6 Ecological Health

This chapter evaluates the potential impacts of the Program alternatives on ecological health. The impact analysis relies heavily on Appendix B, Human and Ecological 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 District. Section 6.2, Environmental Impacts and Consequences, presents the following:

- Environmental concerns and evaluation criteria.
- Discussion of methods and assumptions important to environmental impact analysis
- Discussion of potential impacts of the Program alternatives
- Cumulative impacts summary
- A summary of 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 San Mateo County Mosquito and Vector Control District (SMCMVCD) Service Area (San Mateo County) and the adjacent counties where control activities may be provided upon request (which include San Francisco, Alameda, Santa Clara, and Santa Cruz counties) that are impacted by unwanted vectors 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."

Many chemicals are widely used in agriculture, commercial pest control, residential landscape/garden habitats, land management by public agencies, and vector control operations to control unwanted pests/vectors and vegetation. These chemicals are developed to effectively impact those pest/vector targets with little to no health risk. To assure the relative safety of these chemicals to humans and wildlife, commercially available chemicals are submitted to numerous laboratory tests by the chemical company, the USEPA (which has final oversight and approval), and state and international agencies to identify possible unintended adverse effects to humans nontarget and wildlife.

Risk assessments conducted to estimate potential adverse impacts to wildlife include testing and consideration of nontarget species that may be more sensitive to the chemical or have special adverse effects (i.e., endocrine disruption) than shown in the laboratory tests. The battery of tests includes birds, mammals, fish, invertebrates, reptiles, and bees. The ecological risk component usually includes evaluation of the potential for endocrine disruption and the potential for the chemical to accumulate in the exposed receptors (bioaccumulation). The product label also suggests additional procedures to minimize the potential effects to nontarget biota that may be inadvertently exposed. In the case of many chemicals, extra consideration is given to animals that may or are known to inhabit the proposed treated areas and could be inadvertently exposed. In general, this issue is addressed by several additional batteries of toxicity tests using several surrogate nontarget receptors such as beneficial insects, invertebrates, and wildlife that may be exposed via prey items. The discussion below explains the background information and issues/concerns associated with the use of chemical treatments, while the analysis of potential impacts occurs later in Sections 6.2.5 and 6.2.7.)

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 the following:

- 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)
- 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 in all circumstances. Thus, toxicity and adverse effects can be mitigated by limiting potential exposure to a dose less than the amount that may result in adverse health effects.

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

However, these, and other, coordinated and focused laboratory tests are designed to document the effects of the chemical when a continuous, controlled laboratory exposure that does not realistically reflect the likely patchy exposures typical of the District field application scenarios. As such, the toxicity information is intended as an overview of potential issues that might be associated with maximum exposure levels of applications that are protective of ecological health. These guidelines include numerous "safety margins" in the toxicity calculations that are intended to provide adequate efficacy to target organisms while not adversely impacting humans or nontarget plant and animal species. In some instances, the regulatory guidance may include additional suggestions for protective application to assure no significant adverse effect on nontarget species and humans.

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[1], in actual practice, the amounts actually applied by the District 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). Although numerous precautions (BMPs) and use of recommended application guidance are intended to provide efficacy without adverse effects to nontarget organisms, misapplication or unexpected weather conditions may still result in effects on some nontarget organisms in the exposure area. This potential impact is ameliorated by having the application concentrations consistent with the labels or MSDSs (now SDSs). These documents are designed to protect the health of humans and other nontarget species. The careful use of the other pesticide application BMPs, and advance planning by the District further mitigate impacts (see Sections 6.2.5 and 6.2.7 where the potential impact analyses are provided).

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.

6.1.1.3 Bioaccumulation and Biomagnification

Bioaccumulation is the increase in concentration of a chemical from the environment to the first organism in a food chain, while biomagnification is the increase in concentration of a chemical from one trophic level in the food chain to another. In addition to direct exposures, the issues of bioaccumulation of some chemicals (they have all been categorized by USEPA) and their persistence in the environment are all included in the risk calculations wherever the data are available. Several chemicals are identified as persistent, meaning that they remain in the media of application for relatively long periods (i.e., weeks, months). However, most pesticides currently used by the District are selected preferentially for much shorter half-lives of hours to days. These physio/chemical characteristics of the chemicals selected for vector control are always considered early in the risk calculation process. Only in some special situations such as a USEPA Section

[1] Although the MSDS format is referenced in this document, note that under the international Globally Harmonized System, the MSDS format has been substantially revised and is now largely replaced by standardized Safety Data Sheets (SDSs).

18 “emergency” are the older, more persistent products allowed. These emergency situations are intended for and only to stop dramatic and sometimes potentially catastrophic vector infestations.

Biologically persistent chemicals (and bioaccumulation) by definition address the potential for a chemical to move up the food chain and even increase the tissue concentration (biomagnification) in higher trophic animals. The chemicals known to elicit bioaccumulation and/or biomagnification are specifically addressed in the assessment as each of the “higher” (predator) receptor species is considered. As a result of this focus on biological and chemical properties of selected pesticides, the risk assessment process provides the best, conservative estimate of any potential unwanted adverse effects.

Some chemicals have the potential to be retained in the fatty tissues of organisms and accumulate after their prolonged exposure to contaminated sources (bioaccumulation), resulting in a higher concentration in the organism over time. In some cases, chemicals can even exist in organisms above the exposure media concentrations (biomagnification). However, biomagnification is correlated with an organism that is associated with continued exposure to a contaminated environment (e.g., usually sediments and water) and is not typically associated with the chemical exposures that might result from District applications for vector control. Even chemicals that have a potential to bioaccumulate do not exhibit this phenomenon in all biota, since toxic chemicals are selectively taken up by fat (e.g., a chemical may bioaccumulate in fish but not in all animals). Many toxic substances are excreted or metabolized after ingestion such that bioaccumulation is dependent on the physio/chemical characteristics of the chemical (persistence and toxicity), the concentration of the chemical, and the specific organism exposed.

6.1.2 Program 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 Active Ingredients

Active Ingredient	Vector
Bacillus sphaericus (Bs)	Mosquito (larvae)
Bacillus thuringiensis israelensis (Bti)	Mosquito (larvae)
Spinosad	Mosquito (larvae)
Water soluble surface film	Mosquito (larvae)
Biodegradable alcohol ethoxylated surfactant	Mosquito (larvae)
Methoprene	Mosquito (larvae)
Mineral oil	Mosquito (larvae)
Refined petroleum distillate	Mosquito (larvae)
Aliphatic petroleum hydrocarbons	Mosquito (larvae)
Temephos	Mosquito (larvae)
Pyrethrins	Mosquito (adults)
Piperonyl butoxide (PBO)	Mosquito (adults)
Phenothrin (sumithrin)	Mosquito (adults)
Permethrin	Mosquito (adults)
Prallethrin	Mosquito (adults)
Resmethrin	Mosquito (adults)
Etofenprox	Mosquito (adults)

Active Ingredient	Vector
Naled	Mosquito (adults)
Permethrin	Yellow jacket wasp
Deltamethrin	Yellow jacket wasp
Pyrethrins	Yellow jacket wasp
Piperonyl butoxide (PBO)	Yellow jacket wasp
Resmethrin	Yellow jacket wasp
Lambda-cyhalothrin	Yellow jacket wasp
Prallethrin	Yellow jacket wasp
Tetramethrin	Yellow jacket wasp
Etofenprox	Yellow jacket wasp
Esfenvalerate	Yellow jacket wasp
Potassium salts of fatty acids	Yellow jacket wasp
d-trans Allethrin	Yellow jacket wasp
Phenothrin	Yellow jacket wasp
Permethrin	Tick
Pyrethrins	Tick
Piperonyl butoxide (PBO)	Tock
Esfenvalerate	Tick
Deltamethrin	Tick
Bromadiolone	Rodent
Diphacinone	Rodent
Brodifacoum	Rodent
Cholecalciferol	Rodent
Bromethalin	Rodent
Difethialone	Rodent
Sodium nitrate	Rodent
Sulfur	Rodent
Chlorophacinone	Rodent

Table 6-2 Herbicide Active Ingredients and Adjuvants

Active Ingredient	Vector
Benefin	Weeds
Oryzalin	Weeds
DCPA	Weeds
Dithiopyr	Weeds
Glyphosate	Weeds
Lecithin	Weeds
Methyl esters of fatty acids	Weeds
Alcohol ethoxylate	Weeds
Modified vegetable oil	Weeds
Triclopyr	Weeds
Sulfometuron methyl	Weeds
Imazapyr	Weeds
Alkyl phenol ethoxylate	Weeds
Diuron	Weeds

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 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.

