3 Organization Comments and Responses

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O-MAS

Marin Audubon Society

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September 29, 2015

Philip Smith, District Manager
Marin Sonoma Mosquito and Vector Control District
595 Helman Lane
Cotati, CA 94931

RE: DRAFT PROGRAMMATIC ENVIRONMENTAL IMPACT REPORT

Dear Mr. Smith:

The Marin Audubon Society appreciates the opportunity to comment on the Mosquito Abatement District's (District) Draft EIR. Our comments focus on the impacts to biological resources. Our interest are related to impacts but also specifically to wetland conditions and District activities on our properties.

Marin Audubon Society has special interest in the District's programs, activities and the potential impacts of its activities. MAS also has a long relationship with the District because we own approximately 500 acres which we purchased because they support wetlands and we actively work to protect and enhance them as wetland habitat. We also are experienced with what the District does and are contacted fairly regularly for treatment of our properties in north Marin. There are other properties we own that we are not certain the District treats. 1

In a number of places, the DEIR reports that it is the Districts' practice to coordinate and communicate with agencies in undertaking their work. It also mentions that property owners are consulted and that this is stated in BMP's. We could find no BMP that reference coordinating with non-agency property owners. Because we own tidal or seasonal wetlands and wish to maintain them as beneficial habitat, we would like the assurance that the District is required, through a BMP, to contact and coordinate with property owners, such as ourselves, even through these owners may not be agencies. Please create a BMP that commits to coordination with non-agency/government property owners. 2

The DEIR mentions the Migratory Bird Treaty Act, Bald and Golden Protection Act as background but it does not address potential impacts to species protected by these laws. Species covered by these laws include shorebirds, waterfowl, red-tailed hawks, red-shouldered hawks, American kestrel and other raptors, migratory songbirds, waterfowl and shorebirds. In particular migratory waterfowl and shorebirds would likely be impacted. Discuss the potential impact of the loss of invertebrates on marsh dependent bird, mammal and fish species that rely on invertebrates as a food source. 3

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As the DEIR describes, seasonal wetlands are wetlands, but all of the discussions are focused on vernal pools, which is a type of seasonal wetland. Seasonal wetlands that are not vernal pools provide habitat for overwintering and migrating shorebirds and waterfowl. They are also frequently treated for mosquitoes. Please address the impacts of disturbance, physical modification and loss of insect populations resulting from chemical and other treatments, on seasonal wetlands that are not vernal pools and on the insect, bird and other wildlife that feed, rest and nest in seasonal wetlands. 4

The DEIR acknowledges that the treatment for mosquitoes "could affect the food web" either through toxicity or impacts on non-target organisms. (page 4-51). We consider this to be a potentially significant impact. There needs to be a more comprehensive discussion and information provided about food web impacts We have a number of questions:

- Insect loss is discussed in terms of loss of mosquitoes as a food source, or for other insects, such as dragonflies, stating that the populations of these other species will rapidly be replaced by populations from nearby. How is nearby defined? How close would they have to be? What studies are there that demonstrate that this occurs? Why wouldn't it be assumed that mosquitoes too would be rapidly replaced? 5

- The DEIR acknowledges that "Pesticides can kill natural predators of mosquitoes." Pesticides also kill other non-target species that are part of the food web. Provide a detailed explanation that identifies and discusses the insect species that are part of the food web of the Marin and Sonoma aquatic environments. What insect species occupy our tidal and seasonal marshes that would be expected to be present during the times periods the District treats for mosquitoes in those wetlands? Which of these species would be adversely affected/killed by chemical treatments for mosquitoes? What species occupy our marshes that would not be expected to be impacted by the pesticides used by the District? What species would be expected to survive chemical treatment for mosquitoes and remain in a wetland habitat after treatment so that they can support higher order species? Is it possible/probable that the pesticides used would eliminate all of the insects in a given wetland? 6

- Explain the statement (p-4-73) "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 non-target species and a lower potential for environmental pollution." To understand the lower risk, it is necessary to have "rapidly" and "extended periods" defined. 7

- The DEIR states that the impact of treating seasonal wetlands is not significant because only small areas area treated. Discuss what is meant by "small area" so that this claim is verified. It is our experience in north Marin County that most if not all of the wetlands are treated and these do not add up to small areas. 8

- According to the DEIR (page 4-74), the utilization of resources by wildlife shifts by time of day and season. "If the availability of one resource decreases, the consumer can generally replace that with another resource." Please provide information to support 9

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> these statements. Certainly migratory species are seasonal i.e. present during fall, winter and spring. Aside from this, a significant reason aquatic species move around is because they must feed when the tides are in or our, or when water levels are high or low for others. We do not see why higher food web species such as ducks and shorebirds, would not use them all at the same time. Why would birds be expected to eat only one species of insect until that resources is eliminated, and only then move on to another? The assumption that another resource would be available to be used by wildlife, if one or more are eliminated, also is not substantiated. If all or most of the insects in a given wetland or area of wetland are eliminated, then this could result in a significant impact on the migratory and special status species. 9

The discussions of impacts on aquatic resources are full of vague qualifiers that inhibit understanding of the true nature of the impacts of pesticides that are used. Some examples are: "In general the pesticides used for mosquito control exhibit low or no toxicity to birds or mammals" and pesticides are "generally" used at levels that are "below the effects threshold" for other insects. Under what circumstances would the effects be higher? Identify the other insects that would be impacted. Under what circumstances would the pesticides be toxic to birds and mammals? 10

The loss of mosquitoes as part of the food web must be considered together with the loss of other insect species that are also part of the food web. How is small defined? Taking the North Marin area, much of the land MAS owns along with the publically owned land is treated. This is not a small area. 11

The last time the District did an EIR on the District's program, and we brought up our concern about the tracks left by off-road activities with ATVs/argos leave tracks in the marshes. These depressions are unsightly, damaging to beneficial vegetation and are breeding grounds for mosquitoes. This must be recognized as an adverse impact and discussed. 12

Several corrections to Table 4-4 are needed: 13

> Page 4-36 California Black Rail Point are not primarily found in fresh water marshes. Their preferred habitat is brackish to salt marsh such as associated with Black John Slough in Marin County.
>
> Page 4-37 California clapper rail – the name should be changed to Ridgway's rail and the habitat description revised to show that the primary habitat for this species is cordgrass channels in tidal marshes, not pickleweed.

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Thank you for considering and responding to our comments and questions.

Sincerely,

Barbara Salzman, Co-chair	Phil Peterson, Co-chair
Conservation Committee	Conservation Committee

Comment Letter O-MAS — Marin Audubon Society

Barbara Salzman, Co-chair
Phil Peterson, Co-chair
September 29, 2015

Response 1

Comment noted and considered. No response is required.

Response 2

The District communicates with MAS several times annually regarding the District's operations on MAS properties and has done so for many years. We have assisted MAS in disseminating information regarding unauthorized trespass on their properties by the public and with their restoration projects. For, example, we have met with MAS staff and contractors regarding avoidance measures for restorative wetland plantings; participated in MAS restoration project meetings, planning, and monitoring; and assisted with the implementation of MAS restoration projects.

There are BMPs that specifically mention the resource agencies, specific wildlife refuges, and the public. The PEIR text mentions coordination with landowners in particular where sensitive habitats may be the subject of vector control. Most of the coordination with private landowners occurs initially during surveillance and then again if either chemical or nonchemical treatment is needed. In particular, it is the large-area landowners such as the Marin Audubon Society with whom coordination with the District beyond the usual public requests for service is most likely to occur. The request for a BMP that commits the District to coordination with nonagency/government property owners can be met with the following modification to BMP A1:

> District staff has had long standing and continues to have cooperative, collaborative relationships with federal, state, and local agencies<u> and with special interest groups and land managers/owners</u>. The District regularly communicates with agencies<u>, organizations, and land managers/owners</u> regarding the District's operations and/or the necessity and opportunity for increased access for surveillance, source reduction, habitat enhancement, and the presence of special status species and wildlife. The District often participates in and contributes to interagency <u>and special interest group </u>projects. The District will continue to foster these relationships, communication, and collaboration.

Response 3

The comment is concerned with impacts to migratory waterfowl and shorebirds and the loss of invertebrates on marsh dependent bird, mammal, and fish species that rely on invertebrates as a food source. The underlying question is a concern that removing mosquitoes as a food source would impact substantially other invertebrate and vertebrate species. There are two aspects to this comment addressed below: (1) the removal of mosquitoes and possible indirect effects on other invertebrates and then (2) the potential for the removal of the mosquito food source to impact other species.

The District's objective is to reduce or minimize the possibility of unwanted nontarget effects in the local environment while addressing the need for vector control that guides all nonchemical control as well as pesticide applications. These considerations and how unwanted effects can be eliminated or reduced are embodied in the Program objectives and in each of the applicable BMPs. By restricting chemical applications to times when nontarget insects are not active and using care to treat only vector larvae and adults in locations where they are concentrated (i.e., population is high enough to warrant control), impacts to other species are eliminated or substantially reduced to a level of less than significant. Control of problem insect populations is a public health concern; and the District's treatment using specific pesticides is based on selection of the most effective, yet environmentally compatible, chemical option. If specific insect populations were to be reduced substantially at a given site or within a portion of a given site, there is minimal impact on the insectivorous birds, as they have large foraging ranges and are not dependent on a particularly localized population. This is especially relevant to the migrating bird populations that travel miles in their foraging events.

