0.0001	0.0000	1.4
Northern Salinas Valley MAD	3.7	0.0002	0.0001	3.7
San Mateo County MVCD	270.4	0.0154	0.0063	272.7
Santa Clara County VCD	46.9	0.0027	0.0011	47.3
Solano County MAD	0.0	0.0000	0.0000	0.0
Nine Districts Totals	**378.0**	**0.0210**	**0.0093**	**381.3**

Sources: CARB 2008a; USEPA 2011a, 2012e

Table 11-14 Estimated Annual GHG Emissions for Chemical Control Component

Districts	CO_2 MT/year	CH_4 MT/year	N_2O MT/year	CO_2e MT/year
Alameda County MAD	85.4	0.0048	0.0020	86.2
Alameda County VCSD	0.0	0.0000	0.0000	0.0
Contra Costa MVCD	81.8	0.0046	0.0019	82.4
Marin-Sonoma MVCD	64.2	0.0030	0.0020	64.9
Napa County MAD	52.3	0.0027	0.0013	52.8
Northern Salinas Valley MAD	20.9	0.0009	0.0007	21.1
San Mateo County MVCD	174.2	0.0099	0.0041	175.7
Santa Clara County VCD	131.8	0.0075	0.0031	132.9
Solano County MAD	67.1	0.0031	0.0018	67.7
Nine Districts Totals	**677.7**	**0.0367**	**0.0168**	**683.7**

Sources: CARB 2008a; USEPA 2011a, 2012e

Table 11-15 Estimated Annual GHG Emissions for Other Nonchemical Component

Districts	CO_2 MT/year	CH_4 MT/year	N_2O MT/year	CO_2e MT/year
Alameda County MAD	21.3	0.0012	0.0005	21.4
Alameda County VCSD	0.0	0.0000	0.0000	0.0
Contra Costa MVCD	31.4	0.0018	0.0007	31.7
Marin-Sonoma MVCD	38.0	0.0018	0.0012	38.4
Napa County MAD	2.9	0.0001	0.0001	2.9
Northern Salinas Valley MAD	8.0	0.0004	0.0003	8.1
San Mateo County MVCD	305.3	0.0174	0.0071	307.8
Santa Clara County VCD	0.0	0.0000	0.0000	0.0
Solano County MAD	44.6	0.0020	0.0012	45.0
Nine Districts Totals	**451.5**	**0.0248**	**0.0111**	**455.4**

Sources: CARB 2008a; USEPA 2011a, 2012e

Table 11-16 Estimated Combined Annual GHG Emissions Across Nine Districts

Components	CO_2 MT/year	CH_4 MT/year	N_2O MT/year	CO_2e MT/year
Surveillance	557	0.0309	0.0135	562
Physical Control	52	0.0027	0.0014	52
Vegetation Management	449	0.0251	0.0109	453
Biological Control	378	0.0210	0.0093	381
Chemical Control	678	0.0367	0.0168	684
Other Nonchemical	451	0.0248	0.0111	455
All Components Totals	**2,565**	**0.1410**	**0.0630**	**2,587**

Sources: CARB 2008a; USEPA 2011a, 2012e

11.2.3 Surveillance Component

The Surveillance component involves use of equipment, vehicles, and watercraft for monitoring mosquito and/or vector populations and habitat, their disease pathogens, and the human/vector interactions. Field counting/sampling and trapping are common mechanisms for surveillance.

Generation of Greenhouse Gas Emissions

GHG emissions from the Surveillance component would not be expected to exceed average emissions shown in Table 11-10. Under the Santa Clara County Vector Control District's program, the Surveillance component would emit approximately 171 MT CO_2e per year. Compared to national, statewide, and Bay Area GHG inventories shown in Table 11-3 (i.e., 7054 MMT/year, 479 MMT/year, 96 MMT/year, respectively), the Surveillance component emissions would comprise about 0.00000027 percent, 0.000033 percent, and 0.0002 percent of these respective inventories on an annual basis. These GHG emissions are well within USEPA limits of precision of -2 to +5 percent for fossil fuel combustion (USEPA 2012e) and are, thus, negligible in context and similar to existing conditions. Due to its small scale and GHG mitigations, the Surveillance component would not individually affect the environment or impede the state's ability to meet its 2020 GHG emission reduction.

Agency Plans, Policies, and Regulations

On a statewide basis, agencies in California are in the process of implementing strategies to reduce GHG emissions pursuant to the Global Warming Solutions Act of 2006 (AB 32, Núñez, Chapter 488, Statutes of 2006), which requires that California reduce its statewide GHG emissions to 1990 levels by 2020. AB 32 required CARB to develop the Scoping Plan (2008b) in coordination with the California Energy Commission's (CEC's) Climate Action Team (2010). The Scoping Plan defines a comprehensive set of emission reduction measures such as energy efficiency, renewable energy, cap-and-trade, transportation measures, low-carbon fuels, and targeted GHG fees. Due to its small scale, the Surveillance component would not conflict with state and local plans, policies, or regulations aimed at curbing GHG emissions.

11.2.4 Physical Control Component

The Physical Control component would be a continuation of existing activities currently practiced by the District using applicable techniques, equipment, vehicles, and watercraft. This component involves managing vector habitat using source control and permanent control methods that do not use biological agents or chemical pesticides, such as ditch maintenance, debris removal in natural channels, and blockage of access points.

Generation of Greenhouse Gas Emissions

GHG emissions from the Physical Control component would not be expected to exceed average emissions shown in Table 11-11. Under the Santa Clara County Vector Control District's program, Physical Control component would emit approximately 11 MT CO_2e per year. Compared to national, statewide, and Bay Area GHG inventories shown in Table 11-3 (i.e., 7054 MMT/year, 479 MMT/year, 96 MMT/year, respectively), the Physical Control component emissions would comprise about 0.00000001 percent, 0.000002percent, and 0.00001 percent of these respective inventories on an annual basis. These GHG emissions are well within USEPA limits of precision of -2 to +5 percent for fossil fuel combustion (USEPA 2012e) and are, thus, negligible in context. Due to its small scale and GHG mitigations, the Physical Control component would not individually affect the environment or impede the state's ability to meet its 2020 GHG emission reduction.

Agency Plans, Policies, and Regulations On a statewide basis, agencies in California are in the process of implementing strategies to reduce GHG emissions pursuant to the Global Warming Solutions Act of 2006 (AB 32, Núñez, Chapter 488, Statutes of 2006), which requires that California reduce its statewide GHG emissions to 1990 levels by 2020. AB 32 required CARB to develop the Scoping Plan (2008b) in coordination with the CEC's Climate Action Team (2010). The Scoping Plan defines a comprehensive set of emission reduction measures such as energy efficiency, renewable energy, cap-and-trade, transportation measures, low-carbon fuels, and targeted GHG fees. Due to its small scale, the Physical Control component would not conflict with state and local plans, policies, or regulations aimed at curbing GHG emissions.