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

On October 20, 2006, the US 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 San Mateo County.

Of the 66 pesticides listed in the injunction, the District may employ esfenvalerate, methoprene, and naled for vector control. Esfenvalerate may be applied directly to individual yellow jacket and wasp nests in response to public complaints and tick control if District surveillance indicated a public health risk. Methoprene is used for larval mosquito control. Naled is not currently used, but may be used in the future for adult mosquito control if resistance to other products is evident. Vector control programs are exempt from the stipulated injunction. Specifically, for applications of a pesticide for purposes of public health vector 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: oryzalin, DCPA, glyphosate, imazapyr, diuron, 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:

> 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

> You do not apply the pesticide within 15 feet of aquatic breeding critical habitat or nonbreeding aquatic critical habitat within critical habitat areas, or within 15 feet of aquatic features within noncritical habitat sections subject to the injunction; and

> Application is limited to localized spot treatment using handheld devices; and

> Precipitation is not occurring or forecast to occur within 24 hours; and

> You are a certified applicator or working under the direct supervision of a certified applicator; and

> If using 2,4-D or triclopyr, you are using only the amine formulations (USEPA 2014a).

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, 2,4-D, 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.

6.2 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 scoping process. 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.

a. Require additional information regarding bait blocks, chemical agents, and poisons in sanitary sewers concerning components and effects. Could pose a significant impact on the operation of wastewater treatment plant.

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

b. Describe the effects of all chemicals that are used and/or proposed for use on wildlife and natural ecosystems, including insect prey, birds, mammals, fish, and vegetation. 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.

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

> Bs is a naturally occurring soil bacterium. The District conducts Bs applications to control vector species (mosquitoes) to minimize the adverse impact on public health. Studies indicate a high degree of specificity with Bs (and Bti) for mosquitoes and blackflies with little to no toxicity to chironomid larvae at any of the current mosquito control application rates. Although some nontarget species may be affected, the specificity for target mosquitoes reduces the likelihood that this impact would be lasting. Bs is capable of cycling in the aquatic environment providing weeks of effective mosquito control after a single dose. It is very effective in water with high organic content. The use, fate and transport, and potential toxicity of Bs is discussed in Section 6.2.7 and described in detail in Appendix B.

d. Discuss 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.

e. Concern expressed 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 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.

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

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

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

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

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

> Although larval and adult mosquitoes serve a positive role as prey items for some invertebrates, fish, avian insectivores, bats, small reptiles, and amphibians, the loss of a focus area (infested or large population of mosquitoes) would 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. Mosquito eradication has been a high priority effort where infestations are discovered in order to minimize the negative effect on human health caused by mosquito-borne diseases. Mosquito control has been in effect for 100 years, and the impact on the food web has stabilized over that time. No predators are known that rely exclusively on mosquitoes (larval or adult) for prey.

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

> The use, fate, and transport of each pesticide included in the Program are described in detail in Appendix B, and results are incorporated into the environmental impact analyses in this chapter. 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 vector control treatment, the impacts are weighed against the proximity and timing of each application. If products with a similar or different 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 vector. 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 the potential effects of multiple chemicals used in one application.

j. 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. The District also conducts surveillance and monitoring of treatment results on a routine basis. Additional monitoring programs are beyond the scope of this PEIR and not needed based on information that suggests that the Program would not have a significant adverse effect on biological resources. See Appendix B for fate and transport information on the materials considered for use under the District's IMVMP. However, District staff will monitor selected sites post-treatment to determine if the target vector or target vegetation was effectively controlled with minimum effect to the environment and nontarget organisms. During this time, observations of any nontarget species will be documented and 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.

k. 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).

> 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.

l. 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).

> 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 vectors 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 is considering for use in the future were investigated to provide a preliminary assessment of the potential impacts to nontarget ecological receptors.

6.2.2.1 Evaluation Methods

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 may use
- Pesticide label requirements
- Types of application sites (e.g., habitat types)
- Application procedures
- Estimated applications and sites
- Estimated total amount used per quarter
- Physicochemical properties of the pesticides/active ingredients
- Pesticide target vector efficacy
- Reported adverse effects (e.g., reproductive, developmental, carcinogenic).

Pesticides identified as warranting further evaluation in Appendix B are known to exhibit at least one parameter that appears to exhibit a potential or perceived risk. Toxicity levels (e.g., slight, low, moderate, high, etc.) are used prevalently in the published literature but are not uniformly standardized or representative of specific criteria. They qualitatively describe toxicity in relative terms in the evaluations of herbicides and pesticides in this PEIR and in Appendix B. Toxicity levels are helpful in making significance determinations under CEQA.

The pesticide application scenarios that result in reasonable efficacy with minimal unwanted estimated risk are preferred and are the basis of IPM/IVM approaches and BMPs the District employs. BMPs are described in Chapter 2 (Table 2-8). 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.

For all six 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. (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) thoroughly clean equipment to prevent the spread of weeds. (BMP A10)

For five 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. (BMP A6)

> 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. (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. (BMP B2)

> 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. (BMP B4)

For four of the Program alternatives, excluding Biological Control and Other Nonchemical Control/Trapping Alternatives, the following BMPs apply:

> 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 California Natural Diversity Database, relevant HCPs, NOAA Fisheries and USFWS websites, CAlfish.org, and other biological information developed for other permits. Establish a predetermined 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. (BMP A7)

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

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. (BMP H1)

> 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 only tool used to treat sources of pupae to prevent adult mosquitoes' emergence. The District will use a microbial larvicide (Bti, Bs) or insect growth regulator (e.g., methoprene) instead or another alternative if necessary. (BMP H2)

> 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. (BMP H3)

> To minimize application of pesticides, application of pesticides will be informed by surveillance and monitoring of vector populations. (BMP H4)

> 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. (BMP H5)

> 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. (BMP H6)

> 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. (BMP H7)

> Spray nozzles for the application of larvicides or herbicides will be adjusted to produce larger droplet size rather than smaller droplet size. Use low nozzle pressures where possible (e.g., 30 to 70 pounds per square inch). Keep spray nozzles within a predetermined maximum distance of target weeds or pests (e.g., within 24 inches of vegetation during spraying). For application of adulticides, use ULV sprays that are calibrated to be effective and environmentally compatible at the proper droplet size (about 10-30 microns). (BMP H8)

> Clean containers at an approved site and dispose of at a legal dumpsite or recycle in accordance with manufacturer's instructions if available. (BMP H9)

> Special-Status Aquatic Wildlife Species (BMP H10):

- A California Natural Diversity Database search was conducted in 2012, and updated in 2015, and the results are incorporated into 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.
- The District Uses 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.

> District staff will monitor sites post-treatment to determine if the target vector 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. (BMP H11)

> Do not apply adulticides in 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 honeybee 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. Liquid larvicides are applied only to water bodies. (BMP H12)

> The District will provide notification to the public (24 to 48 hours in advance, if 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 applies or participates in the application of herbicides in areas other than District facilities when a joint effort is most effective and/or efficient. (BMP H13)

> Provide for buffer zones between herbicide (diuron) application sites and surface and usable groundwater supplies. (BMP H14)

> For rodenticides in sewer systems, deploy bait blocks by suspension to reduce potential dietary exposure to nontarget animals. Apply bait block attachments to the wall just under the manhole cover so that rodents are more likely to perish while still in the sewer and away from predators to reduce secondary exposure. (BMP H15)

> For rodenticides in aboveground sites, use tamper-proof bait stations firmly attached to embedded stakes or duckbill anchors so that bait cannot be accessed or be dragged away by nontarget animals. (BMP H16)

> Exercise adequate caution to prevent spillage of pesticides during storage, transportation, mixing, or application of pesticides. Report all pesticide spills and cleanups (excepting cases where dry materials may be returned to the container or application equipment). (BMP I1)

Several BMPs in Table 2-8 apply primarily 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. (BMP G3)

> 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. (BMP G4)

6.2.2.2 Assumptions

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 vector abundance and other variables are included in the District's operating procedures. This evaluation assumes that important parameters, such as soil or sediment half-life, are dependent on the specific conditions at the time of pesticide application, and values listed herein serve as references values.