The District uses pesticides that are highly specific to mosquitoes. For example, two of the mosquito larvicides the District uses (e.g., *Bacillus thuringiensis* and *Bacillus sphaericus*) have been shown to be very specific to mosquito larvae, and nontarget impacts are minimal to nonexistent for invertebrates or amphibians (Glare and O'Callaghan1998). Lawler and Dritz (2013) report that the larvicide spinosad is an effective treatment for mosquito larvae at recommended doses but that at doses greater than those that kill mosquito larvae it can kill mayflies and some other nontarget insects that may serve as prey items for other species. Therefore, Lawler and Dritz (2013) indicate that doses that are effective against mosquito larvae are below levels that would even marginally impact nontarget insect populations. If an impact occurs it would be inconsequential. Even if the spinosad application for mosquito control impacts some individuals in a nontarget insect population, these nontarget populations are reproductively robust and the time to replace the individuals in the population is relatively short (Emlen 1989).

Most mosquito predators have evolved to use several sources of prey available to them at most times. Removal of mosquito larvae through vector control activities is unlikely to affect CTS larval food sources, for example, since the mosquito larvae and pupae do not constitute an important part of their diet, nor the diet of their primary prey. CTS larvae consume a variety of food items including aquatic invertebrates, primarily small crustaceans, as well as Pacific chorus frog tadpoles and snails (Anderson 1968). After hatching, larvae feed primarily on small invertebrates, switching to larger prey (tadpoles and snails) within about two weeks to support their rapid growth. Mosquito larvae and pupae were not found in the stomach contents of CTS larvae in this study, which was conducted in Santa Cruz County, California.

The Draft PEIR disclosed a broad range of issues associated with chemical methods of vector control and made a reasonable effort to address those issues in a manner understandable to the public by PEIR preparers with the appropriate qualifications. The issue of loss of prey and prey habitat is considered by a senior toxicologist in the extensive response below to support the material in Section 4.2.2.6 of the Draft PEIR and the following statement in the Draft PEIR on page 4-75 on predator populations, which is modified as indicated for greater clarity:

> "Mosquitoes are part of the food web and their loss may reduce the food base for some predators. Although mosquitoes serve a role as one of many types of prey items for some fish, avian insectivores, bats, and small reptiles and amphibians, the reduction of mosquito abundance over a small area will not affect the predator populations overall because these species generally have large foraging ranges and can find~~, as~~ other prey sources within the range of their habitat use~~ are available~~." (Williams et al, 1994)

Because of the selective nature of the vector control products for mosquitoes, any potential adverse impact to insect predator populations associated with District applications (as nontarget exposures) would be temporary and inconsequential in the impact to those populations' predator species. Even in the event of ancillary exposures, the recovery of such populations occurs rapidly to maintain the general level of individuals in their populations. The relative higher sensitivity of the target vs nontarget (less sensitive predator) species provides an adequate measure of safety to maintain the balance of predator populations.

Response 4

The commenter requests additional information specifically on potential impacts to seasonal wetlands (not vernal pools) that provide habitat for overwintering and migrating shorebirds and water fowl from vector control disturbance, physical modification, and loss of insect populations.

Control of mosquito populations is a public health concern, and the District's response using specific pesticides is based on selection of the most effective, least harmful, chemical option. Where insect populations are reduced substantially, there is minimal impact on the insectivorous birds since they have large foraging ranges and are not dependent on a particularly localized population. This is especially relevant to the migrating bird populations that travel miles in their foraging events. While management options include control by removing some or most of the unwanted vegetation in these areas, this alternative can result in a greater impact on the habitat used by the migrating shorebirds and waterfowl.

Proper and prudent use of pesticides for vector control thus can substantially lower the potential for an environmental impact on avian species compared to other alternatives. The primary loss of insect populations is the loss of mosquitoes (larvae, pupae, and adults), which does not substantially impact other nontarget insect populations and wildlife as explained in Response 3 above.

Disturbance to both species and habitats is discussed in the PEIR initially under the Surveillance Alternative and then subsequently under the Physical Control and Vegetation Management Alternatives for special-status species and 15 habitat types in both Chapter 4, Biology-Aquatic and Chapter 5, Biology-Terrestrial. The PEIR's consideration of impacts to seasonal wetlands and the species that occupy these wetlands is not limited to vernal pools, but it does include specific reference to vernal pools because they are an area of particular concern to the resource agencies. For example, under the Physical Control Alternative (Section 5.2.4.1.11), the following text is provided:

> "Because of the sensitive nature of seasonal wetland habitat types, the District generally would not undertake physical control measures in these areas. In the event that physical control in seasonal wetlands or vernal pools was required, the District would not implement water management and vegetation removal actions without previously discussing them with the relevant regulatory agencies or refuge wildlife managers to verify that no other alternative or option is preferable to control the mosquito problem at that location and to make sure that any such activity would be done in such a way as to minimize its impacts. As a result, this "consultation prior to implementation" BMP and the practices described above would result in a less-than-significant impact to terrestrial resources." (page 5-45)

In situations where there is potential for physical control/source reduction within a seasonal wetland habitat, the District will typically utilize chemical control for mosquito populations; while physical control strategies are explored and/or planned to minimize impacts to avian species.

An example of wetland habitat used by bird watchers and regularly monitored and treated with mosquito larvicides and adulticides annually (mosquito populations have tested positive for West Nile virus) is the Ellis Creek Water Recycling Facility along the Petaluma River in Petaluma, CA. Typical species observed at this spot are: Great Egret, Snowy Egret, American Coot, Northern Shoveler, Gadwall, Green-winged Teal, Cinnamon Teal, American Wigeon, Mallard, Greater Scaup, Sora, Virginia Rail, Greater Yellowlegs, Lesser Yellowlegs, Wilson's Snipe, Killdeer, Willet, Long-billed Curlew, Long-billed Dowitcher, Western Sandpiper, Least Sandpiper, Canada Goose, Mute Swan, Turkey Vulture, Red-tailed Hawk, Red-shouldered Hawk, Northern Harrier, American Kestrel, White-tailed Kite, Cooper's Hawk, American Crow, Black Phoebe, Say's Phoebe, Western Scrub-jay, Raven, Northern Mockingbird, Western Meadowlark, Red-winged Blackbird, Brewer's Blackbird, Marsh Wren, Tree Swallow, Bushtit, American Robin, Yellow-rumped Warbler, House Finch, European Starling, American Pipit, Song Sparrow, Savannah Sparrow, Golden-crowned Sparrow, White-crowned Sparrow, American Goldfinch (Talcroft 2015) (http://www.colintalcroft.com/Sonoma_County_Bird_Watching_Spots/Ellis_Creek_Water_Recycling_Facility,_Petaluma.html). Many hundreds of bird species have been observed in the expansive wetlands of southeast Petaluma. Recently in January-March 2016, a group of white-faced ibis (migratory species) was observed in the habitat around Petaluma's Ellis Creek water treatment plant and may be overwintering there (Gneckow 2016). The Ellis Creek Water Recycling Facility wetland is an example of seasonal wetlands where the District conducts active surveillance and chemical treatment, using both larvicides and adulticides, and these methods have not interfered with the success of the area as seasonal wetland avian habitat. Furthermore, since birds are susceptible to West Nile virus, mosquito control is important to the health of avian species.

Response 5

The Draft PEIR identifies the potential for food web impacts as an environmental issue but the principal question is whether there are any significant impacts to nontarget species, which is the fundamental question in dealing with food webs. If nontarget species are not substantially impacted by the loss of mosquitoes as a food source, then neither are the related food webs through indirect effects on the other species. If there were an impact determined to be significant, then the species affected would need further analysis. An entire chapter in the PEIR has been devoted to potential ecological health impacts associated with nontarget species (see Chapter 6, Ecological Health) which is based on Appendix B, Ecological and Human Health Assessment Report. The responses herein are prepared by the principal toxicologist on the PEIR, Bill Williams, PhD. Dr. Williams was a charter member of the Avian Dialogue Group, convened by the Conservation Foundation (RESOLVE) to bring industry, academia, and government regulators together to resolve conflicts between the groups on matters dealing with pesticides in the environment and led the preparation of the PEIR Appendix B, Ecological and Human Health Assessment Report.

Concerning the comment on rapid replacement and the choice of words such as “nearby” in the PEIR, which is written as a CEQA document where scientific studies and complex material contained in Appendix B is summarized and written to be understandable to nontechnical readers, the following information is provided. The replacement of insect populations after a significant stress to their numbers can occur within weeks to months. In most higher trophic level species, a reduction in numbers by as high as 30 percent or more is still below the level for irreversible population impacts or extinction. In a study focused on invertebrates and higher tropic level birds and offspring after exposure to a common mosquito larvicide (Golden Bear Oil, GB-1111), Miles et al demonstrated that ducklings held intermittently on the ponds over an 8-day period showed cold related hypothermia but no significant effects of weight loss due to invertebrate prey depletion. (Miles et al. 2002). Insect population replacement based on proximity is only an issue where a highly localized population of a specific insect is being exterminated, and that is not occurring with mosquito control for the reasons cited in Response 4 above and Response 6 below. Nontarget insect predators are not being removed in substantial numbers.

