7 Human Health

Chapter 7 evaluates whether the Program alternatives would cause any potentially significant impacts to human health. Results of the evaluation are provided at the programmatic level. Section 7.1, Environmental Setting, presents an overview of the District's human population and growth estimates and the federal and state regulations that are applicable to the Program. Section 7.2, Environmental Impacts and Mitigation Measures, presents the following:

> Environmental concerns and evaluation criteria

> Discussion of methods and assumptions

> Discussion of potential impacts of the Program alternatives, and mitigation measures, if necessary, for those impacts

> Cumulative impacts summary

> A summary of estimated impacts to human health

Potential ecological health impacts are addressed in Chapter 6.

7.1 Environmental Setting

The Program Area is defined as the Marin/Sonoma Mosquito and Vector Control District (MSMVCD or the District) and surrounding counties including Lake, Mendocino, Napa, and Solano wherein the District could be called in to assist the county with control of unwanted vectors. The following section provides background information on the population in the Program Area, hazards and exposure, and environmental fate and toxicity of pesticides that may be used by the District and an overview of the regulatory setting with respect to chemical treatment using pesticides.

7.1.1 Population Characteristics of the Program Area

The size of the population in the District's two-county Service Area and the larger Program Area (adjacent four counties) are shown in Table 7-1. In 2010, the population of California was estimated at 37.3 million (US Census Bureau 2010b). The population of the six counties in the District's Program Area is approximately 1.44 million, which represents 4 percent of the statewide total (see Table 7-1).

Table 7-1 Population and Growth in the MSMVCD Program Area (1990–2010)

	Population			Population Growth (Compound Annual Average)	
County* / Area	**1990**	**2000**	**2010**	**1990–2000**	**2000–2010**
Lake	50,631	58,538	64,665	1.46%	1.00%
Marin	230,096	247,289	252,409	0.72%	0.21%
Mendocino	80,345	86,407	87,841	0.73%	0.16%
Napa	110,765	124,279	136,484	1.16%	0.94%
Solano	340,421	394,542	413,344	1.49%	0.47%
Sonoma	388,222	458,614	483,878	1.68%	0.54%
Six-County Area	1,200,480	1,369,669	1,438,621	1.33%	0.49%
Statewide Area	**29,760,021**	**33,871,648**	**37,253,956**	**1.30%**	**0.96%**

*Counties in bold represent the District's Service Area.

The California Department of Finance projects steady population growth in the future, with total state population reaching over 44 million by 2030. These projections represent a compound annual average population growth of 0.86 percent.

7.1.2 Hazards, Toxicity, and Exposure 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 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 nontarget humans and wildlife.

Risk assessments conducted to estimate potential adverse impacts to humans include special focused parameters to include children, seniors, and numerous possible human receptor categories based on their likely activity and exposure scenarios. Each of the chemical active ingredients included in this document have undergone extensive evaluations addressing each of the categories of likely activity and exposure and the resulting indicators of risk are provided with a typical range of 10^{-4} to 10^{-6} (one in one thousand to one in a million) to illustrate the estimated risks. This process, conducted using the USEPA guidelines, provides the relative risk to each category of activity for typical human populations. The resulting information is used by the District in its determination of chemicals to use for vector control. The typical volumes and vector control applications of the chemicals discussed in this document are far lower than would be of any concern in a human health risk estimate.

To address the potential risks to special populations of humans, risk assessments are conducted by the chemical company scientists and validated by the USEPA to estimate potential adverse impacts to humans, including special parameters to include children, seniors, and numerous possible human recreational activities, and professional applicators. Some groups of people, such as the elderly, people with health conditions, pregnant women, and infants and children, could be more sensitive to a pesticide due to special exposure conditions and life stage. The regulatory agencies in their recommended risk assessment process emphasize addressing the potential impact to sensitive individuals and populations of humans.

Children: Special parameters considered for children are included in the USEPA's risk assessments to consider the potential susceptibility of children due to several special conditions. Children are evaluated as a separate population using child-specific temporal and physical exposure factors, which address the following:

> Children may have greater exposures to some environmental contaminants than adults (for example, through increased consumption per body weight of certain foods that may be contaminated).

> Behavior patterns, such as playing close to the ground and hand-to-mouth activity, also may increase their exposure to contaminants.

> Children may be more vulnerable to environmental hazards because their organ systems are still developing and may be sensitive to certain chemicals.

> Children also may differ from adults in their metabolism, detoxification, and excretion of some chemicals.

Edlerly persons; In comparison to adult residents, the liver and kidneys of the elderly may become less able to remove chemicals so that older adults may have health problems after a pesticide exposure because the chemical may have more time to react. Consequences of chemical exposure to some elderly persons may be exacerbated by depressed immune and disease-fighting systems, although difficult to assess as a direct effect of the chemical. Although some additional concern may exist about exposures of the elderly to pesticides, their sensitivity to chemicals generally follows similar patterns of "adult residents" in the risk process but are provided an additional measure of consideration if these exposures are particularly likely (i.e., gardening, etc.).

For human risks, the primary animal models are rats, mice, and rabbits. Extrapolations to humans then involve several large safety factors that essentially "dilute" the likely exposure levels to assure risk-averse human exposures (i.e., the rat data for an effect are divided by several orders of magnitude for potential human effects). These tests ensure the likely safety of the chemical of interest under the proposed usage scenarios.

7.1.2.1 Toxicity and Exposure

Toxicology is the study of a compound's potential to elicit an adverse effect in an organism. The toxicity of a compound is dependent upon the following:

> exposure, including the specific amount of the compound that reaches an organism's tissues (i.e., the dose),

> duration of time over which a dose is received, the potency of the chemical for eliciting a toxic effect (i.e., the response), and

> the sensitivity of the organism receiving the dose of the chemical.

Toxicity effects are measured in controlled laboratory tests on a dose/response scale, in which the probability of a toxic response generally increases as the 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 document are generally derived from rigidly controlled laboratory animal studies designed to determine the potential adverse effects of the chemical under several possible routes of exposure. In these studies, the species of interest is exposed to 100 percent chemical at several doses to determine 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 using 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 generated using laboratory tests (and some limited field tests) are intended as an overview of potential issues that might be associated with maximum direct exposures. This information is used to develop and recommend guidance for use that should provide 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 effects 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 material safety data sheets (MSDSs),[1] in actual practice, the amounts actually applied by the District within the District's Program Area are often substantially less than the amounts used in the laboratory toxicity studies. Because of these large safety factors used to develop recommended product label application rates, the amount of chemical resulting in demonstrated toxicity in the laboratory is much higher than the low exposure levels associated with an actual application for vector control. 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 careful use of BMPs and advance planning by the District.

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.

7.1.2.2 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. In general, when a compound or its breakdown products decomposes rapidly in the environment and does not persist for extended periods, then the compound or product poses a lower risk to nontarget species and a lower potential for environmental impacts. Appendix B, *Ecological and Human Health Assessment Report*, 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.

[1] Although the MSDS format is referenced in this document, it should be noted 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).

7.1.3 Program Pesticides and the Environment

The pesticide and herbicide active ingredients included in the Proposed Program are listed in Tables 7-2 and Table 7-3, respectively. Appendix B provides the results of review and evaluations of the active ingredients and adjuvants the District currently uses or proposes to use to control vectors and manage vegetation that provides habitat for mosquitoes.