Concerning the application of multiple chemical treatments in the same area, such as larvicides followed by adulticides (i.e., not likely to occur under normal circumstances), or the application of multiple pesticides at the same time in a specific area (e.g., usually multiple active ingredients in the formulation such as VectoMax, which combines Bti and Bs), 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 vector control application, the impacts are weighed against the proximity and timing of each application. Some commercial products actually contain more than one active ingredient (e.g., FourStar Briquets contain Bs and Bti), and these products are evaluated for toxicity. If products with similar or even different active ingredients are applied simultaneously, the potential toxicity of each is summed to estimate potential adverse effects. This scenario is not typical unless the potential adverse effects of the vector are potentially extreme. The need for reapplication of mosquito larvicides or adulticides is surveillance driven and performed according to the label directions. The District can apply larvicide materials with different active ingredients during a single timeframe if multiple hatches of mosquito larvae occur and results in mosquito populations occurring at different stages of the life cycle. An example of this occurs when liquid Bti and methoprene are applied simultaneously. The combination of the materials is a product called Duplex, and the mixture of the materials and active ingredients is provided for on the product labels. Another example includes a pre-application of a liquid trans allethrin and phenothrin spray product, which may be used to minimize the hazard of approaching a yellow jacket nest. Situations that would produce a residual exposure adequate to cause harm to nontarget wildlife would not occur unless the application(s) were inappropriate or the timing of applications is inappropriately close. Actual applications do not generally occur close together unless a problem with treatment effectiveness occurs. After a material is applied, post-treatment inspection is performed to determine effectiveness. Only if the vectors have not been sufficiently killed would the District reapply a pesticide to the same area.

This evaluation also does not include in an analysis of impacts to food webs. 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

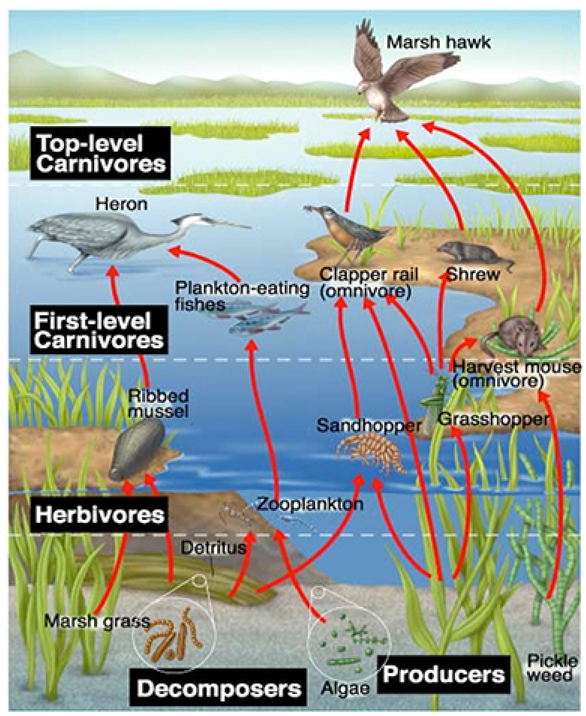

Figure 6-1 Ecological Food Web Concept

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 SDS and Toxicology profiles, providing the basis for the more reasonable, technically feasible approach to evaluate the safety of the pesticides the District commonly uses.

Pesticides can kill natural predators of mosquitoes. The District's activities associated with the Physical Control and Vegetation Management Alternatives would help allow these predators to access habitats where mosquito larvae are present. When chemical control is used to manage mosquitoes, it generally is used at levels that are below the effects thresholds for other insects and invertebrate predators, as described above. Although mosquito pesticides may also affect invertebrate predators (e.g., dragonflies), recovery of predator populations is usually rapid as the predator populations extend beyond the application areas and will rapidly replace any lost individuals. In general, the pesticides used for mosquito control exhibit low or no toxicity to birds or mammals. Limited information is available regarding toxic effects to reptile or terrestrial amphibian mosquito predators.

Mosquitoes are part of the food web and their loss may reduce the food base for some predators. Although mosquitoes serve a role as one of many types of prey items for some fish, avian insectivores, bats, and small reptiles and amphibians, the reduction of mosquito abundance over a small area will not affect the predator populations overall, as other prey sources are available. (See Section 2.8, Biological Control Predators, of Appendix E, Alternatives Analysis Report, for numerous references on studies of gut contents of mosquito predators.)

6.2.3 <u>Surveillance Alternative</u>

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 and MVCAC 2012). 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 via trapping, field inspection of known or suspected mosquito habitat, testing for the presence of SLE, WEE, and WNV antibodies in sentinel chickens or wild birds (e.g., dead specimens brought to the District), collection and testing of ticks, small rodent trapping, and/or response to public service requests regarding nuisance animals or insects (e.g., yellow jacket wasps).

The District uses preexisting roads, trails, and walkways for surveillance activities. Surveillance is conducted using ATVs, but offroad access is minimized and used only when roads and trails are not available. Therefore, habitat disturbance is minimal to negligible, reducing the potential indirect impacts to nontarget species and their habitat. 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.

Tick surveillance is conducted by collection of ticks in public contact areas and submission and identification of ticks brought in by the public. The District responds to public service requests and provides recommendations and control on nonstructural pest populations of yellow jacket wasps.

The District conducts a year-round survey of local rodent populations to assess species distribution and population control needs. Trapping activities conducted to assess the presence and abundance of rodent populations could lead to capture and mortality of nontarget organisms and, thus, trapping is used infrequently, usually for hantavirus pulmonary syndrome surveillance and other rodent-borne diseases.

> **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, streambed alteration permits), and in a manner that generally maintains or improves habitat values for desirable species. Physical control for other vectors such as rodents is based on District site inspections to determine conditions promoting infestation, and property owners are provided educational materials on control measures that include information about the removal of food sources and harborage sites and professionals to contact to remove the infestation.

The Physical Control 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 resources, including sensitive and 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 6.2.2.1, the District implements additional BMPs to avoid or minimize impacts to the marsh-specific plants and animals, the salt marsh harvest mouse, Ridgway’s rail, San Francisco garter snake, and steelhead (see Table 4-5). The District performs these activities in accordance with all appropriate environmental regulations and in a manner that generally maintains or improves habitat values for desirable species. Most of these activities occur in aquatic rather than terrestrial habitats, although by draining areas of standing water, new terrestrial habitat is created. Qualified personnel (e.g., District Biologists) survey sites to establish the presence or absence of special-status and sensitive 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 or sensitive species in California. Therefore, destruction or impairment of vernal pool habitat should be avoided under the Physical Control Alternative. The presence of special-status or sensitive species at aquatic or terrestrial sites or the presence of suitable habitat for sensitive or special-status species would result in cancellation of scheduled physical control activities.

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

Vegetation management in the form of physical removal could include the use of weed-whackers, chainsaws, and shovels. These activities could lead to physical injury to sensitive species of terrestrial plants and animals. The District applies BMPs to reduce these impacts, including the identification of sensitive 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 uses for weed control, as well as the section of Appendix B where they are described in detail.

Table 6-3 Herbicides Employed 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
Diuron*	Section 4.6.7
Benfluralin (Benefin)*	Section 4.6.8
Oryzalin	Section 4.6.9
DCPA	Section 4.6.10
Dithiopyr	Section 4.6.11
APEs*	Section 4.7.1
Modified vegetable oils and methylated seed oil	Section 4.7.3
Lecithin	Section 4.7.4

*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 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 (e.g., imazapyr, sulfometuron methyl, DCPA), while others are selective for certain plants (e.g., oryzalin, dithiopyr).

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, and oryzalin inhibits cell division during seed germination Herbicides used against annual broadleaf weeds are generally of the post-emergent variety, such as triclopyr, sulfometuron methyl, diuron, oryzalin, DCPA, and dithiopyr. 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 uses or may consider for future 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). The following have been shown to exhibit no/low toxicity to nontarget ecological receptors: DCPA (USEPA 1998a), dithiopyr (University of California Agriculture and Natural Resources 2012), sulfometuron methyl (EXTOXNET 1996), and triclopyr (EXTOXNET 1996).

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 2006a). DCPA is included in the final list of chemicals for screening under USEPA's Endocrine Disruptor Screening Program (USEPA 2009a).

The District applies BMPs to minimize the impact of herbicides on ecological receptors, including nontarget special-status terrestrial plants. In particular, the District takes 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 are safely conducted 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 uses exhibit little to no toxicity to mammals, birds, and terrestrial invertebrates. Select herbicides were identified for further evaluation based on use patterns and toxicity (Appendix B) and are discussed in further detail below (and in Section 7.2.5).

6.2.5.1.1 Glyphosate

Glyphosate is a nonselective, post-emergent, and systemic herbicide that is the active ingredient (as an acid or salt) in Alligare, AquaMaster, Buccaneer, and Roundup© products. It is designed to target a biosynthetic pathway specific to plants and some microorganisms, theoretically leading to minimal toxic effects to nontarget species such as mammals (USEPA 1993).