11.2.5 Vegetation Management Component

The Vegetation Management component would be a continuation of existing activities currently practiced by the District using applicable techniques, equipment, vehicles, and watercraft. Vegetation management is used to reduce the habitat value for mosquitoes and other vectors. The District uses hand tools and sometimes heavy equipment to remove vegetation primarily in aquatic habitats.

Generation of Greenhouse Gas Emissions

GHG emissions from the Vegetation Management component would not be expected to exceed average emissions shown in Table 11-12. Under the Santa Clara County Vector Control District's program, the Vegetation Management component would emissions of CO_2e per year would be negligible both in terms of metric tons and as a percentage of national, statewide, and Bay Area GHG inventories shown in Table 11-3 (i.e., 7054 MMT/year, 479 MMT/year, 96 MMT/year, respectively). These GHG emissions are well within USEPA limits of precision of -2 to +5 percent for fossil fuel combustion (USEPA 2012e) and are, thus, negligible in context. Due to its small scale and GHG mitigations, the Vegetation Management component would not individually affect the environment or impede the state's ability to meet its 2020 GHG emission reduction goal.

Agency Plans, Policies, and Regulations On a statewide basis, agencies in California are in the process of implementing strategies to reduce GHG emissions pursuant to the Global Warming Solutions Act of 2006 (AB 32, Núñez, Chapter 488, Statutes of 2006), which requires that California reduce its statewide GHG emissions to 1990 levels by 2020. AB 32 required CARB to develop the Scoping Plan (2008b) in coordination with the CEC's Climate Action Team (2010). The Scoping Plan defines a comprehensive set of emission reduction measures such as energy efficiency, renewable energy, cap-and-trade, transportation measures, low-carbon fuels, and targeted GHG fees. Due to its small scale, the Vegetation Management component would not conflict with state and local plans, policies, or regulations aimed at curbing GHG emissions.

11.2.6 Biological Control Component

The Biological Control component would be a continuation of existing activities currently practiced by the District using applicable techniques, equipment, vehicles, watercraft, and aircraft. It involves the use of mosquito predators, i.e., mosquitofish (*Gambusia affinis*).

Generation of Greenhouse Gas Emissions

GHG emissions from the Biological Control component would not be expected to exceed average emissions shown in Table 11-13. Under the Santa Clara County Vector Control District's program, the Biological Control component would emit approximately 47 MT CO_2e per year. Compared to national, statewide, and Bay Area GHG inventories shown in Table 11-3 (i.e., 7054 MMT/year, 479 MMT/year, 96 MMT/year, respectively), the Biological Control component emissions would comprise about 0.0000001 percent, 0.00001percent, and 0.00005 percent of these respective inventories on an annual basis. These GHG emissions are well within USEPA limits of precision of -2 to +5 percent for fossil fuel combustion (USEPA 2012e) and are, thus, negligible in context. Due to its small scale and GHG mitigations, the Biological Control component would not individually affect the environment or impede the state's ability to meet its 2020 GHG emission reduction goal.

Agency Plans, Policies, and Regulations

On a statewide basis, agencies in California are in the process of implementing strategies to reduce GHG emissions pursuant to the Global Warming Solutions Act of 2006 (AB 32, Núñez, Chapter 488, Statutes of 2006), which requires that California reduce its statewide GHG emissions to 1990 levels by 2020. AB 32 required CARB to develop the Scoping Plan (2008b) in coordination with the CEC's Climate Action Team (2010). The Scoping Plan defines a comprehensive set of emission reduction measures such as energy efficiency, renewable energy, cap-and-trade, transportation measures, low-carbon fuels, and targeted GHG fees. Due to its small scale, the Biological Control component would not conflict with state and local plans, policies, or regulations aimed at curbing GHG emissions.

11.2.7 Chemical Control Component

The Chemical Control component would be a continuation of existing activities currently practiced by the District using applicable techniques, equipment, vehicles, watercraft, and aircraft. It involves the application of insecticides and rodenticides to reduce populations of pest species.

Generation of Greenhouse Gas Emissions

GHG emissions from the Chemical Control component would not be expected to exceed average emissions shown in Table 11-14. Under the Santa Clara County Vector Control District's program, the Chemical Control component would emit approximately 133 MT CO_2e per year in aggregate, less for an individual District. Compared to national, statewide, and Bay Area GHG inventories shown in Table 11-3 (i.e., 7054 MMT/year, 479 MMT/year, 96 MMT/year, respectively), the Chemical Control component emissions would comprise about 0.000002 percent, 0.00002 percent, and 0.0001percent of these respective inventories on an annual basis. These GHG emissions are well within USEPA limits of precision of -2 to +5 percent for fossil fuel combustion (USEPA 2012e) and are, thus, negligible in context. Due to its small scale and GHG mitigations, the Chemical Control component would not individually affect the environment or impede the state's ability to meet its 2020 GHG emission reduction goal.

Agency Plans, Policies, and Regulations

On a statewide basis, agencies in California are in the process of implementing strategies to reduce GHG emissions pursuant to the Global Warming Solutions Act of 2006 (AB 32, Núñez, Chapter 488, Statutes of 2006), which requires that California reduce its statewide GHG emissions to 1990 levels by 2020. AB 32 required CARB to develop the Scoping Plan (2008b) in coordination with the CEC's Climate Action Team

(2010). The Scoping Plan defines a comprehensive set of emission reduction measures such as energy efficiency, renewable energy, cap-and-trade, transportation measures, low-carbon fuels, and targeted GHG fees. Due to its small scale, the Chemical Control component would not conflict with state and local plans, policies, or regulations aimed at curbing GHG emissions.

11.2.8 Other Nonchemical Control/Trapping Component

As applicable, the Other Nonchemical Control/Trapping component would be a continuation of existing activities currently practiced by the District using applicable techniques, equipment, and vehicles. An example of these types of activities would be trapping of rodents and/or yellowjackets.

Generation of Greenhouse Gas Emissions

GHG emissions from the Other Nonchemical Control/Trapping Control component would not be expected to exceed average emissions shown in Table 11-15. Under the Santa Clara County Vector Control District's program, the Other Nonchemical Control/Trapping Control component emissions of 455 CO_2e per year would be negligible both in terms of metric tons and as a percentage of national, statewide, and Bay Area GHG inventories. GHG emissions are well within USEPA limits of precision of -2 to +5 percent for fossil fuel combustion (USEPA 2012e) and are, thus, negligible in context. Due to its small scale and GHG mitigations, the Other Nonchemical Control/Trapping Control component would not individually affect the environment or impede the state's ability to meet its 2020 GHG emission reduction goal.