Concerning the question about rapid replacement of mosquitoes, the District’s surveillance, physical control, vegetation management, and chemical control components (alternatives) of the overall Program are designed to inhibit rapid replacement of mosquitoes.

Response 6

Concerning the many questions on other insect predators, the response herein is provided. It is important to note that the majority of chemical mosquito control operations utilize larvicides to control mosquito larvae. The mosquito larvicides used by the District, as labeled for mosquito control, have minimal if any nontarget impacts. Adult mosquito control products (i.e. adulticides) are used less frequently. The detailed analyses of the materials used in chemical control portion of the District’s IVMP (including scientific references) are included in Chapter 6 and Appendix B of the PEIR.

The use of vector control products is based on selection of specific chemical products that have been tested for efficacy and specificity by the USEPA and other regulatory agencies. Information about the toxicity of each chemical that may be used in the Program is contained in Appendix B. The information in Appendix B has been considered by the PEIR preparers in evaluating the potential Program effects on insect populations and the food web in general. The potential impact to nontarget insects is considered and the relative impact to these species is weighed against the CEQA criteria and questions for this PEIR.

The PEIR contains extensive evidence and analysis supporting a determination that Program impacts to nontarget species, and thus the larger food web, will not be significant. The suggestion that the PEIR evaluate the specific toxicity of each potential chemical on each potential insect found in the County is beyond the scope of a PEIR as it would require a monograph based on substantial original graduate level scholarly research.

In considering the PEIR and whether to continue the Program as it is being implemented or adopt one of the CEQA alternative Programs (e.g., Reduced Chemical Alternative Program), the District decision makers (Board of Trustees) will consider the PEIR evidence in light of the importance of control of the unwanted species and the District's mission to protect public health. Current problems with insect vectors that may be carriers of disease (i.e., consider the potential impact of malaria, dengue, leishmaniasis, Lyme, and even Zika), as conveyed by both flying and crawling insects require intervention/control. The District must determine the appropriate balance between protection of public health and the possible temporary reduction in a localized insect population that does not threaten the survival of other species. No insecticide treatment has or can completely extinguish one of these insect predator populations. Eradication of any insect is extremely difficult to accomplish and is not the objective of the District's Program.

Response 7

The cited statement is found in Draft PEIR Section 4.2.2.5, which is part of the explanation of assumptions and/or background material related to the analysis of hazards, toxicity, and exposure for chemical treatment methods. The discussion is meant to inform the general public about scientific principles and practices, and is not detailed in its use of terms that apply to a range of data presented in Appendix B, especially in Table 6-1. This is an interpretation of the data on how long the active ingredient is "active" or effective once it is subject to environmental factors at the application site. Understanding the risk of impact to nontarget species and an active ingredient's persistence in the environment is related to understanding the following physiochemical factors:

It has been demonstrated and validated over decades that every organic chemical has a physical/chemical degradation characteristic termed "half-life" (a metric used to describe the elapsed time for a chemical to reach ½ of its initial activity). Each organic chemical, whether toxic or not, decays in both activity and toxicity over time. For some chemicals, the half-life can be hours, days, or weeks. By design, few chemicals used as pesticides have half-lives greater than a week and are further degraded by the environmental conditions of the application area. When pesticides get into soil, or water, or are taken up by plants and animals, the half-life characteristics are altered. The environmental fate of pesticides depends on the physical and chemical properties of the pesticide, particularly the pH of the medium, modifying how likely it is to travel through soil (soil mobility), how well it dissolves in water (water solubility), and how likely it is to become airborne (volatility). Once a pesticide has been released into the environment, it can be broken down by exposure to sunlight, (photolysis), exposure to water (hydrolysis), exposure to other chemicals (oxidation and reduction), microbial activity (bacteria, fungi, and other microorganisms), and other plants or animals (metabolism). Most of the new generation chemicals (nonorgan chlorines) break down in soils in a few hours to days, depending on the soil characteristics. Pesticides that are considered to persist for extended periods are generally those that break down rapidly when applied but continue to break down at a slower rate after the initial decrease in measurable concentration. Some pesticides can be found in trace amounts after extended times, but the trace levels are too low to be of consequence. Pesticide labels set out safety and use guidelines that usually focus on three aspects: rates of application (single and cumulative) for registered crops and pests, timing of application, and restrictions on areas of application (including required buffer zones).

The environmental fate of the pesticides used by the District is influenced by their chemical properties and by the environmental conditions in which they are applied. The PEIR's Appendix B, Ecological and Human Health Assessment Report, provides a detailed description of the fate and transport in air, water, and soil for each of the active ingredients applied by the District (and eight other districts). A summary of the potential uses of pesticide products by the District is included in Appendix B Table 6-1 and the narrative addressing each of the active ingredients of interest. As noted, many second-and third-generation insecticides are formulated to act quickly and then dissipate quickly in the environment, often through photolysis or microbial breakdown. Others bind to soils and sediments where they are degraded abiotically or by soil organisms. These effects, the potential for mobilization after pesticide application and the methods used to minimize exposures to unwanted receptors, are considered in the discussion of the Vegetation Management and Chemical Control Alternatives (see Sections 9.2.5 and 9.2.7 of the PEIR).

Response 8

The commenter appears to have taken the statement out of context and has not provided a page number. The preceding comment 7 and the subsequent comment 9 are on pages 4-73 and 4-74. Each impact statement is preceded by an explanation of the reasons why the impact is less than significant. In the case of the Physical Control Alternative, the conclusions that the Program would have less-than-significant impacts on special-status species and habitats is based on extensive evidence and analysis by habitat type. Section 4.2.4.1.4 Seasonal Wetlands (Including Vernal Pools), contains the following information to support the conclusion (in part):

> "The availability of such habitats has been substantially reduced by human land use practices and flood control measures. Reducing the frequency or duration with which such habitats are flooded would adversely affect habitat and aquatic resources. The Physical Control Alternative would not reduce the quantity of this habitat, but simply improve circulation within the marsh. Only inactive channels would be filled to eliminate ponding. All work in wetlands would be subject to additional permitting by the USACE, CDFW, BCDC, and RWQCB." (page 4-81)

As part of its ongoing (at least once annually and typically several times annually) discussion with MAS staff of mosquito surveillance and control on MAS lands with MAS staff, District staff notifies MAS when large-scale aerial mosquito larvicide treatments are conducted on their properties (e.g. 50-160 acres need to be treated with mosquito larvicide). Chemical larvicide treatments of this size are usually done by helicopter and minimize physical disturbance to avian and animal species from people and equipment. Other wetlands of this size in the Highway 37 corridor may require aerial larviciding. Mosquito production within wetlands ranging from 1 acre up to 50 acres in size are typically treated on foot using backpack application equipment and equipment mounted on/from ATVs and the airboat. The District will aerially apply a mosquito larvicide(s) in a wetland smaller than 50 acres if there are already aerial applications scheduled and efficiency can be achieved, if the mosquito population(s) are in the later stages of the lifecycle and timing of ground based application is an issue, if there are site access issues, or dense and abundant vegetation is present that results in larvicide penetration issues. These methods are also used within larger wetlands in which only small sections have mosquito production, i.e., a 100-acre wetland that has 15 acres in mosquito production. It is common to find mosquito production in portions of seasonal and tidal wetlands and not throughout the entire site. Localized treatment of mosquito production according to the District's BMPs ensures that impacts to wetland habitat are not substantial.

Response 9

As a result of the highly selective nature of the District's mosquito and vector control activities (and chemicals), the Program will never result in elimination of all insects from a particular habitat. In any event, the temporary elimination of one type of insect at a particular location would not have an adverse effect on predator species. All wildlife species of birds and mammals forage for food over distances appropriate to their species and habitat availability. The foraging range of birds and mammals are well documented in numerous US Fish and Wildlife journals and USEPA Wildlife Exposures Handbooks (1 and 2) which include the potential foraging ranges for terrestrial mammals and birds. The consumption of selected prey items by these species generally occurs over extended distances (miles or more), and they are thus able to obtain food items in areas beyond application areas. It has been demonstrated, in fact, that most birds and mammals will avoid contaminated food items when alternative choices are available. The comment suggests a misunderstanding of the descriptions of food web foraging strategies as the species of interest do not consume a prey species until extinct, rather the food preferences for most species are varied and not limited to one species of prey. Food webs are described by several trophic level discriminators, including those that consume lower prey species, vegetation choices, and predator/prey hierarchy. The range of foraging areas and site fidelity range from the extremes of migratory birds which have foraging ranges of hundreds to thousands of miles, to many shore birds with ranges of dozens of miles and the ability to utilize numerous prey items in their foraging events.

Response 10

The commenter objects to the statements that summarize toxicity data for the general reader of a PEIR and is interested in the exceptions and how the broader statements are supported. Consistent with the CEQA Guidelines and CEQA best practices, the District has included highly technical information in an appendix and summarized that information in language understandable to the general public. The commenter is directed to Chapter 6 Ecological Health for its coverage of the chemicals used or proposed for use by the District, because relevant information related to toxicity presented in Chapter 4 Biology-Aquatic and Chapter 5 Biology-Terrestrial was summarized from the information in Chapter 6. Chapter 6 information on toxicity, fate, and transport of the chemicals and effects on various vertebrates and invertebrates is summarized from the data contained in Appendix B, Ecological and Human Health Assessment Report, especially the tables contained in the text.

