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6 Ecological Health

This chapter evaluates the potential impacts of the Program alternatives on ecological health. The impact analysis relies heavily on Appendix B, Ecological and Human Health Assessment Report. Results of the evaluation are provided at the programmatic level. Section 6.1, Environmental Setting, presents an overview of hazards, toxicity, and exposure concepts, and contains federal, state, and local ordinances and regulations that are applicable to the Districts. Section 6.2, Environmental Impacts and Consequences, presents the following:

- Environmental concerns and evaluation criteria: A discussion of whether the Program alternatives would cause any potentially adverse impacts to ecological health
- Discussion of methods and assumptions
- Discussion of potential impacts of the Program alternatives and recommendations for mitigation, if required, for those impacts
- Cumulative impacts summary
- A summary of estimated ecological impacts

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 alternatives. Chapters 4 and 5 provide evaluations of the potential impacts 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 impacts related to the Program alternatives.

6.1 Environmental Setting

The Program Area is defined as the Alameda County Mosquito Abatement District which includes Alameda County and the adjacent counties of Contra Costa, San Joaquin, Stanislaus, and Santa Clara. The Program Area is impacted by unwanted mosquitoes that must be controlled to minimize adverse effects, disease, and environmental impacts. 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 in the Environmental Setting

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 (lowest observed adverse effects level or 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 effects level or 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 impact 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.

Although laboratory toxicity testing focuses on tiered concentrations of chemical exposure, the results of these tests produce a series of toxicity estimates of concentrations less than those that produce mortality. Extrapolation of these data is used to generate estimates of chronic toxicity or possible effects of lower doses that may result in sublethal effects such as reproduction or metabolic changes. In reality, these low-dose exposures need to be sustained over longer periods than are relevant to typical application scenarios for vector control including multiple applications in an area such as a wetland.

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 alternatives.

6.1.2 Pesticides and the Environment

The pesticide and herbicide active ingredients included in the Program are listed in Table 6-1 and Table 6-2. Appendix B provides the results of review and evaluations of the active ingredients and adjuvants the District currently uses or proposes to use.

Table 6-1 Pesticide Options for Insect Abatement

Active Ingredient	Vector
Aliphatic Petroleum Hydrocarbons (Mineral Oil)	Mosquito
Biodegradable Alcohol Ethoxylated Surfactant	Mosquito
Bs	Mosquito
Bs and Bti	Mosquito
Bti	Mosquito
Deltamethrin	Mosquito/Yellow jacket wasp
Etofenprox	Mosquito
Etofenprox and Tetramethrin and PBO	Yellow jacket wasp
(S)-Methoprene	Mosquito
Naled	Mosquito
Permethrin and PBO	Mosquito
Permethrin and d-trans Allethrin	Yellow jacket wasp
Permethrin and Tetramethrin and PBO	Yellow jacket wasp
Phenothrin and d-trans Allethrin	Yellow jacket wasp
Prallethrin and Lambda-cyhalothrin	Yellow jacket wasp
Pyrethrin and PBO and Amorphous Silica Gel	Yellow jacket wasp
Pyrethrins and PBO	Mosquito
Resmethrin and PBO	Mosquito
Spinosad	Mosquito
Sumithrin (d-phenothrin) and PBO	Mosquito
Sumithrin (d-phenothrin) and Prallethrin and PBO	Mosquito
Temephos	Mosquito

Table 6-2 Herbicide Options for Weed Abatement

Active Ingredient	Vector
APEs / Butyl alcohol	Weed
APEs / Isopropanol	Weed
Glyphosate	Weed
Imazapyr	Weed
Methylated seed oil of Soybean	Weed
Modified Vegetable Oil	Weed
Polydimethylsiloxane	Weed
Polydimethylsiloxane & Silicon	Weed
Polymeric Colorant (proprietary)	Weed
Proprietary Colorant	Weed
Sulfometuron Methyl	Weed
Triclopyr	Weed

6.1.3 Regulatory Setting

Formulations proposed for each Program Alternative 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). Users of certain aquatic herbicides are required to obtain coverage under the Statewide General NPDES Permit for the Discharge of Aquatic Pesticides for Aquatic Weed Control in Waters of the US (SWRCB Water Quality Order No. 2004-0009-DWQ; NPDES No. CAG 990005; Aquatic Weed Control Permit). Pesticides and herbicides that require state NPDES permitting include Bti, Bs, temephos, spinosad, petroleum distillates, naled, pyrethrin, permethrin, resmethrin, prallethrin, PBO, etofenprox, glyphosate, imazapyr, and triclopyr. 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 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.

6.1.3.2.4 Stipulated Injunction and Order, Protection of California Red-Legged Frog from Pesticides

On October 20, 2006, the U.S. District Court for the Northern District of California imposed no-use buffer zones around California red-legged frog upland and aquatic habitats for certain pesticides. This injunction and order will remain in effect for each pesticide listed in the injunction until the USEPA goes through formal 7(A)(2) consultation with the USFWS on each of the 66 active ingredients, and the USFWS issues a Biological Opinion including a "not likely to adversely affect" statement for the pesticides. Under the injunction and order, no-use buffer zones of 60 feet for ground applications and 200 feet for aerial applications apply from the edge of the following California red-legged frog habitats as defined by the USFWS and the Center for Biological Diversity: Aquatic Feature, Aquatic Breeding Habitat, Nonbreeding Aquatic Habitat, and Upland Habitat. These habitats are found in 33 counties of California including Alameda County.