Table 7-2 Pesticide Active Ingredients

Active Ingredient	Vector
Biodegradable Alcohol Ethoxylated Surfactant	Mosquito (larvae and pupae)
Aliphatic Solvents (e.g., mineral oil, aliphatic petroleum hydrocarbons)	Mosquito (larvae and pupae)
Methoprene	Mosquito (larvae)
Bacillus sphaericus (Bs)	Mosquito (larvae)
Bacillus thuringiensis israelensis (Bti)	Mosquito (larvae)
Spinosad	Mosquito (larvae)
Deltamethrin	Yellow jacket wasp, tick
Tetramethrin	Yellow jacket wasp
Permethrin	Mosquito (adults)
Pyrethrins	Mosquito/yellow jacket wasp, tick
Resmethrin	Mosquito (adults)
Phenothrin	Mosquito/yellow jacket wasp
Allethrins and d-*trans*-allethrin	Yellow jacket wasp, tick
Prallethrin	Mosquito (adults)
Esfenvalerate	Yellow jacket wasp, tick
Etofenprox	Mosquito/yellow jacket wasp
Piperonyl Butoxide (PBO)	Mosquito/yellow jacket wasp

Table 7-3 Herbicide Active Ingredients and Adjuvants

Active Ingredient	Vector
Imazapyr	Vegetation
Glyphosate	Vegetation
Triclopyr	Vegetation
Alkylphenol Ethoxylates (APEs)	Vegetation
Modified Plant Oil/Methylated Seed Oil	Vegetation
Lecithin (phosphatidylcholine)	Vegetation
Aliphatic Polycarboxylate	Vegetation

7.1.4 Regulatory Environment

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.

7.1.4.1 Federal

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

7.1.4.1.1 Federal Insecticide, Fungicide, and Rodenticide Act

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

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

7.1.4.1.2 Federal Food, Drug, and Cosmetic Act

The FFDCA authorizes the USEPA to set tolerances (i.e., maximum allowable amounts) for pesticide residues in/on food. Thus, the FFDCA does not expressly regulate pesticide use, but exceedance of tolerances may result in prosecution or changes in the approved use of a pesticide regulated under FIFRA.

7.1.4.1.3 Clean Water Act and National Pollutant Discharge Elimination System

The CWA establishes the principal federal statutes for water quality protection "to restore and maintain the chemical, physical, and biological integrity of the nation's water, to achieve a level of water quality which provides for recreation in and on the water, and for the propagation of fish and wildlife."

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

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

7.1.4.1.4 Safe Drinking Water Act of 1974

Under the Safe Drinking Water Act of 1974, the USEPA establishes Maximum Contaminant Levels (MCLs), which are specific concentrations that cannot be exceeded for a given contaminant in surface water or groundwater. USEPA has the ability to enforce these nationwide standards or delegate administration and enforcement duties to state agencies. The CDPH administers the federal Safe Drinking Water Act in California.

7.1.4.1.5 California Toxics Rule

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

7.1.4.2 State of California

California's programs for the registration of pesticides and commercial chemicals parallel federal programs, but many of California's requirements are stricter than federal requirements. The Cal/EPA regulates registration of pesticides and commercial chemicals in California. Within Cal/EPA, the CDPR oversees pesticide evaluation and registration through use enforcement, environmental monitoring, residue testing, and reevaluation. The CDPR works with County Agricultural Commissioners, who evaluate, develop conditions of use, approve, or deny permits for restricted-use pesticides; certify private applicators; conduct compliance inspections; and take formal compliance or enforcement actions. The Secretary of Resources has certified California's pesticide regulatory program as meeting CEQA requirements (CDPR 2006).

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

7.1.4.2.1 Porter-Cologne Act and State NPDES Permitting

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

The SWRCB oversees pesticide NPDES permitting in California. Users of selected 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 that require state NPDES permitting include Bti, Bs, temephos, spinosad, petroleum distillates, naled, pyrethrin, permethrin, resmethrin, prallethrin, PBO, etofenprox. Permits are discussed in detail in Chapter 9, Section 9.1.2.2.9.

7.1.4.2.2 Safe Drinking Water Act 1976

The CDPH administers the federal Safe Drinking Water Act in California. In addition to enforcing the primary MCLs (discussed above in Section 7.1.4.1), CDPH uses as guidelines Secondary MCLs that regulate constituents that affect water quality aesthetics (such as taste, odor, or color).

Additionally, under the California Safe Drinking Water Act, Cal/EPA's Office of Environmental Health Hazard Assessment develops Public Health Goals (PHGs) for contaminants in California's publicly supplied drinking water. PHGs are concentrations of drinking water contaminants that pose no significant health risk if consumed for a lifetime, based on current risk assessment principles, practices, and methods. Public water systems use PHGs to provide information about drinking water contaminants in their annual Consumer Confidence Reports.

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

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

7.1.4.2.4 California Pesticide Regulatory Program

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

7.2 Environmental Impacts and Mitigation Measures

This section evaluates the potential impacts from the Program alternatives, focusing on the human health impacts specific to the use of selected chemical and biological pesticides.

7.2.1 Evaluation Concerns and Criteria

The public has indicated concerns about some of the following issues. While not required, the responses to the concerns help to direct the reader to the appropriate section or Appendix B, *Ecological and Human Health Assessment Report*, or they provide explanatory information in concise form.

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

- Potential Chemical Control Alternative impacts are discussed in Section 7.2.7, and toxicity of individual active ingredients is evaluated in greater detail in Appendix B.
- Risk assessments conducted to estimate potential adverse impacts to humans include special focused parameters to include children, seniors, and numerous possible human receptor categories based on their likely activity and exposure scenarios. Each of the chemical active ingredients included in this document have undergone extensive evaluations addressing each of the categories of likely activity and exposure and the resulting indicators of risk are provided with a typical range of 10^{-4} to 10^{-6} (one in one thousand to one in a million) to illustrate the estimated risks. This process, conducted using the USEPA guidelines provides the relative risk to each category of activity for typical human populations. The resulting information is used by the District in its determination of chemicals to use for vector control. The typical volumes and applications of the chemicals discussed in this document are far lower than would be of any concern in a human health risk estimate. The resulting additional modifications to recommended vector control applications (District BMPs) are designed, and have been shown, to reduce risk to these especially sensitive human populations. See Section 7.1.2 for more information.

> The PEIR must list any and all biological or chemical agents proposed for use.

- The biological and chemical pesticide formulations included in the Program are listed in Table 7-2, Pesticide Active Ingredients and Table 7-3, Herbicide Active Ingredients and Adjuvants.

> CDPH should be consulted to ensure all potential risks are identified, characterized, and evaluated.

- The PEIR document and information will be made publicly available and will be reviewed by the appropriate regulatory bodies.

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

- BMPs to reduce exposure to humans and human use areas are discussed in Chapter 2 (Table 2-6), Section 7.2.7 herein, summarized in several other relevant chapters (e.g., Chapters 4 and 6), and evaluated in greater detail in Appendix B.