Agency Plans, Policies, and Regulations

On a statewide basis, agencies in California are in the process of implementing strategies to reduce GHG emissions pursuant to the Global Warming Solutions Act of 2006 (AB 32, Núñez, Chapter 488, Statutes of 2006), which requires that California reduce its statewide GHG emissions to 1990 levels by 2020. AB 32 required CARB to develop the Scoping Plan (2008b) in coordination with the CEC's Climate Action Team (2010). The Scoping Plan defines a comprehensive set of emission reduction measures such as energy efficiency, renewable energy, cap-and-trade, transportation measures, low-carbon fuels, and targeted GHG fees. Due to its small scale, the Other Nonchemical Control/Trapping Control component would not conflict with state and local plans, policies, or regulations aimed at curbing GHG emissions.

12 Noise

Chapter 12 evaluates noise generated by Program implementation. Results of the evaluation are provided at a programmatic level. Section 12.1, Environmental Background, presents an overview of the physical properties and environmental noise; and contains federal, state, and local ordinances, plans, and regulations that are applicable to the Program. Section 12.2, Environmental Evaluation, presents the results of the evaluation. Appendix D, Noise Analysis Technical Report includes additional detailed information regarding the physical properties of noise; federal, state, and local noise regulations; and equipment use noise generated by each of the Program components.

12.1 Environmental Background

12.1.1 Overview of Environmental Sound

Noise may be defined as unwanted sound. Noise is usually objectionable because it is disturbing or annoying. Several noise measurement scales are used to describe noise in a particular location. A decibel (dB) is a unit of measurement that indicates the relative amplitude of a sound. The zero on the decibel scale is based on the lowest sound level that the healthy, unimpaired human ear can detect. Sound levels in decibels are calculated on a logarithmic basis. An increase of 10 dB represents a 10-fold increase in acoustic energy, while 20 dB is 100 times more intense, 30 dB is 1,000 times more intense, etc. A relationship exists between the subjective noisiness or loudness of a sound and its intensity. Each 10-dB increase in sound level is perceived as approximately a doubling of loudness over a fairly wide range of intensities.

Several methods are used to characterize sound. The most common is the A-weighted sound level, or dBA. This scale gives greater weight to the frequencies of sound to which the human ear is most sensitive. Because sound levels can vary markedly over a short period of time, a method for describing either the average character of the sound or the statistical behavior of the variations must be utilized. Most commonly, sounds are described in terms of an average level that has the same acoustical energy as the summation of all the time-varying events. This energy-equivalent sound/noise descriptor is called L_{eq}. The most common averaging period is hourly, but L_{eq} can describe any series of noise events of arbitrary duration.

Because the sensitivity to noise increases during the evening and at night—excessive noise interferes with the ability to sleep—24-hour descriptors have been developed that incorporate artificial noise penalties added to quiet-time noise events. The Community Noise Equivalent Level (CNEL) is a measure of the cumulative noise exposure in a community, with a 5-dB penalty added to evening (7:00 pm to 10:00 pm) and a 10-dB addition to nocturnal (10:00 pm to 7:00 am) noise levels. The day/night average sound level (L_{dn}) is essentially the same as CNEL, with the exception that the evening time period is dropped and all occurrences during this 3-hour period are grouped into the daytime period.

Noise changes both in level and frequency spectrums as it travels from the source to the receiver. The most obvious is the decrease in noise as the distance from the source increases. The manner in which noise is reduced depends on a variety of factors, including the noise source type as well as the region over which the noise source propagates. Noise generated by a point source, such as equipment at a construction site, drops off at a rate of 6 dBA per doubling of distance. Traffic noise attenuates, or is reduced, at a different rate. The movement of vehicles makes the noise source appear to emanate from a line as opposed to a single point when viewed over a period of time. Noise levels drop-off at a rate of about 3 dBA per doubling of distance for this type of source near hard surfaces, such as paved areas or bodies of water. However, ground type also plays into how much of a drop off over distance will occur. Surfaces, such as plowed fields, crops, or grass, absorb some of the sound energy as the sound passes over; therefore, noise is reduced by 4.5 dBA for every doubling of the distance in such areas.

12.1.2 Community Noise Levels

Community noise levels depend on the intensity of nearby human activity. Noise levels are generally considered low when ambient levels are below 45 dBA, moderate in the 45- to 60-dBA range, and high above 60 dBA. In rural and undeveloped areas, L_{dn} can fall below 35 dBA. Levels above 75 to 80 dBA are more common near major freeways and airports. Although people often accept the higher levels associated with very noisy urban areas, they nevertheless are considered to be adverse to public health.

Typical noise levels from both mobile and stationary sources are included in Table 12-1.

Table 12-1 Typical Stationary and Mobile Noise Source Sound Levels in dBA

Noise Source	Sound Level in dBA
Sprayer, hand-held	**10-20**
Noise at ear level from rustling leaves	20
Room in a quiet dwelling at midnight	32
Soft whisper at 5 feet	34
Large department store	50 to 65
Room with window air conditioner	55
Leaf blower/vac	**55-105**
Conversational speech	60 to 75
Pump station equipment with noise abatement	62
Sprayer, powered, truck- or trailer-mounted	**65-105**
Passenger car at 50 feet	69
Vacuum cleaner in private home at 10 feet	69
Tractor, agricultural	**76-110**
Ringing alarm at 2 feet	80
Brush/weed cutter	**90-97**
Roof-top air conditioner	85
Small bulldozer (Cat D3) or excavator (Cat 320)	**74-80**
Heavy bulldozer at 50 feet	87
All-terrain vehicle (ATV)	87-109
Heavy city traffic	90
Lawn mower	**91-98**
Chain saw	**100-120**
Jet aircraft at 500 feet overhead	115
Human pain threshold	120
Construction blast	120 to 145 at 50 feet

Sources: Equipment manufacturer specification sheets, Noise Control Reference Handbook, Industrial Acoustics Company

Note:

Bold indicates equipment used in the Program.

12.1.3 Noise Level Acceptance Criteria

The surrounding land uses dictate what noise levels would be considered acceptable or unacceptable. In rural and undeveloped areas away from roads and other human activity, the day-to-night difference is normally small. Because of diurnal activity, nighttime ambient levels in urban environments are about 7 dB lower than the corresponding daytime levels. Nighttime noise is a concern because of the likelihood of disrupting sleep. Noise levels above 45 dBA at night can result in the onset of sleep interference. At 70 dBA, sleep interference effects become considerable (USEPA 1974).