Of the 66 pesticides listed in the injunction, the District may employ methoprene, permethrin, and naled for mosquito control. Methoprene is used for larval mosquito control. Permethrin and naled may be used for adult mosquito control. However, mosquito control programs are exempt. Specifically, for applications of a pesticide for purposes of public health mosquito control under a program administered by a public entity, the injunction does not apply. The District may use the following herbicides listed in the injunction: glyphosate, imazapyr, and triclopyr. Where used for vegetation management for control of mosquito-breeding habitat, the injunction would not apply. If these herbicides were to be used for invasive species management to assist other agencies or landowners, then the injunction generally applies until such time that the material has been reviewed by USEPA and USFWS determines that it does not apply or the following “exceptions for invasive species and noxious weed programs” can be met:

a. You are applying a pesticide for purposes of controlling state-designated invasive species and noxious weeds under a program administered by a public entity; and
b. You do not apply the pesticide within 15 feet of aquatic breeding critical habitat or non-breeding aquatic critical habitat within critical habitat areas, or within 15 feet of aquatic features within non-critical habitat sections subject to the injunction; and
c. Application is limited to localized spot treatment using hand-held devices; and
d. Precipitation is not occurring or forecast to occur within 24 hours; and
e. You are a certified applicator or working under the direct supervision of a certified applicator; and
f. If using triclopyr, you are using only the amine formulations. (USEPA 2014a).

6.2 Environmental Impacts and Mitigation Measures

This section evaluates the potential ecological impacts from the Program Alternatives, which is primarily focused on the use of active ingredients in herbicides and/or pesticides under the Vegetation Management, Biological, and Chemical Control Alternatives.

6.2.1 Evaluation Concerns and Criteria

The public has requested that the PEIR evaluate the following issues and concerns related to ecological health, which were identified during the project public scoping, comments made during other District activities, and historical questions raised by individuals. These concerns are addressed briefly below and in this chapter. While not required, the responses to the concerns help to direct the reader to the appropriate section or an appendix, or they provide explanatory information in concise form.

g. What are the impacts associated with the Surveillance Alternative?

   > The impacts to ecological health are addressed briefly in Section 6.2.3. The question was meant to address CDFW’s concern that biological impacts be addressed by habitat type. This type of analysis was conducted for aquatic biology in Chapter 4 and for terrestrial biology in Chapter 5. The discussion herein is at a programmatic level for the broad issue of disturbance from people and equipment in conducting surveillance and monitoring activities.

h. 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 active ingredients and adjuvants is evaluated in Appendix B, and select pesticides are discussed in Section 6.2.7, including the potential impacts to nontarget ecological receptors associated with the major classes of active ingredients.

i. 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.

j. Discuss impacts on bees from chemicals in treatment applications.

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

k. 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 PEIR.

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

> As part of its IMMP, 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.

m. Concern that a 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.

n. 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.

o. 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 (and biomagnification) and effects of repeated exposures.

> The use, fate, and transport of each pesticide included in the Program are described in detail in Appendix B. Most products sold as herbicides and pesticides are evaluated both for the active ingredient and for the adjuvants and surfactants used to make the product more useful. When

multiple products are used in a control treatment, the impacts are weighed against the proximity and timing of each application. If products with an identical active ingredient are applied simultaneously, it is likely that the net effect could be the sum of the total active ingredient that is available for uptake. Although a synergy is possible in this scenario, it is typically not an approach used in or directed by the BMPs for that scenario. Because most pesticides and herbicides now in use have considerably less half-life (persistence) than earlier formulations, the overlap that would produce a residual exposure to a product would not occur unless the timing of applications is inappropriately close, i.e., hours rather than several days apart. Actual applications do not generally occur that close together. Many products can be evaluated for synergy and potential additive effects using the CDPR templates for calculation, which provide a means of estimating multiple chemicals and one application.

p. The PEIR should include monitoring programs that are designed to validate assumptions regarding the environmental fate and transport of materials.

> The Surveillance Alternative is described in Section 6.2.3. Mitigation and monitoring under CEQA is described in Section 6.2.11. Monitoring programs for chemical fate and transportation are beyond the scope of the PEIR and not needed based on information that suggests that the Program would not have a significant adverse effect. See Appendix B for fate and transport information on the materials considered for use under the District's IMMP. However, District staff will monitor sites post-treatment to determine if the target mosquitoes or weeds were effectively controlled with minimum effect to the environment and nontarget organisms. This information will be used to help design future treatment methods in the same season or future years to respond to changes in site conditions.

q. The PEIR should 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) and ensure CEQA requirements are met.

> Potential chemical control impacts are discussed in Section 6.2.7 and Appendix B. Potential impacts to sensitive aquatic and terrestrial species are discussed in Chapters 4 and 5, respectively.

r. The PEIR should 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) and ensure CEQA requirements are met.

> Potential biological control impacts are 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. Potential impacts to sensitive aquatic and terrestrial species are discussed in Chapters 4 and 5, respectively.

The CEQA Guidelines Appendix G, Environmental Checklist Form, does not contain criteria for determining significance of impacts to ecological health from the use of pesticides and herbicides. The closest criteria are those contained in Section 4.2.1.2 for biological resources. In short, the determination of significance is based on the potential to degrade the quality of the environment for natural communities and the species therein based on existing data and application methods. The specific concern is whether the activities used to control pest species could result in direct or indirect impacts to other organisms that may be present which are called nontarget ecological receptors.

6.2.2 Evaluation Methods and Assumptions

Pesticides the District uses or proposes to use 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 alternatives (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 and herbicide product use in the Program Area to support the potential exposure and toxicity assessment, including:

> Pesticides the District uses or proposes to use

> 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/IMM approaches and BMPs the District employs. BMPs are described in Chapter 2 (Table 2-6), and the most relevant BMPs for avoidance or minimization of impacts to ecological health, especially nontarget ecological receptors, are repeated below.

For all five Program alternatives, the District uses the following BMPs:

> District staff will implement site access selection criteria to minimize equipment use in sensitive habitats including active nesting areas and to use the proper vehicles for onroad and offroad conditions. (Table 2-6, BMP A9)

> Properly train all staff, contractors, and volunteer help to prevent spreading weeds and pests to other sites. The District headquarters contains wash rack facilities (including high-pressure washers) to regularly (in many cases daily) and thoroughly clean equipment to prevent the spread of weeds. (Table 2-6, BMP A10)

For four of the Program alternatives, excluding Biological Control's use of mosquitofish, the District uses the following BMPs:

> District staff will work with care and caution to minimize potential disturbance to wildlife while performing surveillance and vector treatment/population management activities. (Table 2-6, BMP A6)