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

- Etofenprox, the active ingredient in Zenivex®, is discussed in Section 7.2.7.2.2 and evaluated in greater detail in Appendix B. It does not require concomitant use of a synergist, such as PBO. Therefore, it likely exhibits less toxicity than others that require co-application with other chemicals. Based on toxicity, environmental fate, and usage patterns, etofenprox is not likely to result in unwanted adverse impacts to humans when BMPs are used.

> Concerned that adulticides present danger to humans, as many are known carcinogens and endocrine disruptors.
  - The District's BMPs provide that adulticides are generally applied using ULV techniques to minimize exposure to nontarget species. Aerial and ground application techniques are used to distribute the insecticides. The potential toxicity of the various adulticides included in the Program are discussed in Section 7.2.7-and evaluated in greater detail in Appendix B.

> Concerned that pyrethrins disrupt the normal functioning of sex hormones, while PBO affects the functioning of hormone-related organs.
  - The District generally uses pyrethrins in ULV applications, which are designed to prevent environmental persistence and potential impacts to nontarget species.
  - As a synergist for pyrethrins and pyrethroids, PBO is also generally applied in ULV, and it degrades rapidly in soil and water. Its potential toxicity is discussed in Appendix B.

> How long are pesticides retained in humans (young infant through elderly), pets, home garden vegetables and fruit, etc.?
  - The half-lives of the 42 active ingredients and 4 adjuvants/surfactants used by 9 vector control districts/agencies are listed in Appendix B.

> In addition to short-term effects, what are the long-term effects of repeated exposure to these chemicals?
  - The chronic effects of the various pesticides are discussed in detail in Appendix B.

The CEQA Guidelines Appendix G, *Environmental Checklist Form*, does not contain criteria for determining significance of impacts to human health from the use of pesticides and herbicides. The criteria for hazards and hazardous materials (Checklist Section VIII) are primarily addressed in Chapter 8. However, the first criterion is partly applicable and asks would the project:

> a. Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?

The applicability is for the use of these chemicals. In short, the determination of significance is based on the potential to adversely affect human health based on existing data and application methods including label requirements and additional BMPs the District employs (see Section 2.9). The specific concern is whether the activities used to control pest species could result in direct or indirect impacts to human populations in a treatment area in the short term (i.e., acute toxicity) or over the long term (i.e., chronic toxicity).

7.2.2 Evaluation Methods and Assumptions

Pesticides the District uses were investigated to provide a preliminary assessment of the potential impacts to humans (discussed in detail in Appendix B). A comprehensive literature review was conducted, and the District supplied information to assess potential exposure and toxicity. Information collected included the following:

> 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

> Efficacy of the pesticide to eradicate the target pest

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

Each of the pesticides identified as warranting further evaluation in Appendix B are known to exhibit at least one parameter that appears to exhibit 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. All BMPs are described in Chapter 2 (Table 2-6), and the most relevant BMPs for avoidance or minimization of impacts to human health are repeated below. These BMPs are part of the Program description and are important in making significance determinations under CEQA.

For all currently used Program alternatives, the District applies the following BMPs:

> Operation of noise-generating equipment (e.g., chainsaws, wood chippers, brush-cutters, pickup trucks) will abide by the time-of-day restrictions established by the applicable local jurisdiction (i.e., City and/or County) if such noise activities would be audible to receptors (e.g., residential land uses, schools, hospitals, places of worship) located in the applicable local jurisdiction. Shut down all motorized equipment when not in use. (BMP A11)

> For operations that generate noise expected to be of concern to the public, the following measures will be implemented: (BMP A12)

  - *Measure 1.* Provide Advance Notices: A variety of measures are implemented depending on the magnitude/nature of the activities the District undertakes and may include, but are not limited to, press releases, social media, district websites, emails, phone messages, hand-delivered flyers, and posted signs. Public agencies and elected officials also may be notified of the nature and duration of the activities, including the Board of Supervisors or City Council, environmental health and agricultural agencies, emergency service providers, and airports.

  - *Measure 2.* Provide Mechanism to Address Complaints: District staff is available during regular business hours to respond to service calls and address concerns about nighttime operations.

> The District will perform public education and outreach activities. (BMP A13)

> To minimize air and GHG emissions, engine idling times will be minimized either by shutting equipment and vehicles off when not in use or by reducing the maximum idling time to 5 minutes. Clear signage will be provided for workers at all access points. Correct tire inflation will be maintained in accordance with manufacturer's specifications on wheeled equipment and vehicles to prevent excessive rolling resistance. All equipment and vehicles will be maintained and properly tuned in accordance with manufacturer's specifications. All equipment will be checked by a certified visible emissions evaluator if visible emissions are apparent to onsite staff. (BMP A14)

> A hazardous spill plan will be developed, maintained, made available, and staff trained on implementation and notification for petroleum- based or other chemical-based materials prior to commencement of vector treatment activities. (BMP I5)

> Equip all vehicles used in wildland areas with a shovel and/or a fire extinguisher during the fire season. (BMP J1)

> Train employees on the safe use of equipment and machinery, including vehicle operation. (BMP J2)

> District will regularly review and update their existing health and safety plan to maintain compliance with all applicable standards. Employees will be required to review these materials annually. (BMP J3)

For five Program alternatives, only excluding Biological Control, the following BMPs are protective of human health:

> 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)

For the Vegetation Management and Chemical Control Alternatives, the District uses the following BMPs:

> 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)

> 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 J4)

> 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 J5)

> 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 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 (e.g., within 24 inches of vegetation for hand application) or vectors. Adjusting droplet size would only apply to larvicides, herbicides, and non-ULV applications. Use ULV applications that are calibrated to be effective and environmentally compatible at the proper droplet size (about 10 to 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)

> 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)

> 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 infrequently applies or participates in the application of herbicides in areas other than District facilities. (BMP H13)

> 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)

> Maintain a pesticide spill cleanup kit and proper protective equipment at the District's Service Yard and in each District truck used for pesticide transport. (BMP I2)

> Manage spill sites to prevent entry by unauthorized personnel. Contain and control the spill by stopping it from leaking or spreading to surrounding areas, cover dry spills with polyethylene or plastic tarpaulin, and absorb liquid spills with appropriate absorbent materials. (BMP I3)

> Properly secure the spilled material, label the bags with service container labels identifying the pesticide, and deliver them to a District Supervisor for disposal. (BMP I4)

> Field-based mixing and loading operations will occur in such a manner as to minimize the risk of accidental spill or release of pesticides. (BMP I6)

This evaluation assumes that all pesticides are applied in accordance with label instructions and USEPA and CDPR requirements (and in consideration of the local context for that area, i.e., nearby area land uses and habitats). 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 listing of target organisms, 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. This evaluation assumes that important parameters, such as media half-life, are dependent on the specific conditions at the time of pesticide application, and values listed herein 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. If products with a similar or even different active ingredient are applied simultaneously, it is likely that the net effect could be the sum of the effects of active ingredients to the vector. However, for vector control applications materials with the same active ingredient are not applied to the same specific area simultaneously at a given site. The need for reapplication of mosquito larvicides or adulticides is surveillance driven and performed per the label directions. The District can apply larvicide materials with different active ingredients during a single application. This type of application is necessary 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. When this occurs, the combination of the material is a product called Duplex, and the mixture of the materials and active ingredients is provided for on the product labels. Another example for the District includes a pre-application of a liquid trans-allethrin and phenothrin spray product 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 humans would not occur unless the application(s) were inappropriate or the timing of applications is inappropriately close. Actual applications do not

generally occur that close together unless there is a problem with treatment effectiveness. A material is applied followed by post treatment inspection to determine effectiveness. Only if the mosquitoes/vectors have not been sufficiently killed would the District go back into the area and reapply a pesticide.