The potential risk of glyphosate to nontarget species has received considerable attention in recent years. The specific mode(s) of action for potential nonherbicidal glyphosate toxicity to animals has not been demonstrated, but decades of use have not clearly resulted in adverse impacts to nontarget systems. Several publications have focused on the potential toxicity of glyphosate to nontarget organisms with mixed results. However, laboratory studies to evaluate the potential adverse effects of glyphosate on ecological systems have not produced relevant adverse effects unless the exposures were substantially higher than would ever be seen in the environment. Review of reports on the developmental and reproductive effects of glyphosate and possible links to a mechanism of action on these endpoints found no consistent effects of glyphosate exposure on reproductive health or the developing offspring. As a result, no plausible mechanisms of action for such effects could be suggested (Williams et al. 2012). Research on potential glyphosate uptake and tissue concentrations in aquatic organisms has been conducted to address the potential uptake through food webs (Annett et al. 2014).

Although some laboratory studies using mortality endpoints suggest population-level impacts, such as behavioral and metabolic changes the glyphosate doses used in those laboratory tests were significantly higher than would be experienced in actual field applications (Annett et al. 2014). In addition, studies have shown that the surfactant component of glyphosate-based herbicides may be producing any toxicological effects seen across a range of organisms (Annett et al. 2014). A recent study conducted by Akcha et al. (2012) observed no adverse effects on invertebrate development over a large range of glyphosate concentrations. Mensah et al. (2015) expanded these findings to suggest that proper monitoring of all herbicide usage (including glyphosate) applications would reduce any chance of toxicity in realistic applications in the environment. It is clear that toxicological studies and risk assessments must continue to utilize the most realistic and practical herbicide concentrations in testing protocols to more closely estimate the actual potential risk to nontarget organisms.

Recently, there have been media reports about the potential for glyphosate to impact bees and bee colonies, possibly leading to Colony Collapse Disorder (CCD). Most of these reports have been based on suggestions that populations and colonies of bees are declining (Hopwood et al. 2012; Arnason 2015). These reports have been based on extrapolation of the general use of glyphosate to reports of CCD. In fact, the claims about CCD have usually been associated with applications of neonicotinoid pesticides which have been shown to be toxic to bees with direct thoracic applications of the chemical. Regardless of the potential for toxicity to bees by the neonicotinoid products, the District does not use neonicotinoid products. The label guidance and the BMP approach (BMP H12) are tailored to minimize the potential for direct bee exposure to any of the pesticides the District uses for vector control.

Other potential impacts on bee population may actually be a result of the loss of some vast areas of milkweed that bees and butterflies use for foraging and food sources. Although still an open question with numerous opinions, many associated with both the agricultural and pesticide use scenarios suggest that any adverse impacts to bees and butterflies may be largely due to the loss of milkweed (Menzies, 2015). This indirect effect is not a result of the possible toxicity of the herbicide and/or pesticide products; rather, it is likely a secondary effect and could be alleviated by the conservation of many areas containing this particular weed, which plays an important role in the life cycle of the pollinators. This indirect effect is clearly possible with the result of milkweed loss regardless of the method used to alleviate it.

Removal of mosquito predators as a result of glyphosate applications conducted for vegetation management is a potential nontarget species issue only if a significant portion of the predator population is removed for an extended time. Any impact on some individuals in an insect predator population would be short lived, and population recovery would be rapid. The number of insect predators impacted, when compared to the total population(s) of the predators, would be inconsequential in the long term. The relative impact on target insects versus the nontarget predators of a pesticide has been demonstrated in other studies as well. Davis et al. (2007) and Davis and Peterson (2008) evaluated the relation of target versus nontarget predators in tests using methoprene. Although these authors were evaluating methoprene, the demographics are similar as the lower toxicity to the predators would likely not be problematic. Similar to the results of the studies by Davis et al. (2007) and Davis and Peterson (2008), adverse effects to a few of the individuals in a nontarget predator population as a result of typical glyphosate applications would be inconsequential.

The concern about the potential for some compounds to exhibit endocrine-disruption in animals is a topic of current scientific concern and inquiry. USEPA has identified glyphosate as one of the many candidates for evaluation as a potential endocrine disruptor (USEPA 2009a). Recently, the USEPA renewed the temporary approval of a product with a combination of glyphosate and 2-4-D (Enlist-Duo) for use against weed vectors. This renewal supports the fact that it has not received any significant adverse data to negate the decision (USEPA 2014b), In fact, only very high, generally unrealistic and continued exposures of laboratory animals to the chemicals considered to be potential endocrine disruptors have been linked to the endocrine system.

Glyphosate products are effective, generally safe, products used for weed control (Gertsberg 2011) and management of vector habitat. The District strictly adheres to their vegetation management and herbicide application BMPs and product label requirements, including the restriction of glyphosate application to targets outside an adequate predetermined buffer zone separating water sources and reasonable distance from known special-status species locations (and prohibited herbicide application within this buffer without further agency consultations), which reduces the potential for impacts to special-status species or other nontarget receptors. When comparing the District use rates and application volumes of glyphosate for vegetation control, it is clear that the potential exposures to nontarget receptors would be well below levels that could remotely result in adverse effects of this herbicide. Targeted, small-scale treatments are 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 Diuron

Diuron is widely used by the District and throughout California. It is of low toxicity to mammals and birds, practically nontoxic to bees, but moderately toxic to fish and aquatic invertebrates. Diuron is used to control a wide variety of annual and perennial broad leaved and grassy weeds on both crop and noncrop sites. The mechanism of herbicidal action is the inhibition of photosynthesis. It is rapidly translocated into the stems and leaves of plants, and nontarget terrestrial plants, including sensitive species, are susceptible to its herbicidal effects.

Due to its wide use, diuron may be mobile and persistent in soil. It leaches to groundwater and can contaminate surface waters when transported from the application areas. Based on its toxicity and environmental fate, diuron presents greater risk to aquatic systems (see Chapter 4) than to terrestrial systems. When proper BMPs are applied, particularly to minimize drift (cease/prohibit application in inclement weather including precipitation and wind speed exceedance), the potential impacts of diuron to nontarget and special species plants are minimized.

The District strictly adheres to their BMPs and product label requirements, including the restriction of diuron applications to areas outside of adequate buffer zones.

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

6.2.5.1.3 Benfluralin

Benfluralin, or benefin, is a pre-emergent dinitroaniline herbicide used to control grasses on commercial and residential turf. This active ingredient volatilizes rapidly, but application practices and granular formulations are designed to slow volatilization, increasing the active life of the compound (USEPA 2004a).

Benfluralin has low mobility and variable persistence in soils. It volatilizes rapidly, but application methods are meant to slow volatilization. Benfluralin is practically nontoxic to mammals, birds, and bees on an acute basis. It is highly toxic to fish and aquatic invertebrates and is bioaccumulative. Additionally, benfluralin has been included in the final list of chemicals for screening under USEPA's Endocrine Disruptor Screening Program (USEPA 2009a). When benfluralin is applied to waterbodies, it generally binds to sediments. It also photodegrades when exposed to sunlight and does not persist in soil and sediments. Benfluralin does not generally leach into groundwater from soil applications due to its low mobility in soil. Benfluralin is used according to product label requirements and BMP application techniques, particularly those designed to minimize wind drift (cease/prohibit application in inclement weather including precipitation and wind speed exceedance) and should not result in unwanted adverse effects.

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

6.2.5.1.4 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 used for mosquito habitat control and weed control are presented in Table 6-4. The environmental fate and toxicity of adjuvants the District uses are described in detail in Appendix B. A subset of these adjuvants was identified for further examination based upon use patterns and toxicity (Appendix B) and is discussed below.

Table 6-4 Adjuvants Employed for Insect Abatement/Weed Control

Active Ingredient	Appendix B
APEs	Section 4.7.1
Modified Plant Oils	Section 4.7.3
Lecithin	Section 4.7.4

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.

Modified plant 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.

Little is known about the toxicity or environmental fate of lecithins. Lecithins (phosphatidylcholine) are naturally occurring phospholipids in biological cell membranes (Bakke 2007). Although toxicity and environmental fate information for these products is scarce, using BMP application practices, use of lecithins should not result in unwanted adverse effects to nontarget terrestrial organisms. BMPs the District employs 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-8:** 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 would be a continuation of existing activities using applicable techniques, equipment, vehicles, and watercraft.

Biological control of mosquitoes and other vectors involves the intentional use of vector pathogens (diseases), parasites, and/or predators to reduce the population size of target vectors. Biological control is employed as a method to protect the public from mosquitoes and associated diseases using mosquito parasites, pathogens, and predators. Mosquito parasites are not currently available in the commercial market. Pesticides used on mosquito larvae are bacteria and biological control. 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. A discussion of mosquitofish as a biological control and potential impacts to aquatic resources is discussed in Chapter 4.