The PEIR includes numerous examples of the Program pesticides in use today (or proposed for use in the future) and comprehensive tables of species sensitivity to each. Each pesticide is evaluated in USEPA in-house or contract laboratories to determine the thresholds for acute and chronic toxicity. These tests, in confined laboratory conditions, expose numerous species of concern to 100 percent chemical in food or direct injections of suspended chemicals. In these evaluations the test animals are not provided any alternative food choices that are typically available in the field under natural conditions. As a result of this testing technique, the results of the laboratory tests are far more extreme and certainly can be considered "worst case" exposures and not particularly realistic. However, the purpose is to determine the levels of sensitivity to the test chemical and to develop recommended application rates that provide a large margin of likely safety to the exposures that might occur in the field. Because the District uses chemicals only at recommended application rates for the vector species involved, Program chemical use would not be expected to exceed, or even approach, toxicity thresholds for nontarget species. A table of some of the hundreds of test results can be found in Appendix B, Table 6-1, as summarized in selected entries as examples from that table listed below.

Response 11

See Responses 3 through 10 above.

Table 6-1 Toxicity Values Reported in the Literature for Active Ingredients

Active Ingredient	Mammalian Oral LD50 (mg/kg)[A]	Mammalian Dermal LD50 (mg/kg)[B]	Mammalian Inhalation LC50 (mg/L)[A]	USEPA Tox Rating	Avian LD50 (mg/kg)[C]	Fish LC50 (mg/L)[D]	Aquatic Invert EC50 (µg/L)[E]	Honeybee LD50 (µg/bee)	Other Receptors
Pyrethrins	1400	>2,000	3400	oral and dermal (III), inhalation (IV)	>5,620	0.0051	11.6	no data, likely toxic	no data
Allethrins and *d-trans* allethrin	685 (allethrin, F) 860 (d-trans)	11,332 (allethrin)	no data	no data	>2,000 (allethrin) >5,620 (d-trans)	0.0026 to 0.08	no data	3 to 9	Dog dietary NOEL = 50 mg/kg/Day for 2 years.
Phenothrin (sumithrin or d-phenothrin)	>5,000 (no deaths)	>2,000 (no deaths)	>2.1 (no deaths)	oral and inhalation (IV), dermal (III)	>5,000	0.0158	4.4	no data, likely toxic	no data
Prallethrin	460	>5,000	0.66	no data	1,171	0.012	6.2	0.028	no data
Deltamethrin	>5,000	>2,000	no data	no data	no data	no data	no data	no data	no data
Esfenvalerate	458	2,000	2.93		9,932	0.00026	0.00024	highly toxic	no data
Lambda-cyhalothrin	56 to 144	632 to 696 (rats)	no data	no data	>3,950	0.0021	0.36	0.97	no data
Resmethrin	4,639	>2,000	5.28	no data	75 (blackbird)	.00028	0.063	0.963	no data
Tetramethrin	>5,000	>2,000	no data	oral (III), dermal (IV)	>2,250	0.0037	45	0.155	no data
Permethrin	2280	>2,000	no data	oral and dermal (III), inhalation (IV)	>10,000	0.00079	0.1 (mayfly)	0.13	toxic to cats via dermal route
Etofenprox	>2,000	>2,100	>5.9	no data	>2,000	0.0027	no data	0.27 (oral), 0.13 (contact)	Dog oral LD50 >5,000 mg/kg
Piperonyl butoxide (PBO)	4,570	>2,000	>5.9	oral and dermal (III), inhalation (IV)	>2,250	1.9	510	>25	Tadpole LC50 = 0.21 mg/L
Naled	81 to 85	354	0.19	all acute (II)	52	.087 (lake trout), 2.2 (bluegill)	0.3	0.48	no data
Temephos	444	970	1.3	oral and dermal (II), inhalation (III)	no data	3.49	10	no data	no data
Bacillus sphaericus (Bs)	no data	no data	no data	no data	no data	>15.5	15,500	no data	no data
Bacillus thuringiensis (Bti)	>4,7x10[11] spores/kg	>2.67x10[11] spores/kg	4,7x10[11] spores/kg	all acute (IV)	no data	no data	50,000 (10 Days)	no data	no data
Spinosad	>5,000	>2,800	>5.18	no data	>2,000	5.9	92,700	11,500	Butterfly/moth LD50 = 0.022 mg/kg. No effect on amphibians.
Methoprene and s-Methoprene	>10,000	>2,000	>210	oral and inhalation (IV), dermal (III)	>2,000	>50	89	no data	Frog LC50 >10,000 µg/L
Alcohol Ethoxylated Surfactant (monomolecular film)	no data	no data	no data	no data	no data	No observable effects	No observable effects to shrimp, snails, worms, or mayfly naiads	no data	No observable effects to amphibians.
Aliphatic solvents (mineral oils, aliphatic hydrocarbons, petroleum distillates)	>28,000 (no deaths observed)	>5,000	3.9	no data	>2,250	no effect	<900	no effect	no data
Potassium Salts (soap salts)	no data	no data	no data	all acute effects (IV)	no data	no data	no data	no data	no data
Chlorophacinone	3.15 (rats)	0.329	.007	all acute effects (II)	258	0.45	640	no data	Carnivorous mammals LD50 = 2.1 to 50 mg/kg

Response 12

The comment is concerned with existing off-road tracks caused by off-road vehicles. Such effects may be associated with the District's surveillance and subsequent control activities in the marshes but also from the others who manage the land, including the state and federal refuge managers. Existing tracks are part of the existing condition, and the PEIR impact analyses consider the Program's ATV use in light of the District BMPs designed to avoid creating new tracks by staying on existing tracks or using foot access and by implementing measures in the USFWS's "Walking in the Marsh: Methods to Increase Safety and Reduce Impacts to Wildlife/Plants" (see BMP B1). District BMPs B1 through B6 are for vector control activities in tidal marsh areas. In particular, BMP B2 states the following:

> "District will minimize the use of equipment (e.g., Argos) in tidal marshes and wetlands. When feasible and appropriate, surveillance and control work will be performed on-foot with handheld equipment. Aerial treatment (helicopter and fixed wing) treatments will be utilized when feasible and appropriate to minimize the disturbance of the marsh during pesticide applications. When ATVs (e.g., Argos) are utilized techniques will be employed that limit impacts to the marsh including: slow speeds; slow, several point turns; using existing levees or upland to travel through sites when possible; use existing pathways or limit the number of travel pathways used." (page 2-59)

District staff operate ATVs (e.g., Argos) with great care in seasonal wetlands and tidal marshes in general as well as in MAS-owned properties. Argos are typically used, in part, because of their low ground pressure. They are necessary because of the amount of acreage that requires surveillance and/or treatment or because of safety hazards that exist. For example, one of the seasonal wetlands in Bahia can develop large underwater cracks that can result in serious injuries if trying to walk in the wetland. The District minimizes ATV use as much as possible through mosquito source reduction and physical management. Furthermore, the District assists MAS in managing seasonal wetlands by managing water control structures to maximize habitat while minimizing mosquito production, the need for larvicide applications, and ATV use. Argo tracks are also temporary, often flatten (but generally do not kill or remove) vegetation, and typically do not create "depressions". The aesthetic effect of such temporary vegetation disturbance is subjective; in the District's judgment such limited and temporary disturbance does not constitute a substantial adverse change in the visual character of the properties it treats. Visible Argo tracks do not create "breeding grounds" for mosquitoes.

Response 13

The corrections to Table 4-4 on pages 4-36 and 4-37 will be addressed in the text changes (Section 6.2) of this Final PEIR.

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O-MCGP

Marin Greens
marin county green party

October 2, 2015

Philip D. Smith, District Manager,

Marin Sonoma Mosquito Vector Control District

595 Helman Lane, CA 94931

Dear District Manager Smith:

The Marin County Green Party, through its County Council, thanks you for the opportunity to comment on the use of glyphosate by the District. Marin County's Green Party strongly supports and urges you to adopt a ban on glyphosate-containing herbicides.

Recently, the World Health Organization (WHO) found glyphosate, the active ingredient in Monsanto's Round Up, a probable carcinogen and a significant body of emerging research tends to demonstrate a wide range of serious concerns raised by its continued use in our environment.

These concerns include -

- the proliferation of glyphosate-resistant weeds;
- the impacts of glyphosate on bees, especially with respect to its effects on the plants they depend on and their ability to navigate back to the hive;
- the overall impacts on non-target plants, animals, insects and micro-organisms which may be exposed to glyphosate-containing herbicides;
- glyphosate contamination in soil and the balance of bacteria and fungi, soil ecosystem functions and plant health;
- impacts on the growth and development of amphibians;
- surface and groundwater contamination with highly soluble glyphosate; and
- the persistence of glyphosate in the environment due to a lack of biodegradation.