7.2.3 Surveillance Alternative

Vector surveillance is critical to IVM 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 & Response Plan* [CDPH et al. 2013] and *Best Management Practices for Mosquito Control in California* [CDPH and MVCAC 2012]), continued in Appendix F. These guidelines allow for flexibility in selection and specific application of control methods because local areas vary.

District practices would be a continuation of existing activities using applicable techniques, equipment, vehicles, and watercraft. Surveillance activities involve monitoring the distribution and abundance of adult and larval mosquitoes, field inspection of mosquito habitat, testing for the presence of encephalitis virus-specific antibodies in sentinel chickens or wild birds, collection and testing of ticks, small rodent trapping, and/or response to public service requests regarding problematic animal or insect vectors (e.g., yellow jacket wasps). Surveillance of potential areas of concern is a critical element for directing and responding to potential outbreaks of mosquitoes and the potential for conveying mosquito-borne diseases.

Impact HH-1: No impact would occur to human health from the use of the Surveillance Alternative.

7.2.4 Physical Control Alternative

Physical Control for mosquitoes consists of the management of mosquito-producing habitat (including freshwater marshes and lakes, saltwater marshes, temporary standing water, and wastewater treatment facilities) especially through water control and maintenance or improvement of channels, tide gates, levees, and other water control facilities. Physical control is usually the most effective mosquito control technique because it provides a long-term solution by reducing or eliminating mosquito developmental sites and ultimately reduces the need for chemical applications. The physical control practices may be categorized into three groups: maintenance, new construction, and cultural practices. The District performs these physical control activities in accordance with all appropriate environmental regulations (wetland fill and dredge permits, endangered species review, water quality review, streambed alteration permits, etc.), and in a manner that generally maintains or improves habitat values for desirable species. Physical control for other vectors such as rodents is based on the District's site inspections to determine conditions promoting infestation, and property owners are provided educational materials on control measures that include removal of food sources and professionals to contact to remove the infestation. Physical control techniques have minimal impact on humans due to prior identification and avoidance of potential problem areas and wildlife habitats by publishing scheduled treatment times and locations. For physical control measures used for onsite wastewater treatment systems, see Section 9.2.4.

Impact HH-2: Impacts to human health from use of the Physical Control Alternative would be **less than significant** and mitigation is not required.

7.2.5 Vegetation Management Alternative

The District uses hand tools (e.g., shovels, pruners, chain saws, and weed-whackers) and heavy equipment where necessary for vegetation removal or thinning and sometimes applies 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 and facilitate access to mosquito-breeding habitat. To reduce the potential for mosquito breeding associated with water retention and infiltration structures, District staff may systematically clear or trim

weeds and other obstructing vegetation in wetlands and retention basins (or request the structures' owners to perform this task). These tasks are performed in conjunction with discussions with appropriate agencies (including CDFW) about special-status species and their habitats that must be acknowledged and protected prior to these activities being conducted. Vegetation management is also performed to assist other agencies and landowners with the management of invasive/nonnative weeds for control of mosquito breeding habitat. These actions are typically performed under the direction of the concerned agency, which also maintains any required permits. These activities are conducted during predetermined times of recreational inactivity to provide an additional measure of safety to the public.

> **Impact HH-3: No impact** would occur to human health from the nonherbicide Vegetation Management Alternative.

7.2.5.1 Herbicides

The herbicides the District may consider for future use would be applied in strict conformance with label requirements. Herbicides are discussed in Appendix B, and those that have been identified for additional evaluation are described below. Herbicides would be used to control vegetation in and around mosquito habitats to improve access needed for surveillance and to reduce potential habitat for mosquitoes. These herbicides are listed in Table 7-4 and discussed in detail in the indicated sections of Appendix B.

Table 7-4 Herbicides Used for Mosquito Abatement

Active Ingredient	Appendix B
Imazapyr	Section 4.6.1
Glyphosate	Section 4.6.2
Triclopyr	Section 4.6.3

Herbicides being considered for 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, such as imazapyr. Herbicides used against annual broadleaf weeds are generally of the post-emergent variety, such as triclopyr. 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).

Imazapyr (USEPA 2006b) and triclopyr (USEPA 1998) have been shown to exhibit no/low toxicity to humans. Furthermore, the actual use and human exposure in the field are far less than tested in the laboratory and much higher volumes (exposure) would be needed to result in toxicity.

> **Impact HH-4:** Impacts to human health from the herbicides imazapyr and triclopyr would be **less than significant** and mitigation is not required.

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 the shikimic acid pathway, which is specific to plants and some microorganisms; therefore, glyphosate is thought to have very low toxicity to mammals (USEPA 1993). The District employs an adequate buffer to water sources when it applies glyphosate. It is further mediated by the techniques used for application. Typically, application does not occur when wind is 5 mph or greater or within 15 feet of a crop area or sensitive habitat.

The USEPA classifies glyphosate as Category III for oral and dermal toxicity (USEPA 1993), and the isopropylamine and ammonium salts exhibit low toxicity to mammals via the oral and dermal routes. A 1-

year feeding study resulted in no chronic effects in beagles at daily doses of 500 mg/kg (USEPA 1993). Currently, no published scientific evidence indicates that glyphosate is carcinogenic or mutagenic except in specific instances where workers are exposed to extended industrial uses (USEPA 1993) or some unpublished claims of sublethal effects (Gertsberg 2011). It is poorly biotransformed in rats and is excreted via feces and urine; neither the parent compound nor its major breakdown product bioaccumulates in animal tissue (Williams et al. 2000).

Despite the apparent lack of toxicity to mammals, concerns have been raised about glyphosate's long-term developmental and reproductive effects. Although still in review, glyphosate is included in the final list of chemicals for screening under USEPA's Endocrine Disruptor Screening Program (USEPA 2009a). The issue of endocrine-disrupting compounds is a topic of current scientific concern and inquiry. Recently, the USEPA renewed the temporary approval of a glyphosate and 2-4-D combination product (Enlist-Duo) for use with weed vectors, indicating it has not received significant adverse data to negate the decision (USEPA 2014b). Only very high exposures to those chemicals suggested as endocrine disruptors can be shown to suggest a linkage. Because this exposure linkage is so high, endocrine disruption in a human would require, if real, exposure to substantially higher levels of the chemical than that used for vector control. It is likely that USEPA will provide an updated review of its potential risks in 2015. However, current data indicate that glyphosate is nontoxic to humans, and the endocrine disruption issue is not clear at this time. Glyphosate products are effective, widely used, generally low risk products used for weed control (Gertsberg 2011). Some reports in the press of sublethal effects on disease resistance, biological diversity, or enzyme activity as a result of ingestion/uptake of genetically engineered foods are interesting but without clear mechanisms that can be related directly to glyphosate (Gertsberg 2011).