12.1.4 Sensitive Receptors

Some land uses are generally regarded as being more sensitive to noise than others due to the types of population groups or activities involved. The definition of sensitive receptors varies by jurisdiction, but in general sensitive population groups include children and the elderly and sensitive land uses include residential (single- and multifamily, mobile homes, dormitories, and similar uses), guest lodging, parks and outdoor recreation areas, hospitals, nursing homes and other long-term medical care facilities, and educational facilities, including schools, libraries, churches, and places of public assembly.

12.1.5 Regulatory Setting

Federal and state guidelines and local ordinances, plans, and regulations pertaining to environmental noise within the nine-county Program Area are cited in this section. In addition, a representative selection of counties and cities throughout California that may be potentially treated is cited.

12.1.5.1 Federal Regulations

The federal noise standards or guidelines discussed in this section are relevant to the implementation of Program components. Noise regulations and standards are provided for the following agencies:

> USEPA

> Federal Aviation Administration (FAA)

12.1.5.1.1 US Environmental Protection Agency

The USEPA has developed guidelines on recommended maximum long-term noise levels to protect public health and welfare (USEPA 1974). The USEPA does not enforce these guidelines, but rather offers them as a planning tool for state and local agencies. Table 12-2 provides examples of protective noise levels recommended by the USEPA. They are applicable to noise generated on federal lands, such as national wildlife refuges.

Table 12-2 USEPA-Designated Long-Term Noise Safety Levels

Effects	Noise Level	Area
Hearing Loss	$L_{eq}(24) < 70$ dB	All areas
Outdoor Activity Interference and Annoyance	$L_{dn} < 55$ dB	Outdoors in residential areas and farms and other outdoor areas where people spend widely varying amounts of time and other places in which quiet is a basis for use.
	L_{eq} (24) <55 dB	Outdoor areas where people spend limited amounts of time, such as schoolyards, playgrounds, etc.
	$L_{dn} < 45$ dB	Indoor residential areas

Table 12-2 USEPA-Designated Long-Term Noise Safety Levels

Effects	Noise Level	Area
Indoor Activity Interference and Annoyance	$L_{eq}(24) < 45$ dB	Other indoor areas with human activities such as schools, etc.

Source: USEPA 1974

Notes:

L_{eq} (24) = sound energy averaged over a 24-hour period.

L_{dn} = L_{eq} with a 10-dB nighttime weighting.

12.1.5.1.2 Federal Aviation Administration

The major parts of CFR Title 14: Aeronautics and Space, Chapter I: Federal Aviation Administration, Department of Transportation, Subchapter C, for fixed-wing aircraft noise and Subchapter H for helicopter noise, were reviewed for applicability to Program flight operations, specifically:

Part 91: Flight Operations

Portions of Part 91 are provided to describe operational restrictions associated with different aircraft types. Altitude limitations governing agricultural operations are given in Part 137, Agricultural Operations. They are included because the FAA considers aerial spraying to be an agricultural use, even if it is not specifically used for agricultural purposes.

Fixed-wing aircraft not operating under Instrument Flight Rules, emergencies, during takeoff or landing, or Part 137 are required to maintain the altitudes listed in Section 91.119 - Minimum Safe Altitudes: General (a)-(d). Section 91.119 (a), (b), and (c) are provided below.

Except when necessary for takeoff or landing, no person may operate an aircraft below the following altitudes:

(a) *Anywhere*. An altitude allowing, if a power unit fails, an emergency landing without undue hazard to persons or property on the surface.

(b) *Over congested areas*. Over any congested area of a city, town, or settlement, or over any open air assembly of persons, an altitude of 1,000 feet above the highest obstacle within a horizontal radius of 2,000 feet of the aircraft.

(c) *Over other than congested areas*. An altitude of 500 feet above the surface, except over open water or sparsely populated areas. In those cases, the aircraft may not be operated closer than 500 feet to any person, vessel, vehicle, or structure.

<u>Section 137.49 – Operations over other than Congested Areas</u>

Notwithstanding Part 91 of this chapter, during the actual dispensing operation, including approaches, departures, and turnarounds reasonably necessary for the operation, an aircraft may be operated over other than congested areas below 500 feet above the surface and closer than 500 feet to persons, vessels, vehicles, and structures, if the operations are conducted without creating a hazard to persons or property on the surface.

<u>Section 137.51 – Operation over Congested Areas: General</u>

(a) Notwithstanding Part 91 of this chapter, an aircraft may be operated over a congested area at altitudes required for the proper accomplishment of the agricultural aircraft operation if the operation is conducted:

(1) With the maximum safety to persons and property on the surface, consistent with the operation, and

(2) In accordance with the requirements of paragraph (i) of this section

(i) No person may operate an aircraft over a congested area except in accordance with the requirements of this paragraph.

(3) Prior written approval must be obtained from the appropriate official or governing body of the political subdivision over which the operations are conducted.

(4) Notice of the intended operation must be given to the public by some effective means, such as daily newspapers, radio, television, or door-to-door notice.

(5) A plan for each complete operation must be submitted to, and approved by appropriate personnel of the FAA Flight Standards District Office having jurisdiction over the area where the operation is to be conducted. The plan must include consideration of obstructions to flight, the emergency landing capabilities of the aircraft to be used, and any necessary coordination with air traffic control.

(6) Single engine aircraft must be operated as follows:

(i) Except for helicopters, no person may take off a loaded aircraft, or make a turnaround over a congested area.

(ii) No person may operate an aircraft over a congested area below the altitudes prescribed in Part 91 of this chapter except during the actual dispensing operation, including the approaches and departures necessary for that operation.

(iii) No person may operate an aircraft over a congested area during the actual dispensing operation, including the approaches and departures for that operation, unless it is operated in a pattern and at such an altitude that the aircraft can land, in an emergency, without endangering persons or property on the surface.

(7) Multiengine aircraft must be operated as follows:

(i) No person may take off a multiengine airplane over a congested area except under conditions that will allow the airplane to be brought to a safe stop within the effective length of the runway from any point on takeoff up to the time of attaining, with all engines operating at normal takeoff power, 105 percent of the minimum control speed with the critical engine inoperative in the takeoff configuration or 115 percent of the power-off stall speed in the takeoff configuration, whichever is greater, as shown by the accelerate stop distance data. In applying this requirement, takeoff data is based upon still-air conditions, and no correction is made for any uphill gradient of 1 percent or less when the percentage is measured as the difference between elevations at the end points of the runway divided by the total length. For uphill gradients greater than 1 percent, the effective takeoff length of the runway is reduced 20 percent for each 1 percent grade.