> Identify probable (based on historical experience) treatment sites that may contain habitat for special status species every year prior to work to determine the potential presence of special status flora and fauna using the CNDDB, relevant HCPs, NOAA Fisheries and USFWS websites, CAlfish.org, and other biological information developed for other permits. Establish a buffer of reasonable distance, when feasible, from known special status species locations and do not allow application of pesticides/herbicides within this buffer without further agency consultations. Nonchemical methods are acceptable within the buffer zone when designed to avoid damage to any identified and documented flora and fauna. (Table 2-6, BMP A7)

> Vehicles driving on levees to travel through tidal marsh or to access sloughs or channels for surveillance or treatment activities will travel at speeds no greater than 10 miles per hour to minimize noise and dust disturbance. (Table 2-6, BMP A8)

> The District will minimize the use of equipment (e.g., ARGOs) in tidal marshes and wetlands. When feasible and appropriate, surveillance and control work will be performed on foot with handheld equipment. Aerial treatment (helicopter and fixed-wing) treatments will be used, when feasible and appropriate, to minimize the disturbance of the marsh during pesticide applications. When ATVs (e.g., ARGOs) are used, techniques will be employed that limit impacts to the marsh, including slow speeds; slow, several point turns; using existing levees or upland to travel through sites when possible; using existing pathways or limiting the number of travel pathways used. (Table 2-6, BMP B2)

> District will minimize travel along tidal channels and sloughs to reduce impacts to vegetation used as habitat (e.g., rail nesting and escape habitat). (Table 2-6, BMP B3)

> District staff will minimize the potential for the introduction and spread of spartina, perennial pepperweed, and other invasive plant species by cleaning all equipment, vehicles, personal gear, clothing, and boots of soil, seeds, and plant material prior to entering the marsh, and avoiding walking and driving through patches of perennial pepperweed to the maximum extent feasible. (Table 2-6, BMP B4)

For Vegetation Management and Chemical Control alternatives only, the following BMPs apply:

> District staff will conduct applications with strict adherence to product label directions that include approved application rates and methods, storage, transportation, mixing, and container disposal. (Table 2-6, BMP M1)

> District will avoid use of surfactants when possible in sites with aquatic nontargets or natural enemies of mosquitoes present such as nymphal damselflies and dragonflies, dytiscids, hydrophilids, corixids, notonectids, and ephydrids. Surfactants are the least preferred method but must be used with pupae to prevent adult mosquito emergence. The District will use a microbial larvicide (Bti, Bs) or insect growth regulator (e.g., methoprene) instead or another alternative when possible. (Table 2-6, BMP M2)

> Materials will be applied at the lowest effective concentration for a specific set of vectors and environmental conditions. Application rates will never exceed the maximum label application rate. (Table 2-6, BMP M3)

> To minimize application of pesticides, application of pesticides will be informed by surveillance and monitoring of mosquito populations. (Table 2-6, BMP M4)

> District staff will follow label requirements for storage, loading, and mixing of pesticides and herbicides. Handle all mixing and transferring of herbicides within a contained area. (Table 2-6, BMP M5)

> Postpone or cease application when predetermined weather parameters exceed product label specifications, when wind speeds exceed the velocity as stated on the product label, or when a high chance of rain is predicted and rain is determining factor on the label of the material to be applied. (Table 2-6, BMP M6)

> Applicators will remain aware of wind conditions prior to and during application events to minimize any possible unwanted drift to waterbodies, and other areas adjacent to the application areas.(Table 2-6, BMP M7)

> Clean containers at an approved site and dispose of at a legal dumpsite or recycle in accordance with manufacturer’s instructions if available. (Table 2-6, BMP M8)

> Special status Aquatic Wildlife Species (Table 2-6, BMP M9):

- A CNDDB search was conducted in 2012 and the results incorporated into Appendix A, Biological Resources Technical Report, for this PEIR. District staff communicates with state, federal, and county agencies regarding sites that have potential to support special status species. Staff has visited many sites where the District performs surveillance and control work for many years and staff is highly knowledgeable about the sites and habitat present. If new sites or site features are discovered that have potential habitat for special status species, the appropriate agency or landowner is contacted and communication initiated.
- Use only pesticides, herbicides, 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 suitable habitat for special status species is found, including vernal pools, and if aquatic-approved pesticides, herbicides, and adjuvants treatment methods have the potential for affecting the potential species, then the District will coordinate with the CDFW, USFWS, and/or 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 consultation.

> District staff will monitor sites post-treatment to determine if the target mosquito population or weeds were effectively controlled with minimum effect to the environment and nontarget organisms. This information will be used to help design future treatment methods in the same season or future years to respond to changes in site conditions. (Table 2-6, BMP M10)

> Do not apply pesticides that could affect insect pollinators in liquid or spray/fog forms over large areas (more than 0.25 acre) during the day when honeybees are present and active or when other pollinators are active. Preferred applications of these specific pesticides are to occur in areas with little or no honeybees or pollinator activity or after dark. These treatments may be applied over smaller areas (with handheld equipment), but the technician will first inspect the area for the presence of bees and other pollinators. If pollinators are present in substantial numbers, the treatment will be made at an alternative time when these pollinators are inactive or absent. (Table 2-6, BMP M11)

> The District will provide notification to the public (as soon as operationally possible) and/or appropriate agency(ies) when applying pesticides or herbicides for large-scale treatments that will occur in close proximity to homes, heavily populated, high traffic, and sensitive areas. The District infrequently applies or participates in the application of herbicides in areas other than District facilities. (Table 2-6, BMP M12)

> > Exercise adequate caution 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) will be reported to the Field Operations Supervisor and District Manager and recorded in the District safety and incident file. (Table 2-6, BMP N1)

Several BMPs in Table 2-6 apply just to the Physical Control Alternative. Key BMPs include the following for avoiding or minimizing impacts to ecological health:

> All maintenance work will be done at times that minimize adverse impacts to nesting birds, anadromous fish, and other species of concern, in consultation with USFWS, NMFS, and CDFW. Work conducted will, whenever possible, be conducted during approved in-water work periods for that habitat, considering the species likely to be present. For example, tidal marsh work will be conducted between September 1 and January 31, where possible, and not contraindicated by the presence of

other special status species. Similarly, in-water work in waterbodies that support anadromous fish will be conducted between July 1 and September 30. (Table 2-6, BMP L3)

> Care will be taken to minimize the risk of potential disruption to the indigenous aquatic life of a waterbody in which ditch maintenance is to take place, including those aquatic organisms that migrate through the area. (Table 2-6, BMP L4)

Each of the pesticides and herbicides 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(ies) would be applied in any given area. Criteria used to trigger a particular alternative based on mosquito 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.