The District strictly adheres to herbicide application BMPs and product label requirements, including the restriction of glyphosate application to targets outside an approved (by USFWS) or other commonly used buffer zone separating water sources, which reduces the potential for impacts to special-status species or other nontarget receptors including humans. Targeted, small-scale treatments are conducted to minimize post-application drift and runoff, which minimizes exposure to humans near targeted areas.

> **Impact HH-5:** Impacts to human health from the use of glyphosate would be **less than significant** and mitigation is not required.

7.2.5.2 Adjuvants

An adjuvant is any compound that is added to a pesticide/herbicide formulation or tank mix to facilitate the mixing, application, or effectiveness of that product. FIFRA does not require testing and registration of adjuvants. As such, little information on their fate, transport, and toxicity exists, other than that provided by the manufacturer or published by the scientific community (Bakke 2007; Tu et al. 2001). CDPR does require the registration of adjuvants that are considered to increase the action of the pesticides with which they are used (Bakke 2007). The adjuvants the District employs and where they are used can be found in detail in Appendix B and listed in Table 7-5 except for aliphatic polycarboxylate.

Table 7-5 Adjuvants Used for Weed Abatement

Active Ingredient	Appendix B
APEs	Section 4.7.1
Modified Plant Oil and Methylated Seed Oil	Section 4.7.3
Lecithin (phosphatidylcholine)	Section 4.7.4
Aliphatic Polycarboxylate	Not included

Alkylphenol ethoxylates (APEs) are used as detergents, dispersants, emulsifiers, solubilizers, and foaming and wetting agents. Primary degradation of APEs in the environment generates more persistent shorter chain compounds, some of which may mimic natural hormones and disrupt endocrine function in humans (Ying et al. 2002). Nonylphenol and nonylphenol ethoxylate, which are produced in large volumes and widely used, exhibit low acute oral and dermal toxicity but are highly irritating and corrosive to the skin and eyes (USEPA 2010). The acute toxicity of APEs to mammals is low; however, concern exists regarding the estrogen-mimicking behaviors of these compounds, particularly nonylphenol and nonylphenol ethoxylate (USEPA 2010). The USEPA (2010) has recently recommended that this suite of chemicals be evaluated further due to their widespread use, persistence, and possible estrogen-mimicking behavior.

Plant-derived oils are of two types: triglycerides or methylated oils. Triglycerides are essentially oil-surfactant hybrids and are generally called seed oils. Plant-derived oils (from soybeans, cottonseeds, etc.) decrease surface tension, but they are not as effective as other surfactants at increasing spreading, sticking, or penetration. 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.

Little is known about the toxicity or environmental fate of lecithins. Lecithins 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 including application at the lowest effective concentration for a specific set of vectors and environmental conditions, use of lecithins should not result in unwanted adverse effects to humans.

Aliphatic polycarboxlyates are another category of adjuvants that are essentially nontoxic to biota and are used as an additive to enhance the efficacy of several other products. They are listed as having no known toxicity or adverse biological impacts as a polymer additive with no hazard indications in any of the typical categories used to define toxicity by regulators. (Kegley et al. 2014)

BMPs the District employs include using adjuvants in limited amounts in areas that do not contain special-status species, coordination with CDFW, USFWS, and/or NMFS before conducting management activities in sensitive habitat, keeping spray nozzles within a predetermined maximum distance of target insect or weeds (e.g., within 24 inches of vegetation for hand application), and preventing exposures to nontarget habitats (post-application) including human use areas.

> **Impact HH-6:** Impacts to human health from the use of pesticide adjuvants would be **less than significant** and mitigation is not required.

7.2.6 Biological Control Alternative

Biological control of mosquitoes and other vectors involves the intentional use of vector pathogens (diseases), parasites, and/or predators to reduce the population size of target vectors. Biological control is used as a method of protecting the public from mosquitoes and the diseases using mosquito parasites, pathogens, and predators. At present, mosquito parasites are not commercially available for mosquito control.

7.2.6.1 Mosquito Larvae Pathogens

As part of their Biological Control Alternative, the District employs bacterial larvicides that are highly specific to mosquitoes. These biological controls include Bs, Bti, and may include spinosad in the future. Because the potential environmental impacts of Bs or Bti application are generally similar to those of chemical pesticide applications, these materials and spinosad are evaluated below under Section 7.2.7, Chemical Control Alternative. The environmental fate and toxicity of these control agents is discussed in Appendix B.

7.2.6.2 Mosquito Predators

Mosquitofish (*Gambusia affinis*) are presently the only commercially available mosquito predators. The District's 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, unused swimming pools, and other types of isolated man-made ponds that do not provide habitat that could support native species.

Impact HH-7: No impact would occur to human health from the use of mosquitofish.

7.2.6.3 Other Vectors

No effective natural predators exist to control high rodent populations. Domestic and feral cats may provide short-term control when the rodent population is low, but they can also impact bird populations. The District does not employ cats for rat control. Currently, no commercial biological control agents or products are available for wasp, yellow jacket, and tick control.

7.2.7 Chemical Control Alternative

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

Chemical control is a Program tool that consists of the application of nonpersistent insecticide products demonstrated to reduce populations of larval or adult mosquitoes and other invertebrates (e.g., yellow jacket wasps, ticks). If and when inspections reveal that mosquitoes or other vector populations are present at levels that trigger the District's guidelines for chemical control – based on the vector's abundance/density, species composition, proximity to human settlements, water temperature, or presence of predators – the District applies pesticides to the site in strict accordance with label instructions and federal and state guidelines.

Most of the chemical controls the Program uses are for mosquito abatement and vector control and are classified as larvicides or adulticides. Below is a discussion of the larvicides, adulticides, and other insecticides the District uses. The active ingredients that were identified as warranting further evaluation in Appendix B due to their potential toxicity and/or prevalent use/public concerns are listed in Table 7-6. (Herbicides were discussed previously in Section 7.2.5.)

Table 7-6 Active Ingredients Identified for Further Evaluation in Appendix B

Active Ingredient	Vector	Potential Issue / Concern
Methoprene	Mosquitoes	Prevalent use; toxicity to aquatics and insects
Etofenprox	Mosquitoes, yellow jacket wasps	Toxicity to aquatic organisms; no synergist required
Bti	Mosquitoes	Prevalent use; public concerns
Pyrethrins	Mosquitoes	Prevalent use; requires synergist (PBO)
Resmethrin	Mosquitoes	Requires synergist (e.g., PBO); potential endocrine disruptor
Aliphatic solvents Plant-derived oil/mineral oil mix	Mosquitoes	Contains low percentage of petroleum distillate
Permethrin	Mosquitoes	Toxicity to aquatic organisms; potential endocrine disruptor

7.2.7.1 *Mosquito Larvicides*

Larvicides are used to manage immature life stages of mosquitoes including larvae and pupae in aquatic habitats. For example, larvicide application(s) can be necessary in temporary aquatic habitats that do not have adequate populations of predators (e.g., fish) or habitats with dense and/or abundant populations of emergent or floating vegetation that can support mosquito production. The larvicides are applied using ground application equipment, watercraft, fixed-wing aircraft, and rotary aircraft. District guidelines for selecting application methods are predicated upon access, efficiency and effectiveness of application, size of the area to be treated, and the density and type of vegetation present at the application site (i.e., the likelihood of success in applying the material to the target area). All of the potential treatment options are considered and weighed to select the most appropriate options prior to use, and physical control and chemical treatment may both be used in the target area. District staff may choose to treat soil and/or surface water in the vicinity of an onsite wastewater treatment system that appears to have failed or malfunctioned due to improper lid seals, cracks, or missing vent screens and/or due to drain fields where water ponds on the surface. In this situation, the District may provide selected mosquito larvicide treatment to the tank and/or the septic leach/drain field and system environs. The larvicides currently used include materials not known to adversely impact septic system bacteria: *Bacillus sphaericus* as an active ingredient (e.g., VectoLex), methoprene, (e.g., Altosid briquets), larvicide oils (e.g., BVA 2 and CocoBear), and monomolecular films (e.g., Agnique MMF).