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 *Saccharopolyspora 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 ornamental fish ponds, water troughs, water gardens, fountains, and unused swimming pools. This is sufficient to avoid impacts to special-status species in natural habitats. However, it is possible for individuals of these species or nonlisted species to enter these constructed ponds and not be able to proliferate.

> **Impact ECO-9:** 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 <u>Chemical Control Alternative</u>

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 other invertebrates (e.g., yellow jacket wasps and ticks), and rodenticides to control rats and mice. If and when inspections reveal that mosquitoes or other vector populations are present at levels that trigger the District's criteria for chemical control – based on the vector's abundance, density, species composition, proximity to human settlements, water temperature, presence of predators and other factors – staff will apply pesticides to the site in strict accordance with the pesticide label instructions. The threshold criteria for these response triggers are based on prescheduled application periods relating to the documented and previously monitored likely vector outbreaks or unwanted population expansions. Additional response triggers are based on verified outbreaks, nuisance issues, and public concern about select vectors.

The chemicals the District uses for vector control are presented in Tables 6-1 and 6-2. These pesticides are approved for commercial use by the USEPA and CDPR and, when applied with strict adherence to product label requirements, should not result in adverse effects to nontarget organisms. Detailed discussions of the environmental fate and toxicity of these active ingredients are provided in Appendix B. A subset of these chemicals was selected for further examination based upon issues regarding use patterns, environmental fate, or toxicity characteristics (Table 6-6). 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	Mosquito	Prevalent use; toxicity to aquatics and insects; potentially bioaccumulative
Etofenprox	Mosquito	Toxicity to aquatic organisms; no synergist required; potentially bioaccumulative
Bti	Mosquito	Prevalent use; public concerns
Pyrethrins	Mosquito; yellow jacket wasp; tick	Prevalent use; requires synergist (PBO)
Resmethrin	Mosquito; yellow jacket wasp	Requires synergist (e.g., PBO); potential endocrine disruptor
Permethrin	Mosquito; yellow jacket wasp; tick	Toxicity to aquatic organisms; potential endocrine disruptor
Lambda-cyhalothrin	Yellow jacket wasp	Toxicity to aquatic organisms; potential to bioaccumulate
Bromadiolone	Rat	Toxicity to nontarget organisms including mammals, birds, aquatics
Difethialone	Rat	Toxicity to nontarget organisms including mammals, birds, aquatics

See Appendix B, Table 1-1

In actual uses, the District adheres to and follows the product label guidance and its BMP H12 (below) for use of pesticides that may have an adverse impact on bees and other insect pollinators:

> "*Do not apply adulticides in 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 honeybee 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. Liquid larvicides are applied only to water bodies.*"

Other potential impacts on bee population may actually be a result of the loss of some vast areas of milkweed that bees and butterflies use for foraging and food sources. Although still an open question with numerous opinions, many associated with both the agricultural and pesticide use scenarios suggest that any adverse impacts to bees and butterflies may be largely due to the loss of milkweed (Menzies 2015). This indirect effect is not a result of the possible toxicity of the herbicide and/or pesticide products, rather, it is likely a secondary effect and could be alleviated by the conservation of many areas containing this particular weed, which plays an important role in the life cycle of the pollinators. This indirect effect is clearly possible with the result of milkweed loss regardless of the method used to alleviate it.

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 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 including Attachment B where additional literature was reviewed. The District employs practices that alleviate the potential for exposure and adverse effects to nontarget organisms (see Tables 4-3, 5-3, and 5-4 for an inventory of special-status organisms inhabiting the Program Area).

Table 6-7 Chemicals Employed for Larval Mosquito Abatement

Chemical Classification	Active Ingredient	Appendix B
Organophosphate	Temephos	Section 4.2.2
Bacterial larvicide	Bs	Section 4.3.1
Bacterial larvicide	Bti	Section 4.3.2
Bacterial larvicide	Spinosad	Section 4.3.3
Hydrocarbon ester (aliphatic hydrocarbon ester)	Methoprene	Section 4.3.4
Surfactant	Biodegradable Alcohol Ethoxylated Surfactant (monomolecular film, BVA-2, CoCoBear)	Section 4.3.5

6.2.7.1.1 Organophosphates

OP insecticides irreversibly block acetylcholinesterase activity, which causes accumulation of the neurotransmitter acetylcholine in the central nervous system, leading to excessive neuronal stimulation and then depression. OPs are quickly degraded and exhibit very low environmental persistence. The District may use OPs in rotation with other active ingredients to avoid the development of resistance.

Temephos

Temephos is a cholinesterase inhibitor registered by the USEPA in 1965 to control mosquito larvae (USEPA 2000). Temephos is the only OP employed as a mosquito larvicide. It is used in various 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-10:** The use of the OP 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, *Saccharopolyspora 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-11:** 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 and briquette varieties are also available (e.g., 90-day briquettes), which are longer-lasting and require fewer applications. This product may be more residual in the environment; however, the methoprene active ingredient in this formulation has a short half-life in water and does not migrate through soil, significantly reducing the potential for groundwater impacts.

Considered one of the safest of larvicides available, the District uses methoprene prevalently during each season of the year. Liquid and granular forms are most prevalently used in residential and ornamental pond application scenarios. Treatments to wetlands including marshes require the granular form (e.g., Altosid XRG with Bti) to penetrate dense aquatic vegetation including cattails and tules. Methoprene is also sometimes co-applied with Bti to prevent resistance and ensure all larval stages are controlled.

The larger droplet sizes of aerial (e.g., helicopter) larvicide applications (e.g., methoprene) reduces drift (compared to that of ULV sprays). In addition, aerial treatments are restricted to times when no wind occurs. Methoprene is generally applied in extremely small amounts during treatments due to its efficacy against mosquitoes even at low concentrations. For example, the District applies it at a maximum concentration of 0.5 µg/L. At this application rate, little to no toxicity occurs to nontarget aquatic organisms with the exception of some midges (*Chironomidae*) and blackflies (*Simuliidae*) (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-12:** 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 Biodegradable Alcohol Ethoxylated Surfactant (Monomolecular Film)

Monomolecular films are biodegradable 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).

Biodegradable 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.

> **Impact ECO-13:** 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 potentially used by the District include pyrethrins, synthetic pyrethroids, pyrethroid-like compounds, OPs, and synergists. Table 6-8 lists the adulticides the District uses for mosquito abatement. Several of these active ingredients, as well as a few others are also used for the control of yellow jacket wasps and, in some cases, to control tick populations that pose an imminent threat to people or to pets (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 Chemicals Employed for Adult Insect Abatement

Chemical Classification	Active Ingredient	Vector	Appendix B
Pyrethrin	Pyrethrins	Mosquito; yellow jacket wasp; tick	Section 4.1.1
Pyrethroid	d-*trans* allethrin	Yellow jacket wasp	Section 4.1.2
Pyrethroid	Phenothrin (sumithrin or d-phenothrin)	Yellow jacket wasp	Section 4.1.3
Pyrethroid	Prallethrin	Mosquito; yellow jacket wasp	Section 4.1.4
Pyrethroid	Deltamethrin	Yellow jacket wasp; tick	Section 4.1.5
Pyrethroid	Esfenvalerate	Yellow jacket wasp; tick	Section 4.1.6
Pyrethroid	Lambda-cyhalothrin	Yellow jacket wasp	Section 4.1.7
Pyrethroid	Resmethrin	Mosquito; yellow jacket wasp	Section 4.1.8
Pyrethroid	Tetramethrin	Yellow jacket wasp	Section 4.1.9
Pyrethroid	Permethrin	Mosquito; yellow jacket wasp; tick	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
Potassium salt	Potassium salts	Yellow jacket wasp	Section 4.4.1

6.2.7.2.1 Pyrethrins

Pyrethrins are naturally occurring products distilled from the flowers of certain Chrysanthemum species. Pyrethrins readily degrade in water and soil, but may persist under anoxic conditions. They tend to strongly adsorb to soil surfaces and, hence, have low potential to leach into groundwater. Pyrethrins may be highly toxic to fish (freshwater, estuarine, marine) and invertebrates, although exposures would likely be low during and following ULV applications, which are designed to prevent environmental persistence and potential impacts to nontarget ecological receptors.

The District uses pyrethrin for mosquito and/or yellow jacket wasp control. For yellow jacket wasp control, pyrethrin is applied around parks, landscaping, and directly into ground nests. For mosquito control, pyrethrin is applied to man-made and natural sites including, but not limited to, ditches and moving and standing water.