Concerning the application of multiple chemical treatments in the same area, such as larvicides followed by adulticides, or the application of multiple pesticides at the same time in a specific area, the following information applies:

> Most products sold as herbicides and pesticides are evaluated herein both for the active ingredient and for the adjuvants and surfactants used to make the product more useful. When multiple products are used in a mosquito control application, the impacts are weighed against the proximity and timing of each application. When two approved products are used that contain two active ingredients, this scenario is possible, but the product usually already contains two active ingredients. If products with an identical active ingredient are applied simultaneously, it is likely that the net effect could be the sum of the total active ingredient that is available for uptake by the mosquito. Although a synergy is possible in this scenario, it is not a typical approach used and is limited by the BMPs for that scenario. Although some unusual instances may occur where nonidentical active ingredients could be applied within a short time span and potentially act synergistically, those conditions are neither typical nor generally used. However, in a usual example, a preapplication of a liquid permethrin spray product may be used to minimize the hazard of approaching a yellow jacket nest prior to applying a powdered form of the permethrin. Situations that would produce a residual exposure adequate to cause harm to humans would not occur unless the timing of applications is inappropriately close. Actual applications do not generally occur that close together.

This environmental impact evaluation also does not include an analysis of impacts to specific food webs.

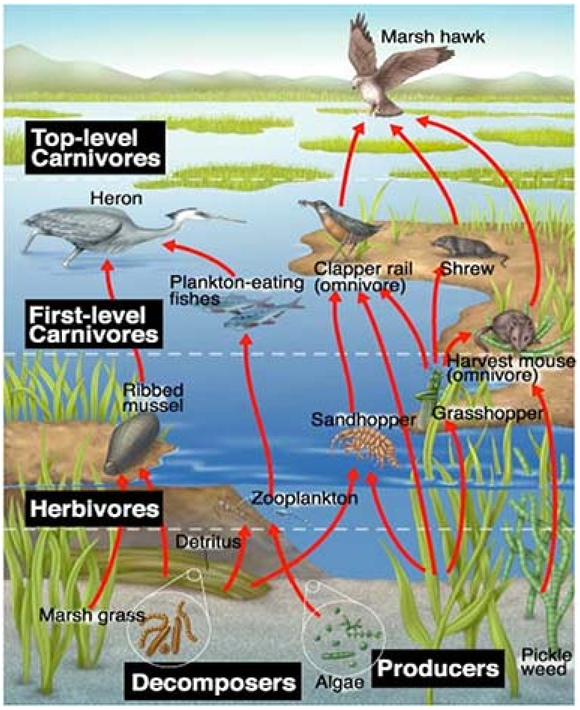

Figure 6-1 Ecological Food Web Concept

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 impacts 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 6-1 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.

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 impacts 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 impacts. 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 assure a minimal impact 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 Alternative

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 et al. 2013) 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 Alternative 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, WNV in mosquitoes and their hosts, and the analysis of public service requests and surveys.

Small impacts to terrestrial and aquatic habitats could occur when the District is required to maintain paths and clearings to access surveillance sites and facilitate sampling. A number of the BMPs listed in Section 6.2.2 above apply to surveillance activities to minimize disturbance to habitats and the species present or potentially present from the use of equipment and walking by District biologists and technicians to obtain samples.

> **Impact ECO-1:** The Surveillance Alternative would have a **less-than-significant** impact on nontarget ecological receptors, including native or special status plants and animals and mitigation is not required.

6.2.4 Physical Control Alternative

The Physical Control Alternative 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), and in a manner that generally maintains or improves habitat values for desirable species.

The Physical Control Alternative would not likely result in measurable adverse impacts to ecological receptors, including terrestrial and aquatic species. This alternative 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 impacts of the Physical Control Alternative on aquatic and wetland resources, including special status species. Chapter 5 discusses impacts to terrestrial resources.

The District employs a number of BMPs when implementing actions under the Physical Control Alternative. For example, all ditch maintenance work will be done at times that minimize adverse impacts to nesting birds, anadromous fish, and other species of concern, in consultation with USFWS, NMFS, and CDFW. As well as the BMPs listed herein in Section 6.2.2, the District implements additional BMPs to avoid or minimize impacts to the marsh-specific plants and animals such as the salt marsh harvest mouse and the Ridgway's rail. The District performs these source control 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) survey sites to establish the presence or absence of special status species in aquatic, terrestrial, and temporary habitats (e.g., vernal pools). Vernal pools provide breeding habitat for mosquitoes but also provide habitat for many special status species in California. Therefore, destruction or impairment of vernal pool habitat should be avoided under the Physical Control Alternative. The presence of special status species at aquatic or terrestrial sites or the presence of suitable habitat for special status species would result in cancellation of scheduled physical control activities.

> **Impact ECO-2:** The Physical Control Alternative would have a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.

6.2.5 Vegetation Management Alternative

The Vegetation Management Alternative 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 may use heavy equipment or apply herbicides where necessary for vegetation removal or thinning to improve surveillance or reduce mosquito habitats. Vegetation removal or thinning primarily occurs in aquatic habitats to assist with the control of mosquitoes and in terrestrial habitats to access mosquito producing sources. 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 special status species concerns exist, vegetation removal and maintenance actions would be restricted to those months or times of the year that minimize disturbance/impacts. Vegetation management may also be 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 injury to special status species of terrestrial plants and animals. The District applies BMPs to reduce these impacts, including the identification of special status species in treatment areas prior to commencing any vegetation removal actions. The nonherbicide component of the Vegetation Management Alternative 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 impacts to nontarget organisms.

> **Impact ECO-3:** The employment of a nonherbicide Vegetation Management Alternative in the form of physical removal would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.