The mosquito larvicides the District uses and where they are used is discussed in detail in Appendix B are listed in Table 7-7: bacterial larvicides, hydrocarbon esters, and surfactants.

Table 7-7 Chemicals Employed for Larval Mosquito Abatement

Chemical Classification	Active Ingredient	Appendix B
Bacterial larvicide	Bs	Section 4.3.1
Bacterial larvicide	Bti	Section 4.3.2
Bacterial larvicide	Spinosad	Section 4.3.3
Hydrocarbon ester	Methoprene	Section 4.3.4
Surfactant	Alcohol Ethoxylated Surfactant (monomolecular film)	Section 4.3.5
Surfactant	Aliphatic Hydrocarbons (mineral oil)*	Section 4.3.6

* CocoBear Oil is a plant-based oil that combines coconut oil with a small amount of mineral oil (10 percent). It is discussed in Section 4.3.6.4 in Appendix B as a mosquito larvicide. Other plant-derived and methylated seed oils are discussed in Section 4.7.3 as adjuvants in Appendix B.

7.2.7.1.1 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 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 are ingested by uninfected larvae. Bs and Bti, produce proteins that are toxic to most mosquito larvae, while the fermentation of *S. spinosa* produces spinosyns, which are highly effective mosquito neurotoxicants. All three bacteria are naturally occurring soil organisms and are commercially produced as mosquito larvicides. Bs can reproduce in natural settings for some time following release. Bs and Bti are applied on a variety of crops and standing and moving waterbodies, Bti materials the District applies do not contain live organisms, only spores. The spores of Bs and Bti can persist in the environment for months, but the endotoxins are readily degraded by UV light

and persist for a few to several days (relatively short half- life). Bacterial spores of Bti are uniquely toxic to nematoceran Diptera (mosquitoes, midges, blackflies, psychodids, and ceratopogonids) (Lacey and Mulla 1990). Both Bs and Bti do not exhibit any human toxicity.

Spinosad alters nicotine acetylcholine receptors in insects, causing constant involuntary nervous system impacts ultimately leading to paralysis and death. It is used on various crops, animal husbandry premises, recreation areas, rights-of-way, and local residences. The USEPA has classified spinosad as a "reduced risk" compound because it is an alternative to more toxic, OP insecticides (CDPR 2002). It exhibits very low acute toxicity by all exposure routes and has not been shown to elicit chronic toxicity in humans.

Impact HH-8a: No impact would occur to human health from the use of bacterial larvicides.

7.2.7.1.2 Hydrocarbon Ester - Methoprene

Methoprene is an insect growth regulator and effective larvicide. It used in a variety of settings including indoors and outdoors at residences, animal husbandry premises, industrial sites, irrigation systems, and standing waterbodies. It is applied either in response to observed high populations of mosquito larvae at a site, or as a sustained-release product that can persist for 4 months or longer if a site has limited accessibility and has regularly produced immature mosquitoes in the past. It is applied using hand equipment, ATVs, watercraft, or by low-flying helicopters and potentially fixed-wing aircraft (particularly for marshes and other highly vegetated areas) but never when winds exceed 10 mph to prevent drift. The larger droplet sizes of aerial (e.g., helicopter) larvicide applications (e.g., methoprene) can reduce drift (compared to that of ULV applications). In addition, aerial treatments are restricted to times when wind is non-existent or at acceptable levels. 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 4.8 µg/L. Methoprene is also sometimes co-applied with Bti (i.e., Duplex) to prevent resistance and ensure all larval stages are controlled. See Section 9.2.7.1 for discussion of use of methoprene in malfunctioning onsite wastewater treatment systems due to improper lid seals, cracks, or missing vent screens and/or due to drain fields where water ponds on the surface.

Methoprene has very low acute toxicity to humans and mammals by all routes (USEPA 1991a). No potentially significant impact exists to humans by exposure to typical application levels of methoprene. To achieve toxicity to humans, exposures hundreds of times higher than legally allowed for use in vector control would be required, and such exposure would need to be extensive. It is of public concern due to its widespread use and unsubstantiated reports of potential nontarget impacts (discussed in Chapter 6, Section 6.2.7.1.2).

Impact HH-8b: No impact would occur to human health from the use of the mosquito larvicide methoprene.

7.2.7.1.3 Surfactants

The monomolecular film formulation used as a surfactant in California for mosquito larvae control is Agnique, an alcohol ethoxylated surfactant. Monomolecular films are low toxicity pesticides that spread a thin film on the water surface that makes it difficult for mosquito larvae, pupae, and emerging adults to attach to the water's surface, causing them to drown (USEPA 2007). 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 2010). Monomolecular films are not environmentally persistent and may typically degrade within 21 days. No evidence supports that these alcohol ethoxylated surfactants are toxic to humans.

Surfactants could result in temporary 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 (Peterson et. al.,

2006). In addition, populations recover quickly following recolonization from adjacent and neighboring sites and habitats (Lawler and Lanzaro 2005).

Aliphatic solvents are often used when monomolecular films (alcohol ethoxylated surfactants) do not provide sufficient mosquito control. They also break down more rapidly (2 to 3 days) and are practically nontoxic to most nontarget organisms. They have a low degree of acute toxicity to mammals. Therefore, mineral oil should not result in adverse effects to human health when applied using District pesticide application BMPs.

Plant oil mixes include the use of a small amount of a mineral oil-alcohol ethoxylated surfactant and a blend of methyl esters of fatty acids.

Plant-derived oils, whether vegetable or fruit, can be used as adjuvants that enhance the effectiveness of herbicides or as surfactants for the management of vectors, especially immature mosquitoes. Plant-derived oils are generally of two types: triglycerides or methylated oils. CocoBear Mosquito Larvicide Oil is the only plant-based oil that is currently available for use in the District's Program (also see Section 4.3.6.4 in Appendix B). This product consists mostly of a modified coconut oil (75 percent or more by volume) combined with 10 percent by volume mineral oil and a very small amount of nonionic surfactant and other proprietary ingredients. This material can be used in various waterbodies such as ditches, stagnant pools, swamps, marshes, temporary rainwater pools and intermittently flooded areas, ponds, catch basins, and man-made containers for the management of immature mosquitoes. CoCoBear has no reported significant toxicity to any receptors likely to be exposed during or after use as a larvicide. Acute oral toxicity to rats is >5,000 mg/kg, acute dermal toxicity to rats is >5,050 mg/kg, and acute inhalation toxicity to rats is >2.16 mg/L (Clarke 2014).