(ii) No person may operate a multiengine airplane at a weight greater than the weight that, with the critical engine inoperative, would permit a rate of climb of at least 50 feet per minute at an altitude of at least 1,000 feet above the elevation of the highest ground or obstruction within the area to be worked or at an altitude of 5,000 feet, whichever is higher. For the purposes of this subdivision, it is assumed that the propeller of the inoperative engine is in the minimum drag position, that the wing flaps and landing gear are in the most favorable positions, and that the remaining engine or engines are operating at the maximum continuous power available.

(iii) No person may operate any multiengine aircraft over a congested area below the altitudes prescribed in Part 91 of this chapter except during the actual dispensing operation, including the approaches, departures, and turnarounds necessary for that operation.

Section 137.53 – Operation over Congested Areas: Pilots and Aircraft

(a) General. No person may operate an aircraft over a congested area except in accordance with the pilot and aircraft rules of this section.

(b) Pilots. Each pilot in command must have at least:

(1) 25 hours of pilot-in-command flight time in the make and basic model of the aircraft, at least 10 hours of which must have been acquired within the preceding 12 calendar months.

(2) 100 hours of flight experience as pilot in command in dispensing agricultural materials or chemicals.

(c) Aircraft

(1) Each aircraft must:

(i) If it is an aircraft not specified in paragraph (c)(1)(ii) of this section, have had within the preceding 100 hours of time in service a 100-hour or annual inspection by a person authorized by Part 65 or 145 of this chapter, or have been inspected under a progressive inspection system.

(ii) If it is a large or turbine-powered multiengine civil airplane of U.S. registry, have been inspected in accordance with the applicable inspection program requirements of Section 91.409 of this chapter.

(2) If other than a helicopter, it must be equipped with a device capable of jettisoning at least one-half of the aircraft's maximum authorized load of agricultural material within 45 seconds. If the aircraft is equipped with a device for releasing the tank or hopper as a unit, there must be a means to prevent inadvertent release by the pilot or other crewmember.

12.1.5.2 State Regulations

California Government Code Section 65302(f) encourages each local government entity to conduct noise studies and implement a noise element as part of its General Plans. In addition, the California Office of Planning and Research published guidelines for evaluating the compatibility of various land uses as a function of community exposure to permanent or long-term noise sources, and they are listed in Table 12-3. In general, noise levels less than 60-dBA L_{dn} are acceptable for all land uses, including residences, schools, and other noise-sensitive receptors.

Table 12-3 Land Use Compatibility for Community Noise Environment

Land Use Category	Community Noise Exposure – L_{dn} or CNEL in dBA													
	50		55		60		65		70		75		80	
Residential – Low-Density Single Family, Duplex, Mobile Home														
Residential – Multifamily														
Transient Lodging – Motel, Hotel														
Schools, Libraries, Churches, Hospitals, Nursing Homes														
Auditorium, Concert Hall, Amphitheaters														
Sports Arena, Outdoor Spectator Sports														
Playgrounds, Neighborhood Parks														
Golf Courses, Riding Stables, Water Recreation, Cemeteries														
Office Buildings, Business Commercial and Professional														
Industrial, Manufacturing, Utilities, Agriculture														

Legend

	Normally Acceptable: Specified land use is satisfactory, based upon the assumption that any buildings involved are of normal conventional construction, without any special noise insulation requirements.
	Conditionally Acceptable: New construction or development should be undertaken only after a detailed analysis of the noise reduction requirements is made and needed noise insulation features are included in the design.
	Normally Unacceptable: New construction or development should be discouraged. If new construction or development does proceed, a detailed analysis of the noise reduction requirement must be made and needed noise insulation features included in the design.
	Clearly Unacceptable: New construction or development generally should not be undertaken.

Source: State of California 1998

CNEL = Community Noise Equivalent Level

dBA = A-weighted decibel(s)

L_{dn} = Day-Night Noise Level

12.1.5.3 Local Regulations

A listing of local plans and noise ordinances for selected localities within each of the nine Districts is included in Appendix D. Cities and counties in California are required to include a noise element in their general plans, which include policies intended to achieve noise compatibility between land uses. These policies typically establish average noise levels that are acceptable at different land uses and are usually the same as or similar to those recommended by the state (Table 12-3). Under the Santa Clara County General Plan Noise Compatibility Standards for Land Uses, "satisfactory" day-night noise levels are 65 dBA for commercial uses (non-hotel), 60 dBA for public or semi-public facilities, and 55 dBA or lower for residential uses.

The County has determined that certain noise levels and vibrations are detrimental to the public health, welfare and safety, and are contrary to public interest. To control unnecessary, excessive and annoying noise and vibration, the County has set standards in its Noise and Vibration Ordinance (Sec. B11-192: Exterior Noise Limits), including exterior noise limits. Under the ordinance, the following limits apply to mobile equipment on Monday through Saturday from 7 a.m. to 10 p.m.: 75 dBA for single-family residential, and 80 dBA for multiple-family residential, and 85 dBA for commercial land uses.

12.2 Environmental Evaluation

The noise evaluation is provided below. The evaluation qualitatively and quantitatively compares probable noise levels against regulatory standards

12.2.1 Evaluation Concerns and Criteria

The potential to exceed noise standards and result in substantial temporary noise levels above those existing (and without the Program equipment in use) within the Program Area are evaluated for each Program component.

Concerns raised during scoping include:

> Noise-related impacts on humans, in particular consistency with local noise regulations

> Noise-related impacts on wildlife

12.2.2 Evaluation Methods and Assumptions

The methodology and assumptions of this noise evaluation of Program components are provided below.

12.2.2.1 Methodology

The methodology used to prepare this programmatic noise evaluation is as follows:

> Reviewed transcripts from public scoping meetings held in 2012.

> Reviewed federal, state, and selected county and municipal noise regulations, plans, ordinances, and/or guidelines for general noise issues and issues related to Program-specific noise sources.

> Obtained source-specific noise data for Program-specific noise sources where available.

> Estimated noise levels for specific and categorical equipment types proposed for Program operations where specific noise data were not available at 50 feet and 400 feet from point of measure.

> Factored into the evaluation the implementation of the following BMPs (see Section 2.8.9) used by the District for operations that generate noise expected to be of concern to the public and which may exceed regulatory standards.