Table 6-3 presents the herbicides the District may use for weed control, as well as the section of Appendix B where they are described in detail.

Table 6-3 Herbicide Options for Mosquito/Weed Abatement

Active Ingredient/Adjuvant	Appendix B
Imazapyr	Section 4.6.1
Glyphosate*	Section 4.6.2
Triclopyr	Section 4.6.3
Sulfometuron methyl	Section 4.6.5
APEs*	Section 4.7.1
Polydimethylsiloxane fluids	Section 4.7.2
Modified vegetable oils and methylated seed oil	Section 4.7.3

*Identified for further evaluation in Appendix B and described below.

The District may use herbicides to control vegetation in and around mosquito habitats to improve surveillance and reduce suitable breeding habitats. Herbicides are typically classified into the following major categories: pre-emergent herbicides (applied to the soil to prevent seedlings from germinating and emerging); post-emergent herbicides (applied after seedlings have emerged and control actively growing plants via contact damage or systemic impacts); contact herbicides (cause physical injury to the plant upon contact); and systemic herbicides (damage the internal functioning of the plant). Herbicides included in the Program have diverse chemical structures, act through distinct modes of action, and exhibit varying levels of potential toxicity to humans and nontarget species. Certain herbicides are nonselective and broad-spectrum, including imazapyr, sulfometuron methyl.

Herbicides generally function by inhibiting growth but do so in a multitude of ways. For example, sulfometuron methyl retards or stops root and shoot development (USEPA 2005). Herbicides used against annual broadleaf weeds are generally of the post-emergent variety, such as triclopyr and sulfometuron methyl. In addition, imazapyr, is a systematic, nonselective, pre- and post-emergent herbicide used for a broad range of terrestrial and aquatic weeds. Glyphosate represents a commonly used herbicide for the control and elimination of grass weeds and sedges. Most of the herbicides are moderately persistent in soil and water (for each herbicide’s half-life in soil and water, please refer to Appendix B).

Herbicides the District may use are characterized by a variety of modes of action against target vegetation and, therefore, may exhibit unique toxicity to nontarget species, including aquatic and terrestrial organisms (see Appendix B for further details regarding toxicity and fate and transport characteristics of Program herbicides). Both sulfometuron methyl (EXTOXNET 1996) and triclopyr (EXTOXNET 1996) have been shown to exhibit no/low toxicity to nontarget ecological receptors.

Certain herbicides may exhibit toxicity to some nontarget ecological receptors. Although no risks exist of concern to terrestrial birds, mammals, and bees or aquatic invertebrates and fish, imazapyr may pose an ecological risk to nontarget terrestrial and aquatic vascular plants (USEPA 2006b).

The District would apply BMPs to minimize the impact of herbicides on ecological receptors, including nontarget special status terrestrial plants. In particular, the District would take action to minimize drift of sprays to nontarget areas, which is accomplished by carefully considering weather variables such as wind velocity and direction and chance of precipitation. To prevent potential impacts to aquatic systems, applications would be safely conducted when wind is below 5 mph, the spray is carefully directed to the target vegetation, and when an adequate buffer to water sources is maintained.

> **Impact ECO-4**: The use of several of the herbicides would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.

The majority of herbicides the District may use exhibit little to no toxicity to mammals, birds, and terrestrial invertebrates (Chapter 5). See Chapter 4 for a discussion of potential impacts to aquatic receptors. Select herbicides were identified for further evaluation based on potential use patterns and toxicity (Appendix B) and are discussed in further detail below.

6.2.5.1.1 Glyphosate

Glyphosate is a nonselective, post-emergent, and systemic herbicide registered for use in agricultural and nonagricultural areas. Although some recent concerns have been expressed about possible sublethal effects of glyphosate products, it is virtually nontoxic to mammals and practically nontoxic to birds, fish, and invertebrates. USEPA has identified glyphosate as a candidate for evaluation as a potential endocrine disruptor (USEPA 2009). Claims that glyphosate is destroying bee and butterfly populations have not been substantiated. The use of glyphosate to control milkweed, which is a severe problem for farmers, may be connected to loss of foraging vegetation and thereby indirectly impacting butterfly populations. However, this effect is an indirect effect and not actually toxicity to the butterflies. At low treatment levels, glyphosate has been shown to be essentially nontoxic to mammals and humans. Based on these issues, it is likely that USEPA will provide an updated review of its potential risks in 2015. In contrast to this issue, the USEPA has recently renewed the approval of a glyphosate and 2-4-D combination product for use for weed vectors. This additional supporting information indicates that USEPA has not received significant data to negate the decision (USEPA 2014b). Glyphosate products are effective, generally safe, products used for weed control (Gertsberg 2011). The District would strictly adhere to BMPs and product label requirements, including the restriction of glyphosate application to targets outside an adequate buffer zone separating water sources, which reduces the potential for impacts to special status species or other nontarget receptors. Targeted, small-scale treatments would be conducted to minimize post-application drift and runoff.

Impact ECO-5: The use of glyphosate would result in a **less-than-significant impact** to nontarget ecological receptors and mitigation is not required.

6.2.5.1.2 Adjuvants

An adjuvant is any compound that is added to an herbicide formulation or tank mix to facilitate the mixing, application, or effectiveness of that herbicide. Adjuvants can either enhance activity of an herbicide's active ingredient (activator adjuvant) or offset any problems associated with spray application, such as adverse water quality or wind (special purpose or utility modifiers). Activator adjuvants include surfactants, wetting agents, sticker-spreaders, and penetrants. Adjuvants potentially used for mosquito habitat control and weed control are presented in Table 6-4. The environmental fate and toxicity of adjuvants the District may use are described in detail in Appendix B. A subset of these adjuvants was identified for further examination based upon potential use patterns and toxicity (Appendix B) and is discussed below.