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, pyrethrin products are only used at night and during predawn hours when bees are not on the wing, and applications are canceled during less than ideal wind and potential drift conditions. For wasp (yellow jacket and paper wasps) control, the District applies pyrethrins in minute volumes directly to ground and tree/house 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. In addition, the risks to nontarget insects such as honeybees are reduced by restricting pyrethrin applications to nighttime hours when bees and other pollinators are inactive. Also, note that pyrethrins are available in can form to the public but not in vessels used for ULV applications.

> **Impact ECO-14:** The use of pyrethrins for adult mosquitoes, yellow jacket wasps, and ticks 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-trans allethrin, phenothrin (sumithrin), prallethrin, resmethrin, and tetramethrin. These pyrethroids are used to control flying and crawling insects in a number of commercial and horticultural applications and are sold for residential use and application on pets to control fleas and ticks. They have effective insect knock-down capabilities but are unstable in sunlight (highly photosensitive). The newer second-generation/“Type II” pyrethroids contain an α-cyano group, which reduces their photosensitivity, thereby increasing their persistence and toxicity. The active ingredients that fall into this group include deltamethrin, esfenvalerate, lambda-cyhalothrin, and permethrin.

Some synthetic insecticides are similar to pyrethroids, such as etofenprox, but have a slightly different chemical composition. The pyrethroids that were identified for further evaluation in Appendix B are discussed below.

Resmethrin

Resmethrin is a pyrethroid (a synthetic class of compounds modified from pyrethrins to increase stability and insecticidal specificity) and the active ingredient in Scourge®. It a restricted-use pesticide due to its toxicity to fish and is available for this use only by certified pesticide applicators or persons under their direct supervision.

Resmethrin may also be persistent in environments free of light (e.g., bound to organic matter in anoxic soils and sediments). Due to the potential for persistence and high toxicity to both aquatic and estuarine/marine fish and invertebrates, use with PBO, as well as the potential for endocrine disruption, resmethrin may be of concern from an ecological health perspective.

The District applies resmethrin to treeholes, 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.

The District uses permethrin for mosquito (marshes, wetlands) and yellow jacket wasps and ticks (residential areas, parks) control during spring, summer, and fall. Permethrin products are 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 and usage patterns, this product is generally 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. It is frequently applied to backyards and patios and sometimes directly to domestic pets. Etofenprox does not tend to persist in the environment or appear to pose a risk to mammals as it is frequently applied to backyards and patios and sometimes directly to domestic pets. It does exhibit some toxicity to fish and aquatic invertebrates; however, it degrades rapidly in surface waters, thereby reducing the potential for long-term exposures and adverse effects. Zenivex does not require synergists such as PBO; therefore, it likely exhibits less toxicity than others that require co-application. In addition, the District strictly adheres to BMPs and product label requirements. Etofenprox is generally applied during the nighttime hours when sensitive receptors such as honeybees are not active.

> **Impact ECO-15:** The use of pyrethroids and pyrethroid-like compounds (e.g., resmethrin, permethrin, and etofenprox) for mosquitoes, yellow jacket wasps, and ticks 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 2006b). It is a registered active ingredient in products used to control flying and crawling insects and arthropods in agricultural, residential, commercial, industrial, and public health settings. No products contain only PBO. It degrades quickly in soil and water but exhibits toxicity to fish and aquatic invertebrates. As a synergist, PBO is applied using the same guidelines as those for pyrethroids and pyrethrins: ULV application occurs (to prevent environmental persistence and adverse ecological effects) with backpack misters, trucks, ATVs and handheld ULV, but it is not applied when wind occurs.

> **Impact ECO-16:** The use of synergists (PBO) for mosquitoes, yellow jacket wasps, and ticks 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 acetylcholinesterase 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 usually 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 registered for use on food and feed crops, farms, dairies, and pastureland, in greenhouses, and over standing water. Although naled has been approved for use in these and other applications, currently, the District uses naled only infrequently.

Naled has been shown to be moderately toxic to a wide range of terrestrial species and birds, and moderately to highly toxic to some aquatic fish, invertebrates and honeybees. It has low water solubility but may be mobile in soils with a short half-life (< 1 day). As reported in Appendix B, environmental concentrations observed immediately after application in field tests ranged from 0.71 µg/L by truck to 20.15 µg/L from aircraft. The reported concentrations in those field tests may be artificially high, since in another field test, the environmental concentration following aerial application was 0.19 µg/L. In these field tests, naled was not detected after about 12 hours. In addition to this short half-life and low persistence, it is generally applied using ULV techniques, which are designed to further prevent environmental persistence. These techniques and the characteristics of this chemical combine to reduce 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) which also degrades rapidly in surface waters. As a result of the short half-life and potential breakdown products, short-term exposure of aquatic nontarget species to naled and dichlorvos is possible but poses little to no potential unwanted toxicity. These factors and the rapid degradation makes the exposure minimal and the potential for unwanted effects a low likelihood. Even with the possibility of some unexpected or unwanted effects, the exposure to nontarget species is so brief as to present little impact. Recovery to this level of exposure is rapid and the resulting impacts are inconsequential. See Chapters 4, Biological Resources – Aquatic, and 9, Water Resources for further details.

Drift is minimal and almost irrelevant for hand and some aerial (e.g., helicopter) applications, since treatments are localized and are restricted to times when no wind occurs. The District strictly adheres to its 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 have been established to reduce spray drift for agricultural uses.

> **Impact ECO-17:** The use of the OP naled following label guidelines and using proven BMP techniques for mosquito control would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.

6.2.7.3 Yellow Jacket Wasp and Tick Adulticides

The District also selectively applies chemicals to control ground-nesting yellow jacket wasps, as well as paper wasps that nest in trees. This activity is generally triggered by public requests for District assistance or action rather than as a result of regular surveillance of their populations. Yellow jacket nests that are off the ground would be treated under special circumstances to protect public health and safety of residents. The District has occasionally done demonstration projects with poison baits for yellow jackets, using small amounts of encapsulated insecticides in protein baits in tamper-resistant bait stations designed for yellow jackets. Tick control is conducted on a very limited basis at the request of parks, private landowners or schools and primarily as a demonstration project.

Whenever District technicians learn that a hive is situated inside or on a structure or is above ground, the resident(s) are encouraged to contact a private pest control company that is licensed to perform this work. When a technician encounters a honeybee swarm or unwanted hive, residents are referred to the County Agricultural Commissioner's Office and/or to the Beekeepers Guild of San Mateo County which maintains a referral list of beekeepers that can safely remove the bees. If District technicians deem it appropriate to treat stinging insects, they will apply the insecticide directly within the nest in accordance with the District's policies to avoid drift of the insecticide or harm to other organisms. Alternatively, they will place tamper-resistant traps or bait stations, selective for the target insect, in the immediate environment of the vector.

Pyrethroid-based chemicals are typically used against ground-nesting yellow jackets, as well as ticks. 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.

6.2.7.3.1 Lambda-cyhalothrin

Lambda-cyhalothrin is available to the public in commonly used products for residential wasp control. The District uses it for targeted application to yellow jacket and paper wasp nests. This product (0.01 percent lambda-cyhalothrin) is used as needed throughout the year. The District may use products containing this active ingredient as a courtesy to the public to assist with wasp control at residences (restricted to yards, gardens, and home exteriors).

The potential for persistence (in the absence of light) of this chemical and its toxicity to mammals, aquatic organisms (vertebrates and invertebrates), and nontarget insects such as honeybees is of concern from a potential ecological health perspective.

Although a potential exists for environmental persistence and exposure to domestic pets and nontarget receptors, this active ingredient is readily available as an insect spray and the District uses are generally focused and localized (wasp nests) to minimize or eliminate exposures. In addition, lambda-cyhalothrin is not applied to vernal pools or where bee boxes are present.

> **Impact ECO-18:** The use of lambda-cyhalothrin for yellow jacket wasps (and paper wasps) would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.

6.2.7.3.2 Potassium Salts

Potassium salts are used to control a variety of insects (e.g., yellow jacket wasps) and mosses, algae, lichens, liverworts, and other weeds in or on many food and feed crops, ornamental flower beds, house plants, trees, shrubs, walks and driveways, and on dogs, puppies, and cats. Potassium salts of fatty acids include potassium laureate, potassium myristate, potassium oleate, and potassium ricinoleate. Once applied, however, these salts are degraded quickly in soil by microbes and do not persist in the environment (USEPA 1992).