1

There appears to be a trend demonstrating a scientific consensus coalescing around the conclusion that glyphosate may pose serious dangers in a variety of ways. (See, for

2

O-MCGP

example, comments from Sustainable TamAlmonte and others on the Draft Marin County Open Space District (MCOSD) Vegetation and Biodiversity Management Plan and the Draft MCOSD Vegetation and Biodiversity Management Plan Tiered Program Environmental Impact Report: http://www.tamalmonte.org/letters/Sustainable_TamAlmonte_et_al_Comment_Letter_on_DRAFT_TPEIR_of_DRAFT_MCOSD_VBMP_7-6-15.pdf); New effects of Roundup on amphibians: Predators reduce herbicide mortality; herbicides induce antipredator morphology, Rick Relyea, Ecological Applications, 22(2), 2012, pp. 634–647; Effects of sub-lethal doses of glyphosate on honeybee navigation, María Sol Balbuena, Léa Tison, Marie-Luise Hahn, Uwe Greggers,Randolf Menzel, and Walter M. Farina. 2

The recent WHO finding that glyphosate is "probably carcinogenic to humans" was based on an International Agency for Research on Cancer assessment. Many of those who oppose the findings are associated with the biotech industry. 3

Rather than rely on the use of glyphosate to reduce fire threats, we believe that we can more effectively reduce fire danger by stepping up maintenance of existing fire breaks and judiciously expanding the use of controlled burns, mowing, manual removal, grazing, chipping and composting of unwanted vegetation and underbrush. We also believe that glyphosate-based herbicides may actually increase the fire threat by their desiccant effect on non-target vegetation including sensitive native species. 4

The Marin Green Party espouses ten Green Party values and the first of these is "Ecological wisdom." We believe that human societies must operate with the understanding that we are part of nature, not separate from nature. We must maintain an ecological balance and live within the ecological and resource limits of our communities and our planet. We support a sustainable society which utilizes resources in such a way that future generations will benefit and not suffer from the practices of current generations. To this end we must practice regenerative land management practices which replenish the soil's ability to absorb more atmospheric carbon, reduce carbon emissions in our generation of power and live in ways that respect the integrity of natural systems. 5

We realize that the use of glyphosates is a controversial decision that you will not take lightly. If, after you review the scientific research available, you are still in any doubt, we urge you to embrace the precautionary principle by banning the use of the "probable carcinogen" glyphosate by the District. In doing so, you will be preserving the 6

O-MCGP

North Bay's beautiful, natural system, both for ourselves and for future generations. ↑ 6

Thank you for your consideration,

Mimi Newton,

Co-Chair, Marin Green Party on behalf of the

Marin Green Party County Council

Comment Letter O-MCGP **Marin County Green Party**

Mimi Newton, Co-chair
October 2, 2015

Response 1

The comments express concern with the potential use of glyphosate by the District under the Vegetation Management Alternative for several reasons addressed below. The first concern of the MCGP is the World Health Organization (WHO) finding that glyphosate is a "probable carcinogen" and also a wide range of concerns demonstrated in emerging research (addressed after the WHO finding).

The **WHO report** is the result of a "panel discussion" (IARC) about the potential for selected chemicals and products that have achieved some level of public interest and concern but may or may not be supported by the data and information available. The panel is comprised of several European scientists and government organizations reporting to the WHO (a scientifically conservative advocacy agency) sponsored by the UN. In most of their reported reviews, the UN IARC has advocated the "precautionary principle" (WHO 2015). The "precautionary principle" is used by some members of the public to argue against chemical use. The precautionary principle is a hypothesis generally rejected by the scientific community that unless one can prove there is or can be no adverse impacts of a substance the substance should be considered hazardous. To those with scientific training, this suggests that one must "prove a negative" which is essentially impossible in any statistical sense in science. In short, the precautionary principle requires "proof of a negative" which demands that the studies disprove any possible unseen negative effect in order to accept the results of a study.

The IARC finding has been challenged by dozens of technical experts who evaluated the process used by the panel to list glyphosate as a probable carcinogen. It has been demonstrated that IARC rejected the 800 studies / 3,000 documents that gave glyphosate a positive safety result, basing their decision of "probably carcinogenic" on only eight studies, of which three actually included results that were themselves arguably insignificant. After the WHO publication listing glyphosate as a probable carcinogen, dozens of practicing scientists in the mainstream scientific community (including European Food Safety Administration, the German Federal Institute for Risk Assessment (*BfR*) and the lead author of one of the studies used by IARC to draw their conclusions) have criticized and disputed the results of the IARC for using a poor methodology and inadequate research. The conclusions drawn by the IARC about the potential adverse effects of glyphosate were based on studies that are not relevant to actual, potential exposures and on studies that were based on high exposures to petri dish cells and in vitro laboratory conditions.

Subsequent to the declaration on glyphosate, the IARC stated that bacon and other animal products are "possibly carcinogenic" but again, the declaration was challenged by several scientists who reiterated that there was no credible research that was clear enough to make such a claim (WHO 2015; Mink et al. 2012).

The District's use of glyphosate and other herbicides is for management of vector habitat and invasive weeds. When used, these herbicides are applied using targeted application equipment mounted from trucks/ARGOs or hand cans to avoid overspray onto other vegetation. The focus of herbicide use has also been on reducing or stopping invasive weed infestations and their spread associated with District activities in the wildlife refuges or in other sensitive habitats. We have provided assistance with and have partnered in invasive plant control investigations (e.g., pepperweed and *Ludwigia* ssp.) with other agencies. District staff are instructed to clean equipment after exposure to weed infested areas to limit seed dispersal.

On the issue of **glyphosate-resistant weeds**, the comment assumes that District use would contribute to the proliferation of this type of weed. Evidence for resistance to herbicides has long been observed in the agricultural use of some products, but this phenomenon is of little importance for District use at a smaller scale. The current and anticipated future use of glyphosate products by the District would not likely lead to observable resistant vegetation in the District, as the applications are not at the levels used in agriculture. The development of resistance to herbicides by specific species of vegetation occurs over years of applications. However, to minimize the potential for the development of weed resistance in an application area, products containing glyphosate would be used in rotation with other products containing imazapyr or triclopyr if repeated applications were necessary at a given site.

On the concern about **glyphosate impacts on bees**, the District's objective is to reduce or minimize the possibility of unwanted nontarget ecological receptors or species effects in the local environment while addressing the need for vector control that guides all pesticide applications including glyphosate. These considerations and how unwanted effects can be eliminated or reduced are embodied in the Program objectives and in each of the applicable BMPs. By restricting chemical applications to times when nontarget insects are not active and using care to treat only vector larvae and adults when populations are large enough to warrant treatment, impacts to other species are eliminated or substantially reduced.

Furthermore, the vegetation management option of using glyphosate has been shown to be one of the least hazardous herbicide products for over 40 years. Glyphosate is practically nontoxic to bees. Claims that glyphosate impacts bees are based on a report by Herbert et al. (2014) that conducted simulated "field tests" to evaluate the effects of glyphosate on honeybee behaviors. These authors designed their study to determine what impact exposures to glyphosate might have on honeybee foraging and hive identification behaviors. Although the hypothesis of these authors predicted that honeybee behaviors would be adversely impacted after exposure to the herbicide glyphosate, the behaviors they studied were not adversely affected by the exposures and their conclusion was "no effect on foraging related behavior was found in these behavioral studies". In several studies, for instance, (Frasier and Jenkins 1972) indicate that both technical and formulated glyphosate are practically nontoxic to honeybees with a contact LD_{50} value greater than 100ug/bee (applied directly to the thorax with a saturated Q-tip), which is clearly considerably greater exposure than likely in the environment where applications could occur. Over the past decades, to update and support the original data submitted by Frasier and Jenkins, several studies on glyphosate have been conducted to confirm and validate the toxicity estimates first submitted to USEPA for registration. These studies have been submitted to the USEPA for inclusion in the Integrated Risk Information System (IRIS, USEPA). The recent data submissions and reports continue to support the finding that glyphosate is "relatively" nontoxic to honey bees (Porterfield 2015; Zhu et al. 2015; Giesy et al. 2000; see also Table 6-1 in Appendix B of the PEIR).

There are many credible theories as to the causes of the reduction in bee numbers (where they occur), including the effect of drought on the flora sources, the rise of parasites, fungi, and other classic bee diseases, and it is likely that these sources of stress are the most important adverse effects on bee colonies.

The concern about **impacts of glyphosate on nontarget plants, insects (other than bees), animals, and microorganisms** is addressed below. Products containing glyphosate (such as Alligare Glyphosate 5.4) are registered for use in habitat restoration and maintenance. The product label states: "When applied as directed, exotic and other undesirable vegetation may be controlled in habitat management areas. Applications may be made to allow recovery of native plant species, to open up water to attract waterfowl, and for similar broad-spectrum vegetation control requirements in habitat management areas. Spot treatments may be made to selectively remove unwanted plants for habitat enhancement. For spot treatments, care should be exercised to keep spray off of desirable plants." Adverse effects to desirable, nontarget plants can be readily avoided by applying the material according to District BMPs to minimize drift and spills (see PEIR BMPs H1 – 13 and I1 – 6, Table 2-9). Material presented in the PEIR's Appendix B, Ecological and Human Health Assessment Report (Section 4.6.2) and summarized in the discussion in the PEIR (Section 6.2.5.1.1, page 6-20) indicates that glyphosate is virtually nontoxic to mammals and practically nontoxic to birds, fish, and invertebrates (Appendix B, page 4-67). Glyphosate is an herbicide that is relatively stable to chemical and photo decomposition. The primary pathway of glyphosate degradation is soil microbial action, which yields the minimally toxic breakdown product aminomethylphosphonic acid (AMPA) and glyoxylic acid. Both products are further degraded to carbon dioxide. Glyphosate adsorbs tightly to soil so that its residues are relatively immobile in soil (USEPA 1993). This characteristic results in the chemical (when it is in the soil) being less available as a route of exposure and would require direct ingestion of the soil or sediment, which is not likely by insect pollinators, who focus on flowers.