Table 6-4 Adjuvant Options for Insect Abatement/Weed Control

Active Ingredient	Appendix B
APEs	Section 4.7.1
Polydimethylsiloxane Fluids	Section 4.7.2
Modified Vegetable Oils and Methylated Seed Oil	Section 4.7.3

APEs include a broad range of chemicals that tend to bind strongly to particulates and persist in sediments. Nonylphenol and short-chain nonylphenol ethoxylates are moderately bioaccumulative and extremely toxic to aquatic organisms. Aside from use in agricultural herbicide mixtures, APEs are commonly present in detergents, cleaners, food packaging, and cosmetics. The acute toxicity of APEs to mammals is low. They are possible estrogen-mimics. Although the USEPA (2010) has recently recommended that this suite of chemicals be evaluated further due to their widespread use (past and present), persistence, and possible estrogen-mimicking behavior, they are currently approved for use.

Polydimethylsiloxanes are insoluble in water and typically sorb to particulates. Degradation time varies depending on moisture in soils. These chemicals appear to be relatively nontoxic to most organisms, but data are lacking. Although toxicity and environmental fate information for these products is scarce for polydimethylsiloxanes, using BMP application techniques, these products should not result in unwanted adverse effects.

Modified vegetable oils and methylated seed oils are essentially nontoxic to most organisms, including plants. Little is known of the environmental fate of these adjuvants. Although toxicity and environmental fate information is scarce for these oils, using BMP application practices, these products should not result in unwanted adverse effects.

BMPs the District would employ include using adjuvants in limited amounts in areas that do not contain special status species and preventing exposures to nontarget habitats (post-application).

> **Impact ECO-6:** The use of adjuvants would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.

6.2.6 Biological Control Alternative

The Biological Control Alternative as the District practices it at present would be a continuation of existing activities focused on mosquitofish using applicable techniques, equipment, vehicles, and watercraft.

Biological control of mosquitoes involves the intentional use of mosquito pathogens (diseases), parasites, and/or predators to reduce the population size of target mosquitoes. Mosquito parasites are not currently available in the commercial market. Pathogens used on mosquito larvae are bacteria and their spores. These products are not considered chemical treatment; however, they are registered and regulated by USEPA and are, therefore, covered more thoroughly in Section 6.2.7, Chemical Control Alternative, because their impacts are similar to other pesticides. A discussion of mosquitofish the District's preferred predator form of biological control and potential impacts to aquatic resources is discussed in Chapter 4, Section 4.2.6, of this PEIR.

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 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 three types of pathogenic bacteria, including Bs, strains of Bti, and *Saacharopolyspora spinosa* (Table 6-5). 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 Alternative, including the discussion of potential impacts. The environmental fate and toxicity of these control agents are described in detail in Appendix B.

Table 6-5 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 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 impact red-legged frog and tiger salamander populations, the District limits the use of mosquitofish to artificial habitats such as ornamental fish ponds, water troughs, water gardens, fountains, and unmaintained swimming pools, which are not connected to natural waterways. Limiting the introduction of the mosquitofish to these sources would be sufficient to prevent impacts to special status species in natural habitats.

> **Impact ECO-7:** The use of mosquitofish as a Biological Control Alternative would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.

6.2.7 Chemical Control Alternative

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

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 potentially other invertebrates (e.g., yellow jacket wasps). If and when inspections reveal that mosquito populations are present at levels that trigger the District's criteria for chemical control – based on 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, any federal and state requirements, and the BMPs listed in Section 6.2.2. The threshold criteria for these response triggers are based on prescheduled application periods relating to the documented and previously monitored likely mosquito outbreaks or unwanted population expansions. Additional response triggers are based on verified outbreaks, nuisance issues, and public concern.

The chemicals the District uses or proposes to use 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 6-6, including herbicides discussed previously in Section 6.2.5). These chemicals are highlighted in the following section specifically in reference to potential ecological health implications associated with their use for vector control.

Table 6-6 Chemicals Identified for Further Evaluation in Appendix B

Active Ingredient	Vector	Potential Issue
Methoprene	Mosquitoes	Prevalent use; toxicity to aquatics and insects
Etofenprox	Mosquitoes/yellow jacket wasps	Toxicity to aquatic organisms; no synergist required
Bti	Mosquitoes	Prevalent use; public concerns
Pyrethrins	Mosquitoes/yellow jacket wasps	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/yellow jacket wasps	Toxicity to aquatic organisms; potential endocrine disruptor
Lambda-cyhalothrin	Yellow jacket wasp	Toxicity to aquatic organisms; potential to bioaccumulate
APEs	Weeds	Toxicity to aquatic organisms; moderately bioaccumulative
Glyphosate	Weeds	Prevalent use; possible endocrine disruptor

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 waterbodies 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 6-7).

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 6-7 Chemical Options 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
	Aliphatic Solvent (Mineral Oil)	Section 4.3.6

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 may be used in various waterbodies 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 impact on fish inhabiting treated sites. In addition, many groups of aquatic invertebrates are only impacted 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, 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.

> **Impact ECO-8:** The use of the organophosphate temephos would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.

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 in insects causing constant involuntary nervous system impacts, 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.

> **Impact ECO-9:** The use of bacterial larvicides would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.

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, pellet, and briquette varieties are also available (e.g., 30-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 impacts.

Considered one of the safest of larvicides available, the District uses methoprene prevalently during each season of the year. Briquette forms are most prevalently used in residential and ornamental pond application scenarios. Treatments to cattails and tules require the granular/pellet forms (e.g., Altosid SBG, Altosid pellets) to penetrate dense aquatic vegetation. The liquid form (e.g., Altosid Liquid concentrate) is frequently used to treat wetlands including marshes. Methoprene is often 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.

> **Impact ECO-10:** The use of methoprene for mosquito larvae would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.

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 waterbodies 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.

6.2.7.1.5 Aliphatic Solvents (Mineral Oil)

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 waterbodies including ornamental ponds, pastures, irrigation systems, drainage systems, and drinking water systems (CDPR 2010a).

Aliphatic solvents such as mineral oil are applied to water surfaces to form a coating on top of water surfaces to drown larvae, pupae, and emerging adult mosquitoes. They are the product of petroleum distillation and, thus, are complex mixtures of long-chain aliphatic compounds. They are applied to a variety of waterbodies, including swamps, marshes, and intermittently flooded areas (CDPR 2010a).

Aliphatic solvents are often used when monomolecular films (alcohol ethoxylated surfactants) do not provide sufficient mosquito control. They also break down more rapidly (2 to 3 days) and are practically nontoxic to most nontarget organisms. Therefore, mineral oil should not result in adverse ecological effects when applied using District BMPs.