Potassium salts are of low toxicity to birds and mammals, but highly toxic to fish and aquatic nontarget invertebrates. The District does not apply potassium salts directly to water and, therefore, pose little risk to sensitive aquatic invertebrates (USEPA 1992). Currently, the District uses potassium salts infrequently. Following product label requirements and District BMPs, potassium salts may be effective in a variety of application sites with little risk to nontarget ecological receptors.

> **Impact ECO-19:** The use of potassium salts would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.

6.2.7.4 Rodenticides

The District has more recently developed a rat population control program to serve residents in the Program Area. The limited use of rodenticides by the District is not performed as result of surveillance, but in response to resident requests. Table 6-9 lists the pesticides used or proposed for use by the District for control of rats. Two different groups of anticoagulant rodenticides, including first-generation and second-generation rodenticides may be utilized by the District for rapid knock-down of rat populations. First-generation rodenticides require consecutive multiple doses or feedings over a number of days to be effective. Second-generation rodenticides are more acutely toxic and are lethal after one dose. These products are effective against rodents that have become resistant to first-generation rodenticides. A neurotoxin type of rodenticide may also be used where rapid breakdown of the active ingredient is desired to minimize the potential for secondary poisoning of nontarget animals. The description of the District rodent abatement program is provided in Section 2.3.5.3, and key activities and practices are repeated below.

Table 6-9 Chemicals Employed for Rodent Abatement

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

* Under consideration for future use

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

The District takes part in a control program that consists of baiting along aboveground public storm control waterways, primarily in residential and commercial areas including urban creeks and not in open-space or recreational areas where children may play. Bait stations may be placed at the edge of public areas, such as an untraveled edge along a fence that separates the public area from homes, or a fenceline in a remote section of a park. The bait is placed in an anchored tamper-proof bait station that only allows the target animal (mostly rats) to enter to eat the bait and then to leave the station to die. If the entrance size is compromised from animal gnawing, then the bait station is disposed of and replaced with a new one. All stations are labeled with a caution sticker, contents, and District information. All bait stations must be located a safe distance above the water line, and every effort is made to take advantage of natural vegetation and other factors to conceal the stations from children to the greatest extent possible.

All stations are placed within 50 feet of a man-made structure unless a “feature” is associated with the site beyond 50 feet that is harboring rodents that could infest the main structure. Under no circumstances are bait stations placed in areas where children are known to play. In areas where it is obvious that children do not play, the bait stations must still be adequately concealed so they are not conspicuous to the ordinary child. In addition, the areas being baited are in heavily residential areas that contain very few predatory birds and no foxes, mountain lions, or other predators. If predatory animals are present, the technician will select a less toxic bait (i.e., bromethalin, a neurotoxin that works on the nervous system to reduce the likelihood of acute death) that reduces the chance of secondary poisoning. Dead rodents are picked up and disposed of if seen during inspection periods. The baits are applied largely by a third party PCO, and the District acts as a quality control component. In certain circumstances, District staff will place the bait stations themselves. The bait is monitored regularly and, depending on results, may be moved to other locations if rodent activity is low. Bait stations may also be placed in public rights-of-way and on public property but not where children play.

6.2.7.4.1 Anticoagulants

As their name suggests, anticoagulants function by inhibiting the production of blood-clotting factors. First-generation compounds (e.g., chlorophacinone, diphacinone) are effective if consumed over multiple doses (typically ranging from 0.005 to 0.1 percent). Chlorophacinone is currently registered for the control of rodents in and around buildings and residences, industrial areas, and food processing, handling, and storage areas and facilities. Diphacinone baits are typically used in/ around buildings and similar man-made structures.

The newer second-generation compounds (e.g., brodifacoum, bromadiolone, difethialone) exhibit the same mode of action as their first-generation counterparts, but are fatal to rodents after a single dose (typically 0.001 to 0.005 percent). The acute toxicity of second-generation rodenticides presents a greater hazard to wildlife and pets as they are retained much longer in body tissues of primary consumers (Hartless and Jones 2011). Second-generation anticoagulants also have a significantly longer liver half-life than first generation anticoagulants (Hartless and Jones 2011). Brodifacoum has the greatest acute toxicity of the Program rodenticides, but the District uses it very infrequently. Anticoagulants may pose some risk to secondary avian predators and scavengers (e.g., birds of prey, coyotes), which may feed on poisoned rodents. The District will remove dead rodents in aboveground areas if seen when checking on bait stations, and stations are not placed in wildlife refuges or habitat conservation areas. The focus is on controlling rats in residential areas, urban creek corridors, and sewer vaults. In addition, small mammals and ground-foraging birds could be at risk from primary consumption of anticoagulant rodenticides. However, primary risks to mammals and avian receptors are reduced by proper use of bait stations, which preclude entry of larger nontarget wildlife.

Products containing second-generation active ingredients are no longer available to the general public. These products remain available to professional pest control personnel, and strict adherence to product label requirements and District BMPs (especially BMPs H15 and H16) can ensure their safe use for controlling and eradicating nuisance rodent populations, including the use of tamper-proof bait stations; securing bait stations at deployment locations to prevent disruption and/or removal by wildlife; and proper education of citizens including residents about the potential risk to pets, wildlife, and children.

> **Impact ECO-20**: The use of first- and second-generation anticoagulants would result in a **less-than-significant** impact to nontarget ecological receptors and no mitigation is required.

The anticoagulant rodenticides, bromadiolone and difethialone, that were selected for further evaluation in Appendix B are discussed below. In addition, bromethalin, a neurotoxin rodenticide sometimes employed when anticoagulants lose efficacy on targeted rodent populations (considered for future use by the District) is also described.

Bromadiolone

Bromadiolone, the active ingredient in Contrac products, is a second-generation anticoagulant rodenticide. It is moderately persistent in soils and is generally applied as food bait blocks or pellets. Bromadiolone is highly toxic to mammals, domestic pets, and nontarget mammalian wildlife. Bromadiolone is often found in the tissues of wildlife, including avian and mammalian predators. Bromadiolone is also usually wax-encased (e.g., Contrac Blox) in block form, which has exceptionally low water solubility and low leaching potential. Therefore, risk to downstream waterbodies is negligible.

Bromadiolone is a single-dose rodenticide that when used properly (such as in the absence of food competition), causes rapid knock-down of rat populations and very limited potential for impacting aquatic systems resulting in exposure to nontarget wildlife.

The District adheres to BMPs (especially BMPs H15 and H16) and product label requirements when using this rodenticide in residential locations, urban creek corridors, and sewer vault settings. Bromadiolone blocks are sometimes deployed in sewers, suspended by a string usually below manhole covers. This method of bait deployment reduces the probability of exposure (by multiple routes) to nontarget wildlife. This technique essentially negates the possibility of unwanted dietary exposure to ground-foraging birds and mammals present above ground. The rapid mortality that results for target rodents in sewers prevents the likelihood for ingestion by secondary terrestrial consumers.

The District also places bromadiolone baits above ground in tamper-proof bait stations, which are also anchored at treatment locations (e.g., wires, stakes, etc.) to ensure that they cannot be dragged away by wildlife. The District provides public outreach regarding their practices, such as educating citizens about the locations of deployed bait stations and potential risks to pets and children.

The District will consider new, more protective rodenticide bait stations (reported by USEPA 2008a; http://www.epa.gov/rodenticides/ rodent-control-pesticide-safety-review) as those products become available. The use of such alternatives to bromadiolone would reduce the potential for exposure and impact to nontarget ecological receptors, including birds and small mammals, even further than occurs at present.

> **Impact ECO-21:** The use of the anticoagulant bromadiolone would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.

Difethialone

Difethialone is persistent in soils and is generally applied as food bait blocks or pellets. This second-generation rodenticide is highly toxic to mammals, domestic pets, and nontarget mammalian wildlife. Difethialone is often found in the tissues of wildlife, including avian and mammalian predators. Difethialone has been categorized as “likely to adversely affect” several species of sensitive California wildlife, and registered uses of difethialone exceed the (lowest observed concentration) for effects related to both primary and secondary exposure. Indirect effects to habitat have been suggested for areas where difethialone is used for pest control (Housenger and Melendez 2011).

The District would adhere to BMPs and product label requirements when using this rodenticide in residential locations, urban creek corridors, and sewer vault settings. Difethialone baits are deployed in tamper-proof bait stations, which are also anchored at treatment locations (e.g., wires, stakes, etc.) to ensure that they cannot be dragged away by wildlife *BMP H16). The District provides public outreach regarding their practices, such as educating citizens about the locations of deployed bait stations and potential risks to pets and children (see Chapter 7, Human Health).

The District will consider new, more protective rodenticide bait stations (reported by USEPA 2008a; http://www.epa.gov/rodenticides/ rodent-control-pesticide-safety-review) as those products become available. The use of such alternatives to the anticoagulant difethialone would reduce the potential for exposure and impacts to nontarget ecological receptors, including birds and small mammals, even further than occurs at present.