- Measure 1: Provide Advance Notices. A variety of measures are implemented depending on the nature/magnitude of the activities and the District involved, including press releases, social media, District websites, hand-delivered flyers, posted signs, emails, and phone alerts. Public agencies

and elected officials also may be notified of the nature and duration of the activities, including the local Board of Supervisors or City Council, environmental health and agricultural agencies, emergency service providers, and airports.

- Measure 2: Provide Mechanism to Address Complaints. The District staff is available during regular business hours to respond to service calls and may staff phone lines to address concerns during nighttime operations.
- Measure 3: Follow Established Procedures for Airboat Operations. Airboat operators are limited to certain areas and follow the guidelines established for those areas.

> Determined probable noise impacts associated with the components proposed in Chapter 2 based on the above significance thresholds. The evaluation is based on detailed information regarding equipment and vehicle types and usage, and land uses. Detailed information regarding the noise generated by each type of equipment and vehicles that would be used is shown in Appendix D, Tables 4-1 through 4-7.

12.2.3 Surveillance Component

The Surveillance component involves both ground surveillance and water surveillance. The number and type of vehicles and equipment required by the Santa Clara County Vector Control District are shown in Table 12-4, with ground surveillance requiring the periodic use of light trucks and ATVs in the vicinity of various land use types. Water surveillance requires the use of ATVs and, occasionally, boats and sprayers and most frequently occur in agricultural and open-space areas including wildlife refuges, where noise-sensitive human receptors are typically not located. Table 12-4 also shows the range of noise levels that vehicles and equipment typically would generate at 50- and 400-foot distances from the source. As indicated, noise attenuates, or is reduced, rapidly as the distance from the noise source increases. Detailed information regarding the average number of hours per day and the number of days in a quarter that equipment and vehicles would be used is included in Appendix D. Most equipment would only be operated a few hours per day for varying periods of time throughout the year.

Table 12-4 Surveillance Component–Primary Equipment Use, Noise Levels, and Land Use Types

Activity	Application Equipment	Predicted Noise Level (dBA)		Land Use Types				
		50 feet	400 feet	Residential	Commercial	Industrial	Agricultural	Open Space
Ground Surveillance & Application/Mgt	Light trucks	83	65	●	●	●		●
Water Surveillance & Applications/Mgt	ATVs	87	69					●

12.2.3.1 Exceedance of Noise Standards

As discussed in Section 12.1.5.3, many jurisdictions specifically exempt activities intended to protect public health and safety, such as those implemented under the Program, from their noise standards. Other noise standards address either temporary construction noise or long-term or permanent noise sources, which are not relevant to the types of activities implemented as part of this Program. Some jurisdictions include provisions for brief periods of noise that exceed their land use compatibility standards, which are based on average daily noise levels, such as L_{dn} or CNEL. Noise from this component is periodic, limited to brief periods of time spread out over multiple days in multiple locations, minimizing the amount of time any sensitive receptor was exposed to increased noise. The noise levels shown in Table 12-4 represent those that are generated while the equipment or vehicles are operating, and they do not operate constantly; thus, daily average noise levels are considerably lower. Noise from light trucks do not exceed the long-term land use compatibility guidelines at nearby sensitive receptors because a limited number of vehicles would be used; any change to the average noise level are not perceptible because it takes a doubling of trips to increase noise levels by only 3 dBA. ATVs and other equipment are used primarily in agricultural and open-space areas, as well as industrial areas. Therefore, usage of this equipment is more likely to be at least 400 feet away from residential uses and well below the noise limit of 75 dBA under the County's noise ordinance. Agricultural and open-space areas are not typically considered noise-sensitive. Although certain types of open-space areas may have increased sensitivity to noise, such as those used by recreational users seeking quiet, given the temporary, sporadic increase in noise at any given location, noise from the Surveillance component does not exceed regulatory standards.

12.2.3.2 Substantial Temporary Increase in Noise Levels

Noise from the use of light trucks generally are not be distinguishable from ambient noise levels because it takes a doubling of traffic to increase noise levels by only 3 dB. The types of light trucks that are used (e.g., pickup trucks and jeeps) are common, and a limited number of vehicles are used and dispersed over a large area. Water surveillance activities occur in agricultural and open-space areas, not in proximity to noise sensitive receptors; moreover, limited numbers of equipment and vehicles are used for brief periods of time over a large area. Given the sporadic use of vehicles and equipment and the limited duration that they are used in any given location, noise levels are not increase by 3- to 5-dBA CNEL in proximity to noise-sensitive receptors. In addition, BMPs are implemented as appropriate by providing advance notification of noise-generating activities expected to be of concern to the public and providing a means for registering public complaints about noise, thus further minimizing the potential for public annoyance. Airboats also are required to operate only in certain areas, as allowed by the land management agencies, minimizing the potential for impacts in other areas.

12.2.4 Physical Control Component

The Physical Control component involves a variety of actions, some of which do not directly result in noise generated by the District; they include educating and advising landowners regarding appropriate methods to control vectors such as rats and mosquitoes. Other activities require the implementation of maintenance activities within marshes and wetlands, which typically are in undeveloped areas and not in proximity to noise-sensitive receptors. Other activities take place in more urban areas, such as those including localized vegetation management associated with wastewater treatment facilities. These activities typically involve the use of light trucks, as shown in Table 12-5. Table 12-5 also shows the range of noise levels that they typically would generate at 50- and 400-foot distances from the source. This table also shows the land use types where activities occur.

Table 12-5 Physical Control Component–Primary Equipment Use, Noise Levels, and Land Use Types

Activity	Application Equipment	Predicted Noise Level (dBA)		Land Use Types				
		50 feet	400 feet	Residential	Commercial	Industrial	Agricultural	Open Space
Ground Surveillance & Application/Mgt	Light trucks	83	65	●	●	●		●

12.2.4.1 Exceedance of Noise Standards

The discussion under the Surveillance component is generally applicable to the Physical Control component because similar types of vehicles and equipment would be used, or they generate similar amounts of noise and are used for a similar length of time. Noise generated by the Physical Control component does not exceed noise standards due to the sporadic, temporary nature of these.

12.2.4.2 Substantial Temporary Increase in Noise Levels

The discussion under the Surveillance component is generally applicable to the Physical Control component because similar types of vehicles and equipment are used, or they generate similar amounts of noise are used for a similar length of time. In addition, BMPs are implemented as appropriate by providing advance notification of noise-generating activities expected to be of concern to the public based on past complaints and providing a means for registering public complaints about noise, thus further minimizing the potential for public annoyance.