> **Impact ECO-11:** The use of surfactants for the control of mosquito larvae would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.

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 infrequently and only when necessary to control mosquito populations.

Adulticides the District potentially uses include pyrethrins, synthetic pyrethroids, pyrethroid-like compounds, OPs, and synergists. Table 6-8 lists the adulticides the District may use for mosquito abatement. Several of these active ingredients may also be used for the control of yellow jacket wasps (Table 6-8 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 6-8 Chemical Options for Adult Insect Abatement

Chemical Classification	Active Ingredient	Vector	Appendix B
Pyrethrin	Pyrethrins	Mosquito; yellow jacket wasp	Section 4.1.1
Pyrethroid	Allethrins and d-*trans* allethrin	Yellow jacket wasp	Section 4.1.2
Pyrethroid	Phenothrin (sumithrin or d-phenothrin)	Mosquito; yellow jacket wasp	Section 4.1.3
Pyrethroid	Prallethrin	Yellow jacket wasp	Section 4.1.4
Pyrethroid	Deltamethrin	Mosquito; yellow jacket wasp	Section 4.1.5
Pyrethroid	Lambda-cyhalothrin	Yellow jacket wasp	Section 4.1.7
Pyrethroid	Resmethrin	Mosquito	Section 4.1.8
Pyrethroid	Tetramethrin	Yellow jacket wasp	Section 4.1.9
Pyrethroid	Permethrin	Mosquito; yellow jacket wasp	Section 4.1.10
Pyrethroid-like compound	Etofenprox	Mosquito; yellow jacket wasp	Section 4.1.11
Synergist	PBO	Mosquito; yellow jacket wasp	Section 4.1.12
Organophosphate	Naled	Mosquito	Section 4.2.1

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 impacts to nontarget ecological receptors.

The District may use pyrethrin for mosquito and/or yellow jacket wasp control. For yellow jacket wasp control, pyrethrin is applied directly into ground nests. For mosquito control, pyrethrin is applied to man-made and natural sites including, but not limited to, residential, industrial, recreational areas, and municipalities.

Pyrethrins are of concern because they are used prevalently and require 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 impacts to nontarget ecological receptors. As an additional measure, applications of over an acre with pyrethrin products occur primarily 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. In actual field applications, the hazard to bees is often lessened because bees are repelled by pyrethroids, reducing their contact with plant surfaces that have recently been sprayed. This reduced contact with plant surfaces decreases the chance of bees receiving a toxic dose. For wasp (yellow jacket and paper wasps) control, the District may apply pyrethrins in minute volumes directly to ground and tree/eave nests, which essentially negates any impact 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 waterbodies, 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. Also, note that pyrethrins are available in can form to the public but not in vessels used for ULV applications.

> **Impact ECO-12:** The use of pyrethrins for adult mosquitoes and yellow jacket wasps would result in a **less-than-significant** impact to nontarget ecological receptors including aquatic organisms and mitigation is not required.

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, 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 tree hole habitats, residential areas near reclaimed marshes, and 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 uses resmethrin only when absolutely necessary and then in ULV applications so that the rapid degradation of the products reduces the potential for impacts 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. Although potentially toxic effects would occur to some aquatic species, risk assessments provided in support of registration indicate that the acute and chronic risk quotients for terrestrial avian species are below the USEPA's levels of concern. The acute risk quotients for terrestrial mammals are also below the USEPA's acute levels of concern. (USEPA 2009a).

The District may use permethrin for mosquito (marshes, wetlands) and yellow jacket wasp control during spring, summer, and fall. Permethrin products may be used in areas adjacent to reclaimed marshes, around residences, and directly to ground nests of yellow jacket wasps.

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 this product would be used with careful and strict BMP techniques such as in very small, localized applications. 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 impacts 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 by the general public 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 would strictly adhere to BMPs and product label requirements. Etofenprox would primarily be applied during the nighttime hours when sensitive receptors such as honeybees are not active.

> **Impact ECO-13:** The use of pyrethroids and pyrethroid-like compounds (e.g., resmethrin, permethrin, and etofenprox) for mosquitoes and yellow jacket wasps would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.

6.2.7.2.3 Synergists (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 but exhibits toxicity to fish and aquatic invertebrates. As a synergist, PBO would be 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 would not be applied when wind occurs.

> **Impact ECO-14:** The use of synergists (PBO) for mosquitoes and yellow jacket wasps would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.

6.2.7.2.4 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.

Naled

Naled is an OP insecticide that has been registered for use in the US since 1959. It is used in rotation with pyrethrins or pyrethroids for control of adult mosquitoes to prevent the development of resistance. Naled is an indoor and outdoor general use pesticide and is used on food and feed crops, farms, dairies, pastureland, in greenhouses, and over standing water. Currently, the District does not use naled.

Naled has been shown to be moderately to highly toxic to wide range of species, including aquatic fish and invertebrates, as well as waterfowl (mallards) and honeybees. It has low water solubility but may be mobile in soils. However, it is generally applied using ULV techniques, which are designed to prevent environmental persistence and potential impacts to nontarget ecological receptors, including aquatic species (see Section 6.2.7.2 for additional details of ULV techniques). Naled tends to degrade quickly in surface waters especially following ULV applications. Dichlorvos is a breakdown product of naled (also a registered pesticide) and also degrades rapidly in surface waters. Short-term naled and dichlorvos exposures to aquatic nontargets are possible; however, they would be limited due to rapid degradation. See Chapters 4, Biological Resources – Aquatic, and 9, Water Resources for further details.

Drift is almost irrelevant for hand and some aerial (e.g., helicopter) applications since treatments are restricted to times when no wind occurs. The District strictly adheres to their BMPs and product label requirements, including the restriction of naled application to targets outside adequate buffer zones around permanent waterbodies to reduce runoff. In addition, spray setbacks are established to reduce spray drift for agricultural uses.

> **Impact ECO-15:** The use of the organophosphate naled would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.