Impact ECO-22: The use of the anticoagulant difethialone would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.

Chemical Nervous System Toxins (Bromethalin)

Bromethalin is used to kill rodents that have become resistant to anticoagulants or where risk of secondary poisoning could occur. Because its name resembles that of the anticoagulant baits bromadiolone and brodifacoum, bromethalin is often mistaken for anticoagulant bait (Dunayer 2003). Bromethalin is a unique highly potent rodenticide exhibiting a mode of action different from anticoagulant rodenticides because it provides a lethal dose to rodents in a single feeding with death generally delayed 2 to 3 days. Because the mode of action is a delayed response, the neurological effect (uncoupling of oxidative phosphorylation, leading to decreased cellular ATP production and failure of Na+, K+-ATPase pumps), bromethalin is relatively safe to most nontarget species. Toxicological data indicate that bromethalin bait is safer for predators because the delayed action allows the target species to survive while the neurological effect takes place and the chemical concentration decreases. Bromethalin is considered safer to the environment and some products currently meet USEPA's new, more protective risk reduction standards. When applied properly, these products present a lower risk of accidental exposure to children, pets, and wildlife, and USEPA has proposed them as safer alternatives to anticoagulants. They would be applied in tamper-resistant and weather-resistant bait stations (USEPA 2013a), which prevent entry by small mammals and birds. Bait stations are secured to the ground or structures to avoid being dragged away by wildlife from deployment locations (BMP H16). The District educates citizens about the locations of deployed bait stations and potential risks to pets.

Impact ECO-23: The use of the neurotoxin bromethalin would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.

6.2.7.4.2 Sterol (Cholecalciferol)

Cholecalciferol is a sterol (Vitamin D3) and its ingestion results in hypercalcemia from mobilization of calcium from bone matrix into blood plasma leading to metastatic calcification of soft tissues (Clock-Rust and Sutton 2011). Use of this compound usually requires "prebaiting" prior to addition of the chemical to achieve adequate bait acceptance. Although it is highly toxic to target rodents, cholecalciferol is considered of low hazard to nontarget ecological receptors.

Residential treatments would involve bait station deployment generally within 50 feet of homes. Bait stations would be anchored to treatment locations (e.g., wires, stakes) to ensure that they cannot be dragged away by wildlife. In addition, bait stations have small openings that prevent the entrance and exposure to nontarget small mammals (e.g., squirrels, skunks, etc.). Residents are properly educated regarding the location of deployed tamper-proof bait stations and potential risks to children and pets.

Impact ECO-24: The use of cholecalciferol would results in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.

6.2.7.4.3 Fumigants

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

Elemental sulfur, when applied as a pesticide, will become incorporated into the natural sulfur cycle. The main processes and dissipation of elemental sulfur are oxidation into sulfate and reduction into sulfide.

These processes are mainly mediated by microbes (USEPA 2008b). Sulfur is nontoxic to mammals, birds, and bees.

Sodium nitrate fumigants work by the combustion of charcoal in the formulation of each product. Pyrolysis of these sodium nitrate products results in simple organic and inorganic compounds, mostly in the form of gases such as nitrous oxide and carbon monoxide, which eventually diffuse through burrow openings or into the soil causing organisms to die of asphyxiation (USEPA 1991a). Sodium nitrates are naturally occurring substances and exposure of the environment is limited and localized when the products are used as fumigants in burrows (USEPA 1991b). When used as indicated by the product label, any organism inside of a treated burrow would likely be killed by the toxic fumes. The District would not apply sodium nitrate fumigants when evidence of nontarget animal presence exists (see Chapter 5). The District would employ BMPs to determine the presence of sensitive or special-status species and determine whether or not the use of fumigants is appropriate. These practices reduce or eliminate the potential exposure of sensitive or special-status species.

Impact ECO-25: The use of fumigants would result in a **less-than-significant** impact to nontarget receptors and mitigation is not required.

6.2.8 Other Nonchemical Control/Trapping Alternative

The trapping of rodents (or other nuisance wildlife) is conducted when these organisms pose a threat to public health and welfare. For this vector species, District staff place the tamper-resistant or baited trap(s) primarily at the request of the property owner or manager. The District does not remove rats that are in or on structures. When these requests are made, residents are referred to the local animal control or to a directory of private pest control companies. Trapping is also used for the removal of nuisance wildlife such as ground squirrel, raccoon, skunk, and opossum when these animals pose a threat to public health and safety. The District conducts limited trapping for vectors and nuisance wildlife, employing mechanisms and baits specific to target pests to reduce the potential impacts to nontarget ecological receptors.

Impact ECO-26: The Other Nonchemical Control/Trapping Alternative would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.

6.2.9 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 and vector 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 San Mateo County Mosquito and Vector County District's Program Area for 2006-2010 and Table 13-2, Pesticide Use within the San Mateo County Mosquito and Vector County District's Service Area.

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 and vector 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.

6.2.10 Environmental Impacts Summary

Table 6-10 presents a summary of impacts to ecological health associated with the six alternatives compared to existing conditions.

Table 6-10 Summary of Ecological Health Impacts by Alternative

Impact Statement	Surveillance	Physical Control	Vegetation Management	Biological Control	Chemical Control	Other Nonchemical/ Trapping
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	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	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	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	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	na
Impact ECO-6: The use of diuron would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.	na	na	LS	na	na	na
Impact ECO-7: The use of benfluralin would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.	na	na	LS	na	na	na
Impact ECO-8: 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	na

Table 6-10 Summary of Ecological Health Impacts by Alternative

Impact Statement	Surveillance	Physical Control	Vegetation Management	Biological Control	Chemical Control	Other Nonchemical/ Trapping
Impact ECO-9: 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	na
Impact ECO-10: The use of the OP temephos would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.	na	na	na	na	LS	na
Impact ECO-11: 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	na
Impact ECO-12: 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	na
Impact ECO-13: 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	na
Impact ECO-14: The use of pyrethrins for adult mosquitoes, yellow jacket wasps, and ticks 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	na
Impact ECO-15: The use of pyrethroids and pyrethroid-like compounds (e.g., resmethrin, permethrin, and etofenprox) for mosquitoes, yellow jacket wasps, and ticks would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.	na	na	na	na	LS	na
Impact ECO-16: The use of synergists (PBO) for mosquitoes, yellow jacket wasps, and ticks would result **in** a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.	na	na	na	na	LS	na

Table 6-10 Summary of Ecological Health Impacts by Alternative

Impact Statement	Surveillance	Physical Control	Vegetation Management	Biological Control	Chemical Control	Other Nonchemical/ Trapping
Impact ECO-17: The use of the OP naled following label guidelines and using proven BMP techniques for mosquito control would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.	na	na	na	na	LS	na
Impact ECO-18: The use of lambda-cyhalothrin for yellow jacket wasps (and paper wasps) would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.	na	na	na	na	LS	na
Impact ECO-19: The use of potassium salts would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.	na	na	na	na	LS	na
Impact ECO-20: The use of first- and second-generation anticoagulants would result in a **less-than-significant** impact to nontarget ecological receptors and no mitigation is required.	na	na	na	na	LS	na
Impact ECO-21: The use of the anticoagulant bromadiolone would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.	na	na	na	na	LS	na
Impact ECO-22: The use of the anticoagulant difethialone would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.	na	na	na	na	LS	na
Impact ECO-23: The use of the neurotoxin bromethalin would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.	na	na	na	na	LS	na
Impact ECO-24: The use of cholecalciferol would results in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.	na	na	na	na	LS	na
Impact ECO-25: The use of fumigants would result in a **less-than-significant** impact to nontarget receptors and mitigation is not required.	na	na	na	na	LS	na

Table 6-10 Summary of Ecological Health Impacts by Alternative

Impact Statement	Surveillance	Physical Control	Vegetation Management	Biological Control	Chemical Control	Other Nonchemical/ Trapping
Impact ECO-26: The Other Nonchemical Control/Trapping Alternative would result in a **less-than-significant** impact to nontarget ecological receptors and mitigation is not required.	na	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

6.2.11 Mitigation and Monitoring

Although application scenarios are conducted using rigorous, strict BMPs 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 control and treatment results on a routine basis. Receipt of information about vector outbreaks or unwanted population expansion of pest vectors 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. However, the District will research new, more protective rodenticide bait stations (reported by USEPA 2008a; http://www.epa.gov/rodenticides/ rodent-control-pesticide-safety-review), and will consider them for use in addition to present formulations as those new products become available.

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