> **Impact HH-8c: No impact** would occur to human health from the use of surfactant larvicides (alcohol ethoxylated surfactant and aliphatic solvents).

7.2.7.2 Mosquito Adulticides

The District may use pesticides for control of adult mosquitoes as a component of the IVMP. For example, adulticides would be used when other tools are not effective or appropriate and adult mosquito control guidelines are met, including species composition, abundance (as measured by landing count or other quantitative method), proximity to human populations, and/or human disease risk. Adulticide materials are used only as needed to control adult mosquito populations. The adulticides the District uses to control mosquitoes, ticks, and yellow jacket wasps and the scenarios when they are used is discussed in detail in Appendix B and are listed in Table 7-8. Control of yellow jacket wasps and ticks are also discussed in Section 7.2.7.3.

Table 7-8 Chemicals Employed for Adult Vector/Insect Abatement

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

Table 7-8 Chemicals Employed for Adult Vector/Insect Abatement

Chemical Classification	Active Ingredient	Vector	Appendix B
Pyrethroid	Permethrin	Mosquito; yellow jacket	Section 4.1.10
Pyrethroid	Etofenprox	Mosquito	Section 4.1.11
Synergist	PBO	Mosquito; yellow jacket	Section 4.1.12

7.2.7.2.1 Pyrethrins

Pyrethrins are naturally occurring compounds distilled from the flowers of certain Chrysanthemum species. They effectively induce temporary paralysis in insects but are not acutely lethal by themselves; thus, they are typically used concomitantly with the synergist PBO, which inhibits metabolism of the pyrethrins so that a lethal dose is assured (USEPA 2006c). The District uses pyrethrins on crops, animal husbandry premises and pastures, outdoor household areas, and for wide-area mosquito abatement in areas that include aquatic habitats.

Pyrethrins have low to moderate acute mammalian toxicity via the oral, dermal, and inhalation routes (Categories III and IV, see Table 6-1, Appendix B). They are a moderate eye irritant (Category III), a mild dermal irritant (Category IV), and not a skin sensitizer. The effects of pyrethrins are (1) neurobehavioral effects following acute, short-term, and chronic exposure, with nervous system lesions observed in the rat and mouse following acute exposure; (2) thyroid effects, following chronic exposure in the rat and dog; and (3) liver effects, following short- and long-term exposure in the rat, dog, and mouse. The neurobehavioral effects are considered relevant to humans because the effects are observed in both the rat and mouse, and the mode of action affects a basic function of the nervous system that is common to all animals (USEPA 2006c). Several studies have shown that pyrethrins applied using ULV techniques do not accumulate in water or sediment following repeated applications. These studies also determined that no toxicity is associated when exposure is limited to the amounts used when following ULV protocols for mosquito control (Lawler et al. 2008; Amweg et al. 2006).

Pyrethrins are of concern because they are used prevalently and require the use of the synergist PBO, a potential endocrine disruptor (USEPA 2009a). However, the District uses pyrethrins only when absolutely necessary and in minimal amounts in ULV applications that are designed to break down rapidly, resulting in very low potential exposure to humans and domestic animals (BMPs H3, H4, H11). As an additional measure, pyrethrin applications are canceled during less than ideal wind and potential drift conditions (BMP H6). For wasp (yellow jacket and paper wasps) control, the District applies pyrethrins in minute volumes directly to ground and tree nests,

> **Impact HH-9:** Impacts to human health from the use of pyrethrins would be **less than significant** and mitigation is not required.

7.2.7.2.2 Pyrethroids, Pyrethroid-Like Compounds, and Synergists

Pyrethroids are synthetic compounds that are chemically similar to the pyrethrins but have been modified to increase stability and activity against insects. Pyrethroids bind to neuronal voltage-gated sodium channels, preventing them from closing; this persistent activation of the channels then leads to paralysis.

First generation or “Type I” pyrethroids include d-allethrin, phenothrin (sumithrin), prallethrin, resmethrin, and tetramethrin. These pyrethroids are used to control flying and crawling insects in a number of commercial and horticultural applications and are sold for residential use and application on pets to control fleas and ticks. They have effective insect knock-down capabilities but are unstable as they are highly photosensitive (i.e., easily degraded by light). The newer second-generation/”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, and permethrin.

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

7.2.7.2.3 Resmethrin

Resmethrin is the active ingredient in Scourge®. It is a restricted-use pesticide due to its toxicity to fish and is available for use only by certified pesticide applicators or persons under their direct supervision.

Resmethrin has low acute toxicity via the oral (Category III), dermal (Category III), and inhalation (Category IV) routes of exposure. Resmethrin is included in the final list of chemicals for screening under USEPA's Endocrine Disruptor Screening Program (USEPA 2009a).

Though public concern regarding resmethrin exists because of its potential endocrine-disrupting properties and concomitant use of PBO, Scourge® is rarely used and is being phased out of the District's program and replaced with a nonresmethrin alternative.

7.2.7.2.4 Permethrin

Permethrin is also a pyrethroid. Dermal exposure in humans can cause tingling and pruritus with blotchy erythema on exposed skin (ATSDR 2003). In humans, acute effects observed subsequent to ingestion of permethrin included nausea, vomiting, abdominal pain, headache, dizziness, anorexia, and hypersalivation. Reports of severe poisoning are rare and usually follow ingestion of substantial, but poorly described, amounts of permethrin. Symptoms of severe poisoning include impaired consciousness, muscle fasciculation, convulsions, and noncardiogenic pulmonary edema (ATSDR 2003). Systemic effects are similar to those seen in acute and chronic ingestion with prolonged contact or contact with high concentrations of permethrin. Acute toxicity to permethrin via inhalation has been shown to be very small. The USEPA (2006c) has classified permethrin as Category III for acute oral and acute dermal toxicity, Category III for eye irritation potential, and Category IV for dermal irritation potential.

Because permethrin is included in the final list of chemicals for screening under USEPA's Endocrine Disruptor Screening Program (USEPA 2009a), it is of concern to the public. However, the District rarely uses it, applies it through ULV application with a backpack mister or hand can/duster, and does not apply during high winds. Risk assessments provided in support of product registration indicate that the acute risk quotients for terrestrial mammals are below the USEPA's acute levels of concern. (USEPA 2009b).

7.2.7.2.5 Etofenprox

Etofenprox is a pyrethroid-like insecticide that is the active ingredient in Zenivex®. It differs in structure from pyrethroids in that it lacks a carbonyl group and has an ether moiety, whereas pyrethroids contain ester moieties. Under general use by homeowners, it can be used indoors, as a spot treatment for pets, and as an outdoor fogger to control flying and crawling insect pests in backyards and patios. The District applies it to aquatic habitats/outdoors. It has low acute toxicity to humans and mammals. The District strictly adheres to application BMPs, such as monitoring of sites post–treatment (BMP H11) and product label requirements. Etofenprox is generally applied during the nighttime hours, pre-dawn and at dusk when sensitive receptors such as honeybees are not active (BMP H12), and in general, people are not active at these times either.

> **Impact HH-10:** Impacts to human health from the use of pyrethroids and pyrethroid-like compounds as mosquito adulticides would be **less than significant** and mitigation is not required.