The commenter’s concern about possible **contamination of soil and soil microorganisms** and function, is not supported by evidence. As stated above the primary pathway of glyphosate degradation is soil microbial action (under aerobic and anaerobic conditions), which would not occur if glyphosate were harming these microbes.

The commenter is concerned about glyphosate’s **impacts on the growth and development of amphibians**. Some reports cited by the public suggest that the potential impact of glyphosate and glyphosate products includes adverse impacts to several life stages of amphibians and their habitats. These reports are not directly relevant to the potential impact of glyphosate on amphibians such as the California red-legged frog (CRLF) in the environment, as the data presented is based primarily on toxicity in laboratory studies using both high doses and several sequential lower doses in a laboratory setting. The toxicity of glyphosate to dozens of species is listed in Table 6-1 of Appendix B.

While the addition of some surfactants to glyphosate products may make the products more toxic to some biota, the primary concern for red-legged frog is toxicity based on studies using high, continuous exposures to the products in laboratory tests. The exposures in the laboratory studies are clearly not representative simulations of the potential exposures in field applications because the laboratory studies involve captive test species, unable to choose uncontaminated food or habitat. Many laboratory tests are designed and conducted to determine the ”worst-case” exposure to a chemical and then to lower the test concentrations slowly until a test concentration shows no adverse effect to the test animals (USEPA 2012; Williams et al. 1994). In this way, the concentrations that produce exposures with little or no adverse response can be documented and used to define the applications that should be nonhazardous to the animals and environment. As in all of the relevant laboratory toxicity studies, the exposures in laboratory conditions are essentially 100 percent with no ability to choose areas of lessor concentrations, and use non-representative exposures. The best available evidence indicates that glyphosate toxicity would not occur as a result of the District’s method of use of the chemical under the Program.

The primary causes identified by the California Department of Pesticide Regulation and California Department of Fish and Wildlife as leading to an adverse impact on the status of the threatened California red-legged frog are loss of habitat and overwhelming predation, invasive species, and competition for foraging items (National Wildlife Federation listings). The potential impact of glyphosate on the CRLF is marginal and only applicable in situations of excess exposure to incorrectly treated areas. The toxicity and adverse effects reported in laboratory studies would not be expected to occur as a result of the District’s potential herbicide applications for mosquito habitat or invasive species control in the field, because of the much lower potential exposures and the District’s adherence to its BMPs. Special care is taken to avoid applications where CRLF have been identified and reported by resource agency personnel or District biologists and technicians based on observations and database investigations.

The commenter is also concerned that **glyphosate could impact surface water and groundwater**. This issue is addressed in Section 9.2.5.2.1 of the PEIR, page 9-28:

> “Glyphosate is a nonselective, post-emergent, and systemic herbicide registered for use in agricultural and nonagricultural areas. It is used to control emergent foliage, but is not effective on submerged or mostly submerged foliage. Glyphosate is highly water-soluble, but binds tightly to soil and sediments. It has a low tendency to run off when applied to land because of strong adsorption to soil particles and it has a low potential to move to groundwater. Glyphosate degrades in soil in about a month. It has low toxicity to fish and aquatic invertebrates.”

The conclusion was that application of the herbicide active ingredients imazapyr, glyphosate, triclopyr and the adjuvant alkylphenol ethoxylates (APEs) each would have a less-than-significant impact to surface water or groundwater resources when applied in accordance with label instructions and District BMPs.

The commenter believes that glyphosate is persistent in the environment due to a lack of biodegradation. This statement is not supported by the data, which indicates that glyphosate has a typical half-life of about 2 to about 40 days, depending on the environmental conditions. The average half-life of glyphosate *is* a moderately rapid rate compared with degradation of other compounds. The variability in rates of glyphosate degradation in the published literature is primarily due to the varying microbial activity and extent of soil-binding associated with the application area. This phenomenon is unrelated to the bioaccumulation potential. Uptake and bioaccumulation is related to specific chemical characteristics associated with the physical structure of each chemical.

For decades, scientists have demonstrated and validated that every organic chemical has a physical/chemical degradation characteristic termed "half-life" (a metric used to describe the elapsed time for a chemical to reach ½ of its initial activity). Each organic chemical, whether toxic or not, decays in both activity and toxicity over time. For some chemicals, the half-life can be hours, days, or weeks. By design, few chemicals used as pesticides have half-lives greater than a week and are further degraded by the environmental conditions of the application area. When pesticides get into soil, or water, or are taken up by plants and animals, the half-life characteristics are altered. The environmental fate of pesticides depends on the physical and chemical properties of the pesticide, particularly the pH of the medium, modifying how likely it is to travel through soil (soil mobility), how well it dissolves in water (water solubility), and how likely it is to become airborne (volatility).

Once a pesticide has been released into the environment, it can be broken down by exposure to sunlight, (photolysis), exposure to water (hydrolysis), exposure to other chemicals (oxidation and reduction), microbial activity (bacteria, fungi, and other microorganisms), and other plants or animals (metabolism). Pesticide labels set out safety and use guidelines that usually focus on three aspects: rates of application (single and cumulative) for registered crops and pests, timing of application, and restrictions on areas of application (including required buffer zones).

Also see information above on soil microbial action.

Response 2

The commenter is concerned with adverse effects of glyphosate identified by others on the Marin County Open Space District's Vegetation and Biodiversity Management Plan, Draft Tiered Program Environmental Impact Report (MCOSD 2015). Specifically, the District is referred to a comment letter on the Draft PEIR; however, this letter was not provided and the hyperlink did not allow the PEIR preparers to access the TamAlmonte website. From an internet search, it appears the MCOSD has not published a Final PEIR, so this letter is not available publically. The comment also cites what appears to be two studies by Rick Relyea and by Maria Sol Balbuena et al. Neither study was provided by the MCGP, and no hyperlinks to these two studies were provided. The PEIR preparers are not obligated to conduct searches for research reports referenced in comment letters. Moreover, the referenced comments are comments on another EIR, not comments on the IVMP PEIR, and the commenter does not explain how the information in those comments, even if they were available, relates to the specific evidence and analysis in the PEIR.

The commenter did not provide the cited document on effects of sub-lethal doses of glyphosate on honeybee navigation. However, the PEIR preparers considered this issue and specifically a 2014 study prepared by Herbert et al that conducted simulated "field tests" to evaluate the effects of glyphosate on honeybee behaviors. These authors designed their study to determine what impact exposures to glyphosate might have on honeybee foraging and hive identification behaviors. Although the hypothesis of these authors predicted that honeybee behaviors would be adversely impacted after exposure to the herbicide glyphosate, the behaviors they studied were not adversely affected by the exposures and their conclusion was "no effect on foraging related behavior was found in these behavioral studies". Disregarding their negative behavioral results, the authors suggested that the bees may have been able to carry pesticide to the hive (which was not and is not a measurable endpoint) as a reason for the reduction in the number of bees (which was also not observed in their studies). Because the study results did not support the authors' speculation about glyphosate effects on bees, this 2014 study provides no support to the hypothesis of behavioral deficit after exposure to glyphosate.

It should be noted that the term "sub-lethal effect" is often misused outside the scientific community. In the scientific context the term defines the effects of a stressor (pesticide in this case) that is less than mortality. It includes evaluation of the potential effects on physiological and behavioral systems that may occur over time or result in a deficit of a physiological function. Although important in the determination of the potential adverse impacts of the pesticide, it is the "endpoint" most susceptible to influence by confounding, outside, and environmental factors. Adverse effects that are categorized as sub-lethal are also often confused with the concept of chronic effects, which include low level effects that are continued over long periods of time and usually associated with constant exposures to a stressor. Because this condition (constant exposure to chemicals) is not typical of District vector control applications of the chemical glyphosate and other herbicides (generally single localized applications) and the insecticides (localized with some multiple applications) that do not produce constant exposures, it is not relevant to the evaluation of District use of pesticides.

The PEIR preparers have considered dozens of documents and studies related to glyphosate in evaluating the Program's potential impacts on ecological and human health. Furthermore, the author of the responses on pesticide use herein, both insecticides and herbicides, and the ecological and human health impact conclusions and related material in the Draft PEIR, is Bill A. Williams, PhD, a toxicologist with the educational and experiential background as an expert on pesticides and their use in aquatic and terrestrial environments. Dr. Williams has more than 30 years of experience and expertise in environmental risk assessment and toxicology, including CERCLA, NRDA, NEPA, and CEQA projects ranging from upland to sediment to freshwater/marine projects. Dr. Williams has been a member of numerous international, National Academy, and federal committees and workshops to define risk assessment guidelines, test procedures, field study approaches, and avian and mammalian test protocols, and to provide other technical assistance utilized by US EPA regulators. He helped develop US EPA's Framework for Ecological Risk Assessment and US EPA's risk assessment of 2,3,7,8 TCDD (tetrachlorodibenzo-p-dioxin or dioxin). He was a charter member of the Avian Dialogue Group, convened by the Conservation Foundation (RESOLVE) to bring industry, academia, and government regulators together to resolve conflicts between the groups. Dr. Williams has led and supported dozens of successful projects that were acceptable to the Washington Department of Ecology, Oregon Department of Environmental Quality, Oregon Department of Fish and Wildlife, US Environmental Protection Agency, Regions 2, 9, 10 and numerous other US EPA regions nationwide. Dr. Williams has served on several Oregon DEQ advisory science committees and workshops. He has been a member of several national and regional EPA Science Advisory Panels, including the National Science Advisory Panel on endocrine disruptors, uncertainty in risk assessments, and the panel on use of laboratory data in estimates of risk to wildlife.