12.2.5 Vegetation Management Component

Certain elements of the Vegetation Management component would not directly generate noise, such as teaching landowners how to perform vegetation management on their property. At other times, District staff periodically would undertake vegetation management activities, which require the use of hand tools or other mechanical means (i.e., heavy equipment) for vegetation removal or thinning to improve surveillance or reduce vector habitats. Vegetation removal or thinning primarily occurs in aquatic habitats to assist with the control of mosquitoes and in terrestrial habitats to help with the control of other vectors. To reduce the potential for mosquito breeding associated with water retention and infiltration structures, District staff may systematically clear weeds and other obstructing vegetation in wetlands and retention basins (or request the structures' owners to perform this task). District "brushing" activities rely almost entirely on hand tools.

12.2.5.1 Exceedance of Noise Standards

District vegetation management activities rely almost entirely on hand tools. It does not use motorized equipment that would emit substantially higher sound levels. Use of equipment and vehicles increases noise levels during operations, but this increase does not exceed regulatory thresholds.

12.2.5.2 Substantial Temporary Increase in Noise Levels

Because the District does not use motorized equipment as part of the Vegetation Management component, Noise generated would not result in a substantial temporary increase in noise levels.

12.2.6 Biological Control Component

The Biological Control component involves the use of mosquito pathogens, parasites, and predators (i.e., mosquitofish). The parasites are not commercially available at present. The other options would generate noise, from the periodic use of light trucks (for distribution of mosquitofish at artificial water bodies only), and occasionally, ATVs, boats, tractors, and sprayers (for the pathogens which are discussed under the Chemical Control component for most resources). Examples of bacteria pathogenic to mosquitoes are Bs, the several strains of Bti, and *Saacharopolyspora spinosa*.(or spinosad).

The types of used by the District are shown in Table 12-7, which also shows the range of noise levels that they typically would generate at 50- and 400-foot distances from the source and the land uses that would be affected.

Table 12-7 Biological Control –Primary Equipment Use, Noise Levels, and Land Use Types

Activity	Application Equipment	Predicted Noise Level (dBA)			Land Use Types				
		50 feet	400 feet	500 feet	Residential	Commercial	Industrial	Agricultural	Open Space
Ground Surveillance & Application/Mgt	Light trucks	83	65	—	●	●	●		●
Water Surveillance & Applications/Mgt	Tractor	76	58	—	●		●		●

12.2.6.1 Exceedance of Noise Standards

The discussion under the Surveillance component is generally applicable to the Biological Control component because similar types of vehicles and equipment are used, or have similar noise levels and also are used for brief periods of time over multiple locations

12.2.6.2 Substantial Temporary Increase in Noise Levels

The discussion under the Surveillance component generally is applicable to the Biological Control component because similar types of vehicles and equipment are used, or they have similar noise levels and also are used for brief periods of time over multiple locations.

12.2.7 Chemical Control Component

A variety of activities would be implemented under the Chemical Control component. Some activities, such as baiting, would not result in noise, other than from the use of vehicles to access the bait treatment sites. Others would require more extensive use of vehicles and equipment.

The District would use a variety of techniques and equipment to apply mosquito larvicides, including hand-held sprayers, backpack sprayers and blowers, truck- or ATV-mounted spray rigs, and helicopters or other aircraft. The District uses conventional pickup trucks and ATVs as larvicide vehicles. Equipment used in ground applications of liquid formulations include hand-held sprayers (handcans or spray bottles), and backpack sprayers and blowers. Hand-held sprayers (handcans) are standard 1- or 2- or 3-gallon garden style pump-up sprayers used to treat very small isolated areas. Backpack sprayers are either hand pump-up for liquid applications and have a 2.5/3 to 5-gallon tank or are gas powered. When large areas are

simultaneously producing mosquito larvae at densities exceeding District treatment thresholds, then the District may use helicopters or other aircraft to apply larvicides. Aerial application of larvicides is a relatively infrequent activity for the Districts, typically occurring only a few times each year/once every few years, with each application covering around 200 to 1200 acres. Aerial application of liquid larvicides typically occurs during daylight hours and at an altitude above the treatment site of less than 40 feet. Granular applications would occur during daylight hours at a less-than-50-foot altitude.

The most common form of adulticide application is via insecticide aerosols at very low dosages using ULV- equipment mounted on trucks, ATVs, golf carts, and boats or hand-held for ground applications. Barrier or residual treatments for adult mosquitoes consist of an application using a material generally applied with a compressed air sprayer to the preferred foliage, buildings, or resting areas of the mosquito species.

Aerial applications using helicopters and fixed-wing aircraft are used to obtain effective control in areas bordered by extensive mosquito production sites or with small, narrow, or inaccessible network of roads. The flight parameters differ by program and technique. Some operations fly during hours of daylight so their applications begin either at morning's first light or before sunset and work into twilight. The aircraft can be flown at a less than 200-foot altitude, which may make it easier to hit the target area. Other operations may be conducted in the dark of the night, typically after twilight or early in the morning before dawn. The aircraft typically are flown between 200- and 300-foot altitudes. Swath widths vary from operation to operation but are normally set somewhere between 400 and -1,200 feet. Aerial applications may be conducted over, but are not limited to, the following land uses within the Program Area: salt marsh, diked marsh, seasonal wetlands; evaporation ponds and wastewater ponds; and agricultural, residential, commercial, industrial, and recreational areas.

Table 12-8 shows the type of vehicles and equipment and range of noise levels that they typically would generate at 50- and 400-foot distances from the source and the land uses that would be affected. Noise from helicopters also is shown at a 500-foot distance. All land use types potentially could be treated through aerial applications, although those shown are the most likely to be affected.

Table 12-8 Chemical Control Component–Primary Equipment Use, Noise Levels, and Land Use Types

		Predicted Noise Level (dBA)[a]			Land Use Types				
Activity	**Application Equipment**	**50 feet**	**400 feet**	**500 feet**	**Residential**	**Commercial**	**Industrial**	**Agricultural**	**Open Space**
Ground Surveillance & Application/Mgt	Light trucks	83	65	—	●	●	●		●
Water Surveillance & Applications/Mgt	ATVs	87	69	—					●
	Tractor	76	58	—	●		●		●
Aerial Applications*	Helicopter/Fixed Aircraft			84-87					●

Notes:

[a] Noise from fixed wing aircraft used for agricultural operations, such as those expected to be used for aerial applications, is not regulated by the FAA and, therefore, no noise information is available. Noise likely would be comparable to that of helicopters.

12.2.7.1 Exceedance of Noise Standards

The discussions under the Surveillance component and Biological Control component are generally applicable to the Chemical Control component because similar types of vehicles and equipment would be used, or they would have comparable noise levels and also would be used for brief periods of time over multiple locations. Helicopters or fixed-wing aircraft are used under this component; they are used only briefly in any given area and generally operate in open-space or agricultural areas, although other land use types could be affected as well. Use of equipment, vehicles, and helicopters increases noise levels during operations, but this increase does not exceed regulatory thresholds.