7.2.7.2.6 Piperonyl Butoxide

PBO is a pesticide synergist that enhances the effectiveness of pesticide active ingredients, such as pyrethrins and pyrethroids, by inhibiting microsomal enzymes and, thus, the breakdown of the other active ingredient(s) (USEPA 2006a). It is a registered active ingredient in products used to control flying and crawling insects and arthropods in agricultural, residential, commercial, industrial, and public health settings. No products contain only PBO. It degrades quickly in soil and water. PBO has a low acute toxicity by oral, inhalation, and dermal routes, but it is included in the final list of chemicals for screening under USEPA's Endocrine Disruptor Screening Program (USEPA 2009a). As a synergist, PBO is applied using the same guidelines as those for pyrethroids and pyrethrins: ULV application with a backpack mister or hand can/duster, and it is not applied during high winds, which minimizes the exposure of people to this synergist.

> **Impact HH-11:** Impacts to human health from the use of the synergist PBO in mosquito adulticides would be **less than significant** and mitigation is not required.

7.2.7.3 Yellow Jacket Wasp and Tick Adulticides

The District selectively applies insecticides to control ground-nesting yellow jackets that pose an imminent threat to people or pets. The District does not currently perform control work with respect to tick populations but may potentially do a limited amount of control work in the future using esfenvalerate. This activity would likely be triggered by public or agency requests for District assistance or action rather than as a result of regular surveillance of their populations. The District does not apply pesticides to yellow jacket populations that are located in or on a structure. Whenever the District learns that a hive is situated in or on a structure or is above ground, the resident(s) are encouraged to contact a private pest control company that is licensed to treat the infestation. Yellow jacket nests that are off the ground would be treated only under special circumstances to protect public health and safety of the District's residents. When a District technician encounters a honeybee swarm or unwanted hive, residents are referred to the County Agricultural Commissioner's Office, which maintains a referral list of beekeepers that can safely remove the bees. If a District technician deems it appropriate to treat stinging insects, they will apply the insecticide directly within the nest in accordance with the District's policies to avoid drift of the insecticide or harm to other organisms. Alternatively, they will place tamper-resistant traps or bait stations, selective for the target insect in the immediate environment of the vector. The pesticides the District uses to control yellow jacket wasps are shown in Table 7-8.

Pyrethroid-based chemicals are typically used against ground-nesting yellow jackets and are applied directly into the underground nest, which prevents drift and further reduces the potential for nontarget exposure to these compounds. Also 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). The potential environmental impacts of these materials are minimal. See Section 7.2.7.2.1 and impact HH-9 which covers the use of pyrethrins for yellow jackets. See Sections 7.2.7.2.2 and impact HH-10 which covers the use of pyrethroids for yellow jacket and tick control.

7.2.8 Other Nonchemical Control/Trapping Alternative

The trapping of rodents and/or yellow jackets may be conducted in the future when these organisms pose a threat to public health and welfare. For both vector species, District staff would place the tamper-resistant or baited trap(s) primarily at the request of the property owner, manager, or agency. The District does not remove rats or yellow jackets that are in or on structures. When these structural requests are made, residents are referred to the local animal control or to a directory of private pest control companies. No impact to human health is expected from the District's use of this alternative.

> **Impact HH-12: No impact** would occur to human health from the District's use of the Other Nonchemical Control/Trapping Alternative.

7.2.9 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 human health, include past, present, and reasonably foreseeable actions that potentially impact humans. 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 13.5 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 the health of human populations. It includes Table 13-1, Historical Pesticide Use within the Marin-Sonoma Mosquito and Vector Control District's Program Area for 2006-2010 and Table 13-2, Pesticide Use within the Marin-Sonoma Mosquito and Vector Control 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 District uses BMPs in their pesticide applications for mosquito and vector control and is attempting to reduce total pesticide use where possible consistent with IVM practices.

The District's incremental contributions to overall pesticide use within its Program Area are not substantial and do not trigger a cumulatively considerable impact on pesticide use. 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 given use of BMPs to mitigate potential impacts. Therefore, the **Program's long-term activities including chemical applications would not contribute considerably to human health impacts.** The Program alternatives would not result in significant cumulative impacts to the human health condition of the region.

7.2.10 Environmental Impacts Summary

Table 7-9 presents a summary of human health impacts associated with the six alternatives. The human health impacts correspond to those in Sections 7.2.3 through 7.2.8. All of the impacts were determined to be either "no impact" or a "less-than-significant impact."

Table 7-9 Summary of Human Health Impacts by Alternative

Impact Statement	Surveillance	Physical Control	Vegetation Management	Biological Control	Chemical Control	Other Nonchemical/ Trapping
Effects on Human Health						
Impact HH-1: No impact would occur to human health from the use of the Surveillance Alternative.	N	na	na	na	na	na
Impact HH-2: Impacts to human health from use of the Physical Control Alternative would be **less than significant** and mitigation is not required.	na	LS	na	na	na	na
Impact HH-3: No impact would occur to human health from the nonherbicide Vegetation Management Alternative.	na	na	N	na	na	na
Impact HH-4: Impacts to human health from the herbicides imazapyr and triclopyr would be **less than significant** and mitigation is not required.	na	na	LS	na	na	na
Impact HH-5: Impacts to human health from the use of glyphosate would be **less than significant** and mitigation is not required.	na	na	LS	na	na	na
Impact HH-6: Impacts to human health from the use of pesticide adjuvants would be **less than significant** and mitigation is not required.	na	na	LS	na	na	na
Impact HH-7: No impact would occur to human health from the use of mosquitofish.	na	na	na	N	na	na
Impact HH-8a: No impact would occur to human health from the use of bacterial larvicides.	na	na	na	na	N	na
Impact HH-8b: No impact would occur to human health from the use of the mosquito larvicide methoprene.	na	na	na	na	N	na
Impact HH-8c: No impact would occur to human health from the use of surfactant larvicides (alcohol ethoxylated surfactant and aliphatic solvents).	na	na	na	na	N	na
Impact HH-9: Impacts to human health from the use of pyrethrins would be **less than significant** and mitigation is not required.	na	na	na	na	LS	na

Table 7-9 Summary of Human Health Impacts by Alternative

Impact Statement	Surveillance	Physical Control	Vegetation Management	Biological Control	Chemical Control	Other Nonchemical/ Trapping
Impact HH-10: Impacts to human health from the use of pyrethroids and pyrethroid-like compounds as mosquito adulticides would be **less than significant** and mitigation is not required.	na	na	na	na	LS	na
Impact HH-11: Impacts to human health from the use of the synergist PBO in mosquito adulticides would be **less than significant** and mitigation is not required.	na	na	na	na	LS	na
Impact HH-12: No impact would occur to human health from the District's use of the Other Nonchemical Control/Trapping Alternative.	na	na	na	na	na	N

LS = Less-than-significant impact

N = No impact

na = Not applicable

SM = Potentially significant but mitigable impact

SU = Significant and unavoidable impact

7.2.11 Mitigation and Monitoring

All impacts to human health are identified as either “no impact” or a “less-than-significant impact.” Therefore, mitigation measures are not applicable to the insignificant impacts identified for all of the Program alternatives described.