The substantial evidence contained in the Draft PEIR and in the Final PEIR compiled by Dr. Williams and the best professional judgment exercised by Dr. Williams in the context of this CEQA evaluation of vector control is sufficient to support the PEIR's determination that impacts from glyphosate use under the Program would be less than significant.

Response 3

MCGP comments again on the WHO finding addressed in Response 1 above and suggests that those who oppose the findings are associated with the biotech industry. The PEIR preparers for the District are not associated with the biotech industry and are fully capable of exercising best professional judgment in reviewing all of the studies on pesticides including glyphosate in an objective, technically defensible manner appropriate for the CEQA process. See Response 2 above for more information on the qualifications of Dr. Williams.

Response 4

The comments on use of glyphosate to reduce fire threats is not relevant to the District's PEIR. The District's use of glyphosate and other herbicides is for the management of vector habitat including the control of invasive weeds when these are problematic for vector control. The PEIR Chapter 8 Public Hazards is focused on the potential for District staff to access fire hazard areas and potentially ignite a fire from vehicle access. This potential hazard is minimized with BMPs included in the Program Description (Table 2-9):

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

> 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)

Response 5

Comments explaining the MCGP's values called "ecological wisdom" are noted and considered. Greenhouse gas emissions from the Proposed Program are addressed in Chapter 11. The District's energy requirements and conservation measures are described in Section 14.4 of the PEIR:

"All equipment used in Program implementation would be kept up to date with maintenance requirements and would be used as efficiently as possible, i.e., minimize idling time of all vehicles and equipment; service and maintain all equipment according to manufacturer's instructions to remain in good working order; maintain vehicle tire pressure to manufacturer specifications; and inspect and reinflate tires at regular intervals, as stated in BMP A14 in Table 2-6." (page 14-2)

Response 6

The comment to use the precautionary principle is addressed in Response 1. Instead of eliminating all use of glyphosate, District staff believes it should be included in its Vegetation Management Alternative along with other herbicide options as appropriate, and thus has proposed to allow its use under the Proposed Program. However, the District has, for at least the past 2 decades, taken an integrated systems approach to mosquito and vector control, utilizing a suite of tools that consists of public education, surveillance, source reduction (e.g., physical control, vegetation management, water management), biological controls, and chemical controls. As stated in PEIR Section 2.3, three core tenets are essential to the success of a sound Integrated Vector Management Program (IVMP).

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

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

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

The District's integrated vector management approach seeks to protect human and animal health while minimizing environmental impacts.

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O-RRK

RUSSIAN RIVERKEEPER®

October 1, 2015

Marin Sonoma Mosquito and Vector Control District
Board of Trustees
595 Helman Lans
Cotati, CA 94931

RE: Comments on MSMVCD PEIR on ESA issues raised by use of synthetic pyrethroids

Dear Board of Trustees,

Russian Riverkeeper ("RRK") is one of twelve California Waterkeeper organizations within the California Coastkeeper Alliance ("CCKA") network and a member of the international Waterkeeper Alliance. We represent our watershed community and our over 1600 members interest in the long-term health of the Russian River. As such we are gravely concerned with the lack of specific mitigations to ensure protection of ESA listed salmon habitat in the Marin Sonoma Mosquito and Vector Control District Integrated Vector Management Program Draft Programmatic PEIR (PEIR) dated August 2015. We have reviewed the PEIR and have the following comments to ensure the protection of water quality and Federal and State listed species of Salmon.

Significant Impacts to ESA listed Salmonids in the Russian River and tributaries:

- PEIR fails to adequately analyze potential impacts to ESA listed salmon from use of pyrethrin/pyrethroid class pesticides
- PEIR fails to adequately mitigate the potential impacts to ESA listed salmon through use of pyrethrin/pyrethroid class pesticides

1. Pyrethroids are persistent and bind with sediments and research has shown widespread presence of pyrethroids in benthic sediments at concentrations are acutely toxic to benthic organisms that are prey for salmon. [1,2,3,4] Pyrethroid use distant to streams still results in stormwater runoff that brings pyrethroids to streams.[5] Numerous existing sources of pyrethroids from urban and agricultural uses has resulted in elevated concentrations of pyrethroids in most waterways sampled. [6] 1

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2. USEPA, 2011; Pyrethroiud Cumulative Risk Assessment; available at: http://www.regulations.gov/ - !documentDetail;D=EPA-HQ-OPP-2011-0746-0003
3. Use and toxicity of pyrethroid pesticides in the Central Valley, California, USA; Amweg, Erin L.; Weston, Donald P.; Ureda, Nicole M.; Environmental Toxicology and Chemistry (2005), 24 (4), 966-972 CODEN: ETOCDK; ISSN:0730-7268. (SETAC Press)
4. Weston, D.P., Holmes, R.W., Lydy, M.J. 2009. Residential runoff as a source of pyrethroid pesticides tourban creeks. Environ. Poll. 157:287 -294
5. See # 4
6. **Occurrence and Potential Sources of Pyrethroid Insecticides in Stream Sediments from Seven U.S. Metropolitan Areas**
Kathryn M. Kuivila*†, Michelle L. Hladik†, Christopher G. Ingersoll‡, Nile E. Kemble‡, Patrick W. Moran§, Daniel L. Calhoun||, Lisa H. Nowell†, and Robert J. Gilliom†
Environ. Sci. Technol., 2012, 46 (8), pp 4297–4303

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O-RRK

Urban areas such as the Santa Rosa Plain are significant sources of pyrethroid at concentrations
that are often acutely toxic to test species such as *H. Azetca* and was found to affect growth at
concentrations below the LC50.[7,8] Macroinvertebrates and terrestrial insects make up the bulk of
Coho Salmon that are listed as Endangered in the Russian River.[9] Freshwater macroinvertebrate
species that are highly intolerant of pyrethroid concentrations at or below 1ug/L, such as 2
Diptera, Amphipods & Oligochaeta comprise the majority of prey species for juvenile Coho
Salmon.[10] In addition, Legacy toxicity from past use of pesticides such as DDT continue to
persist in benthic sediments and this is often overlooked in risk assessments such as performed
by this PEIR.[11] Use of pyrethroid class pesticides for the Project will diminish these food sources
and impact ESA listed salmon contrary to the assertions in PEIR Section 4.2.7.1.2. This PEIR and
analysis of possible impacts from use of Mosquito Adulticides states in Section 4.2.7.1.2 that,
"Numerous studies have found that these ULV applications result in concentrations in the
aquatic environment of 0.23 to 3.77 μg/L and had little to no effect on fish or nontarget aquatic 3
invertebrates (see Appendix B)." None of the studies listed considered additive effects from
other pesticides, the severely degraded baseline for salmon habitat or the synergistic effects of
legacy pesticides that could present significant un-mitigatable impacts.[12,13] The Impact Analysis
in Chapter 5 Biological Aquatic Impacts state on "Both sets of compounds tend to break down
relatively quickly in the environment, often within hours, and usually within a few days", this
is directly refuted by several research papers that show far longer half-life under certain
conditions that are frequently present in the Russian river and tributaries such as the Laguna de
Santa Rosa. According to the California Department of Pesticide Regulation, the half-life of 4
Permethrin, is estimated at 51-240 days- this directly refutes the PEIR statement that is has no
significant impacts due to Permethrin's short half life[14] Therefore any use of Permethrin is a
significant impact to ESA listed Salmonid habitat and food sources well into winter months
when juvenile fish lack adequate nutrition resources. This PEIR is deficient in not properly
analyzing potential significant impacts to ESA listed Salmon claiming no significant impacts, 5
the PEIR additionally fails to mitigate those impacts and should not be approved or certified
until the failures are remedied.

Noticing Issues for Relevant Public Agencies

First the list of State and Federal Agencies contacted on Page S-3 and S-4 doesn't contain the
North Coast Regional Water Quality Control Board or the National Marine Fisheries Service
and appears to indicate not all relevant agencies were contacted as required. The North Coast
Waterboard is the regulatory agency for water quality impacts in over half of the project area.
Additionally National Marine Fisheries Service – not USFWS – is the Federal Agency charged 6
with implementing the Federal ESA with regards to Salmon and Steelhead which inhabit almost
all of the project area which is common knowledge. Not contacting these agencies appears to be
a significant omission from noticing all relevant agencies.

We strongly urge that the Board of Trustees use its discretionary authority to ban use of any
pyrethroid class pesticide and associated synergists to avoid significant impacts to ESA Listed 7
Salmonids in the Project Area.