6.2.7.3 Yellow Jacket Wasp Adulticides

The District may selectively apply chemicals to control ground-nesting yellow jacket wasps, as well as paper wasps that nest in trees. This activity is generally triggered by access needs to mosquito sources rather than as a result of regular surveillance of their populations. Yellow jacket nests that are off the ground would be treated under special circumstances to protect the health and safety of employees. When a technician encounters a honeybee swarm or unwanted hive, they contact the County Agricultural Commissioner's Office, 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.

Pyrethroid-based chemicals are typically used against ground-nesting yellow jackets. The potential environmental impacts 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 yellow jacket 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 may use to control yellow jacket wasps are shown in Table 6-8.

6.2.7.3.1 Lambda-cyhalothrin

Lambda-cyhalothrin is available to the public in commonly used products for residential wasp control. The District may use it for targeted application to yellow jacket and paper wasp nests. This product (0.01 percent lambda-cyhalothrin) may be 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 Districts potential use is 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.

> **Impact ECO-16:** The use of lambda-cyhalothrin for yellow jacket wasps would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.

6.2.8 Cumulative Impacts

"Cumulative impacts" are defined as "two or more individual effects which, when considered together, are considerable or compound or increase other environmental impacts (CEQA Guidelines, Section 15355). Cumulative impacts, as they relate to ecological health include past, present, and reasonably foreseeable actions that potentially impact aquatic/terrestrial mammalian and avian wildlife, herptiles, aquatic organisms, nontarget invertebrates and pollinators, and botanical resources. Cumulative impacts can result from individually minor, but collectively significant, projects taking place over a period of time. The cumulative impact analysis is contained in Section 13.4 and focuses on the potential for the use of pesticides for mosquito control to contribute to regional pesticide use, which is of concern for its potential impacts to nontarget ecological receptors. It includes Table 13-1, Historical Pesticide Use within the Alameda County Mosquito Abatement District's Program Area for 2006-2010 and Table 13-2, Pesticide Use within the Alameda County Mosquito Abatement District's Service Area, 2006-2010.

Although large uncertainty and high variation exist in the reported amounts of pesticide use within the District's Program Area counties, they vary according to particular needs, majority of habitat type, and seasonal vector outbreaks. The public is aware of these pesticide uses and, in general, is pressuring agencies within these counties to use less pesticide whenever possible. The District uses very strict and thorough BMPs in their pesticide applications for mosquito control and is attempting to reduce total pesticide use where possible consistent with IPM practices.

The District's small incremental contributions to overall pesticide use within its Program Area do not trigger a cumulatively considerable impact. While overall use of pesticides throughout the Program Area may be considered cumulatively significant, the District's small incremental contributions to this impact are not cumulatively significant. Therefore, the **Program's long-term activities including chemical applications would not contribute considerably to nontarget ecological receptor impacts.** The Program alternatives would not result in significant cumulative impacts to the ecological health of the region.

6.2.9 Environmental Impacts Summary

Table 6-9 presents a summary of impacts to ecological health associated with the five alternatives compared to existing conditions.

Table 6-9 Summary of Alternative Ecological Health Impacts

Impact Statement	Surveillance	Physical Control	Vegetation Management	Biological Control	Chemical Control
Effects on Ecological Health					
Impact ECO-1: The Surveillance Alternative would have a **less-than-significant** impact on nontarget ecological receptors, including native or special status plants and animals and mitigation is not required.	LS	na	na	na	na
Impact ECO-2: The Physical Control Alternative would have a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.	na	LS	na	na	na
Impact ECO-3: The employment of a nonherbicide Vegetation Management Alternative in the form of physical removal would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.	na	na	LS	na	na
Impact ECO-4: The use of several of the herbicides would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.	na	na	LS	na	na
Impact ECO-5: The use of glyphosate would result in a **less-than-significant impact** to nontarget ecological receptors and mitigation is not required.	na	na	LS	na	na
Impact ECO-6: The use of adjuvants would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.	na	na	LS	na	na
Impact ECO-7: The use of mosquitofish as a Biological Control Alternative would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.	na	na	na	LS	na
Impact ECO-8: The use of the organophosphate temephos would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.	na	na	na	na	LS
Impact ECO-9: The use of bacterial larvicides would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.	na	na	na	na	LS
Impact ECO-10: The use of methoprene for mosquito larvae would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.	na	na	na	na	LS

Table 6-9 Summary of Alternative Ecological Health Impacts

Impact Statement	Surveillance	Physical Control	Vegetation Management	Biological Control	Chemical Control
Impact ECO-11: The use of surfactants for the control of mosquito larvae would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.	na	na	na	na	LS
Impact ECO-12: The use of pyrethrins for adult mosquitoes and yellow jacket wasps would result in a **less-than-significant** impact to nontarget ecological receptors including aquatic organisms and mitigation is not required.	na	na	na	na	LS
Impact ECO-13: The use of pyrethroids and pyrethroid-like compounds (e.g., resmethrin, permethrin, and etofenprox) for mosquitoes and yellow jacket wasps would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.	na	na	na	na	LS
Impact ECO-14: The use of synergists (PBO) for mosquitoes and yellow jacket wasps would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.	na	na	na	na	LS
Impact ECO-15: The use of the organophosphate naled would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.	na	na	na	na	LS
Impact ECO-16: The use of lambda-cyhalothrin for yellow jacket wasps would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.	na	na	na	na	LS

LS = Less-than-significant impact
N = No impact
na = Not applicable
SM = Potentially significant but mitigable impact
SU = Significant and unavoidable impact

6.2.10 Mitigation and Monitoring

Although application scenarios are conducted using rigorous, strict BMP and treatment schedules that avoid periods when the nontarget receptors may be more sensitive to stresses (nesting, breeding, migration, known movements between habitats [small mammals and reptiles]), the District also conducts surveillance and monitoring of results on a routine basis. Receipt of information about mosquito outbreaks or unwanted population expansion of pest mosquitoes is dealt with on a case-by-case basis. Pesticide use is conducted according to the verified requirements and guidance in the product labels (mandated by the USEPA) for the safe use of labeled products and the ultimate protection of humans and ecological receptors.

Because all impacts to ecological health are less than significant, no mitigation is required.

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