12.2.7.2 Substantial Temporary Increase in Noise Levels

The discussions under the Surveillance component and Biological Control component are generally applicable to the Chemical Control component because similar types of vehicles and equipment would be used, or they would have similar noise levels and also would be used for brief periods of time over multiple locations. As discussed in the preceding section, helicopters/fixed-wing aircraft also would be used, but only for brief periods up to several times a year, and they would affect any given area only briefly. In addition, BMPs are implemented as appropriate by providing advance notification of noise-generating activities expected to be of concern to the public and providing a means for registering public complaints about noise, thus further minimizing the potential for public annoyance.

12.2.8 Other Nonchemical Control/Trapping Component

This component primarily includes the trapping of rodents and/or yellowjackets that pose a threat to public health and welfare. The District does not use motorized vehicles or equipment to conduct these activities.

12.2.8.1 Exceedance of Noise Standards

The District does not use motorized vehicles or equipment that would emit substantially higher sound levels. Noise generated does not exceed noise standards.

12.2.8.2 Substantial Temporary Increase in Noise Levels

The District does not use motorized vehicles or equipment that would emit substantially higher sound levels. Noise generated does not result in a substantial temporary increase in noise levels.

13 List of Preparers

The following personnel were directly involved in preparation of the Environmental Evaluation:

Santa Clara County Vector Control District

Russell Parman, District Manager

Noor Tietze, Project Manager/Scientific-Technical Services Manager

Arika Owens, Management Analyst

Santa Clara County Department of Planning and Development

David Rader, Senior Environmental Planner

13.1 Consultant Team

Technical and support personnel from Cardno ENTRIX and the entire consultant team that were involved in technical analyses and document preparation are listed in Table 16-1.

Table 16-1 Technical and Support Personnel

Preparers	Degree(s) Years of Experience	Role in Preparation	Experience and Expertise
Cardno ENTRIX			
Hootkins, Susan	MUP, Urban and Regional Planning BA, Human Biology 39 years	Project Manager	> Environmental Planning > Socioeconomics
Bonin, Adam	PhD, Environmental Science & Resources BS, Environmental Management 18 years	Ecological Hazard Assessment; Human Health Hazard Assessment	> Environmental Microbiology > Ecological Risk Assessment > Environmental Chemistry > Quality Assurance/Quality Control Chemistry
Boyes, Brad	MBA, Project Management BS, Environmental Engineering 33 years	Air Quality Climate Change	> Air Quality > Climate Change / GHGs > Health Risk Assessments > Risk Management Plans > Environmental Site Assessment
Brice, Doug	BS, Geography: Emphasis on GIS and Environmental Planning 20 years	GIS Coordinator	> GIS Systems > Field/Data Collection > Geospatial Application Development > Environmental Planning
Butler, Karen	27 years	Production Specialist	> Production Support

Preparers	Degree(s) Years of Experience	Role in Preparation	Experience and Expertise
Clare, Anna	MA, Geography BS, Geographic Information System 6 years	GIS Analyst	> GIS System > Environmental Analysis > Physical Geography > Cartographic Research
Dillon, Reinhold	BA, History MA, Medieval History and Literature 30 years	Technical Editing Style Guide	> Technical Editing > Language Control
Eschen, Iris	35 years	Production Manager	> Production management and coordination, word processing, desktop publishing
Floyd, Emily	PhD, Ecology BA, Marine Science 11 years	Aquatic Ecology	> Aquatic Ecology > Fish Physiology > Ecotoxicology > Habitat Alteration
Knaapen, Anthony	BA, General Biology 2 years	Staff Scientist	> Public Scoping > Technical Support
Koppel, Emily	MS, Biology BS, Fisheries & Wildlife 8 years	Toxicity Assessment Aquatic Ecology	> Parasite and Disease Ecology > Marine Biology > Terrestrial Ecology > Environmental Toxicology
Lebednik, Gretchen	MS, Botany BA, Environmental Biology 25 years	Terrestrial Ecology	> Vegetation Ecology > Habitat Restoration > Rare plant Surveys > Wetland Delineation > Riparian Vegetation assessment
Lee, Michele	MS, Wildland Resource Science BA, Psychology 15 years	Terrestrial Ecology	> Vegetation Ecology > Habitat Restoration > Rare plant Surveys > Wetland Delineation > Riparian Vegetation assessment > Public Services and Hazards
Pavich, Steve	MS, Agricultural and Resource Economics BA, Economics 11 Years	Urban and Rural Land Use	> Socioeconomics > Resource Economics > Recreation > Land use planning

Preparers	Degree(s) Years of Experience	Role in Preparation	Experience and Expertise
Thompson, Tim	MS, Geological Sciences BS, Geological Sciences 27 years	Water Resources	> Water Resource Science > Regulatory Issues
Williams, Bill	PhD, Physiology and Biophysics MS, Physiology and Biophysics BA, Physiology and Biophysics 33 years	Ecological Hazard Assessment Task Leader; Human Health Hazard Assessment Task Leader; Terrestrial Biology	> Ecological and Human Health Risk Assessments > Natural Resource Damage Assessments > Pesticide Regulation > Toxicology
Wise, Larry	MA, Marine Biology BS, Marine Biology and Limnology 23 years	Aquatic Biology Aquatic Ecology	> Ecology of Freshwater, Estuarine, and Marine Systems
Woodman, Lorraine	PhD, Anthropology MA, Anthropology BA, Anthropology 29 years	Noise Analysis	> Habitat Conservation
URS Corporation			
Cooke, Terry	MS, Marine Sciences BA, Chemistry 32 years	Water Resources	> TMDLs / Water Quality > Stormwater Management > NPDES Permitting
de Berry, Bonnie	MFS, Aquatic Chemistry BS, Natural Resources and Environmental Sciences 15 years	Water Resources	> Water Quality > Hydrology > Stormwater Management > Wetland Mitigation > NPDES Permitting
Nielsen, Elizabeth	MS, Environmental Engineering BS, Biology 12 years	Water Resources	> Water Quality > Ecological Risk Assessment > NPDES Permitting
Grant Visual Technology			
Grant, Douglas	BS, Geological Sciences 22 years	Noise	> Geology > Engineering Design > Acoustical Modeling
Somach Simmons and Dunn			
Taber, Kelley	JD Major AB, East Asian Studies State Bar of CA, 1996 18 years	Environmental Compliance	> Legal Support > Water quality focus > CDFA consultant team

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