Sincerely,

Don McEnhill
Executive Director

7. See #3 *ibid*

O-RRK

8. See #2 *ibid*
9. Diet and Prey Consumption of Juvenile Coho Salmon (Oncorhychus Kisutch) in three Northern California Streams, Gonzales, Eric, HSU, 2006; Available at: http://www2.humboldt.edu/cuca/documents/theses/gonzalesthesis.pdf
10. #9 *ibid*
11. The legacy of pesticide pollution: An overlooked factor in current risk assessments of freshwater systems; · Jes J. Rasmussena, , , Peter Wiberg-Larsena, Annette Baattrup-Pedersena, Nina Cedergreenb, Ursula S. McKnightc, Jenny Kreugerd, Dean Jacobsene, Esben A. Kristensena, Nikolai Friberg
12. *Ibid*
13. Factors Leading to Federal Listing (of Coho Salmon), NOAA Fisheries; available at: http://www.westcoast.fisheries.noaa.gov/publications/recovery_planning/salmon_steelhead/domains/north_central_california_coast/central_california_coast_coho/factors_i.pdf
14. Environmental Fate of Permethrin, Heather Imgrund, Environmental Monitoring Branch, Department of Pesticide Regulation, 2003

Comment Letter O-RRK — Russian Riverkeeper

Don McEnhill, Executive Director
October 1, 2015

Response 1

The commenter is concerned with the use of pyrethrins and pyrethroids and states that the Draft PEIR does not adequately address significant impact on salmonids, a special-status species. In short, Mr. McEnhill disagrees with the conclusions of the Draft PEIR and cites studies on these chemicals in support of his opinion.

The Draft PEIR evaluates this topic in several locations in the Draft PEIR text, which is based on the Appendix B, Ecological and Human Health Assessment Report, that discusses the toxicity and environmental fate and transport of the natural and synthetic pyrethroids. While we do not argue about the potential for these active ingredients to cause harm to nontarget species, including salmonids, the issue for the PEIR is whether the type of application, method of application, application rate, and the limited/targeted use of these chemicals by the District for vector control has the potential to cause a substantial adverse direct or cumulative impact to salmonids. The Draft PEIR also considers the context (environmental conditions) in which the District's use of pyrethrins and pyrethroids occurs in making a determination of significance under CEQA. For example, in covering the topic of water quality impacts in Section 9.2.7.2.1, the following information is provided:

> "Pyrethrins and pyrethroids quickly adsorb to suspended solids in the water column and partition into the sediment. They adsorb strongly to soil surfaces, and are generally considered immobile in soils and, therefore, are unlikely to leach to groundwater (USEPA 2006c). These materials are relatively nontoxic to mammals and birds, but are highly toxic to fish and invertebrates. The major route of degradation is through photolysis in both water and soil. Pyrethrins and pyrethroids may be persistent in environments free of light, and pyrethroids as a class have been implicated in 303(d) listings of sediment toxicity in urban creeks (BASMAA 2013). However, the ULV applications common to mosquito control and the limited use at ground-dwelling yellow jacket wasp nests (that pose an imminent threat to people or to pets) encourage dissipation rather than persistence in the environment.
>
> "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 would have a less-than-significant impact on surface water or groundwater, including their limited use near septic systems, when applied following District BMPs and using ULV techniques, and when used in accordance with label requirements and the District's PAP." (page 9-36)

Therefore, the concern that ULV applications of pyrethrin/pyrethroids for adult mosquito control and the very limited/focused use of it in nests of ground-dwelling yellow jacket wasps (in response to public service requests) would result in pyrethrin/pyrethroids being present in storm water runoff and subsequently in stream sediments is substantially overstated. The District's BMP H6 states: "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." Additional substantial evidence to support the PEIR's determination of a less-than-significant impact to surface water is presented below.

As noted in Section 9.1.2.1.1, *Section 303(d) Water Quality Limited Surface Waters* (page 9-9): This section requires each state to provide a list of impaired waters that do not meet or are expected not to meet state water quality standards as defined by that section. Note that the District is not proposing to use diazinon or any of the pesticides called out as contributing to impairment of surface waters under Section 303(d) within Marin and Sonoma counties.

As described in Section 9.1.2.2.8, the District operates under the Statewide NPDES Vector Control Permit but does not use all of the chemicals listed below:

> "The Statewide NPDES Permit for Biological and Residual Pesticide Discharges to waters of the US from Vector Control Applications (SWRCB Water Quality Order No. 2011-0002-DWQ with amendments; NPDES No. CAG 990004; Vector Control Permit) covers the point source discharge of biological and residual pesticides resulting from direct and spray applications for vector control. The District completed application requirements, including preparation of a Pesticide Application Plan (PAP) and public notice requirements, and received permit approval on October 31, 2011. Permitted larvicide active ingredients include monomolecular films, methoprene, *Bacillus thuringiensis* subspecies *israelensis* or Bti, *Bacillus sphaericus* or Bs, temephos, petroleum distillates, and spinosad. Permitted adulticide active ingredients include malathion, naled, pyrethrin, deltamethrin, lambda-cyhalothrin, permethrin, resmethrin, sumithrin, prallethrin, the synergist PBO, etofenprox, and N-Octyl bicycloheptene dicarboximide (MGK-264). The permit also includes language that allows adulticides and larvicides that are newly registered in California and that are based on active ingredients currently registered by CDPR to be used for vector control without having to further amend the permit. The permit contains a receiving water limitation for malathion and receiving water monitoring triggers for the other active ingredients. To obtain coverage under the permit, each discharger (typically a vector control district) must submit a Notice of Intent, application fee, and PAP, which is subject to approval by the SWRCB following a 30-day public comment period." (pages 9-13, 9-14)

Further support for the conclusions of less-than-significant impacts is provided in a 2-year monitoring study conducted for the State Water Resources Control Board by the Mosquito and Vector Control Association of California (MVCAC) monitoring coalition to determine whether vector control activities were contributing contaminants to State waters. The MVCAC monitoring coalition conducted chemical monitoring for adulticides at 61 locations during 19 application events in 2011 to 2012 and coordinated physical monitoring for 136 larvicide application events in 2012. Samples were collected from agricultural, urban, and wetland environmental settings in both northern and southern California. The adulticides evaluated included pyrethrin, permethrin, sumithrin, prallethrin, etofenprox, naled, malathion, and the synergist piperonyl butoxide. This monitoring study (MVCAC 2013) was conducted in accordance with the Statewide NPDES Vector Control Permit and had the following results:

- 1 out of 136 visual observations showed a difference between background and post-event samples;
- 108 physical monitoring samples showed no difference between background and post-event samples; and
- 6 out of 112 samples exceeded the receiving water monitoring limitation or triggers.

The report concluded that there was no significant impact to beneficial uses of receiving waters due to application of vector control pesticides in accordance with approved application rates. This is consistent with the primary mandate for vector control districts of protecting public health by reducing vector-borne diseases from mosquitoes and other vectors.

The State Water Resources Control Board evaluated the results of this study (MVCAC 2013) and a concurrent toxicity study conducted by researchers from UC Davis (Philips et al. 2013) and concluded that based on the monitoring data, the application of pesticides in accordance with approved application rates does not impact beneficial uses of receiving waters (SWRCB 2014). Therefore, the monitoring and reporting program for the Statewide NPDES Vector Control Permit was amended in March 2014 to limit the required monitoring to visual observations, monitoring and reporting of pesticide application rates, and reporting of noncompliant applications (SWRCB 2014). The totality of the evidence indicates that the District's use of pyrethroid pesticides under the Program would not result in contamination of surface water or benthic sediments at levels that would cause toxicity to salmonids or salmonid prey, including benthic invertebrates.

Response 2

The commenter concludes that use of pyrethroid class pesticides will diminish a number of food sources (macroinvertebrates and terrestrial insects) that "make up the bulk of Coho Salmon that are listed as Endangered in the Russian River." Specific invertebrates are mentioned as comprising the majority of prey species for juvenile Coho Salmon.

The text in Section 4.2.7.1.2 includes the following:

> "Adulticides are applied from the ground via truck, ATVs, utility vehicles, or handheld devices as an ULV application.
>
> "Aerial adulticiding could be used in the future to deal with a severe outbreak or risk of mosquito-borne disease transmission. Aerial applications would be made using ULV techniques. Aerial application of adulticide may be the only reliable means of obtaining effective control in areas bordered by extensive mosquito production sites with a small, narrow, or inaccessible network of roads, or to cover a very large area quickly in case of unusually severe mosquito outbreaks or vector-borne disease epidemics. In making the decision to use this technique, the District considers the potential effects on human health and the potential for environmental harm. For example, the maximum application rate of an adulticide that could be used is 0.87 ounce/acre, although maximum application rates are generally not required. The concentration of the active ingredient is 5 percent or less of this volume. This translates into a water concentration of 1.04 µg/L if the water is one foot deep or 4.14 µg/L if the water is three inches deep. This assumes all of the product contacts the water. Aerial applications are made over vegetated areas preferred by adult mosquitoes, so the amount of product encountering the water is generally a fraction of this. The chemicals used are selected for rapid breakdown and are typically present for a few hours to a couple of days after application." (page 4-97)

What is critical to note here is that the bulk of any pyrethroid product applied over (as a fog) or near water would not contaminate the water because of the application method, and any resulting concentrations would be very low and not persistent. Because of the low frequency of applications and low concentrations of pyrethroids in the water column, the Program's use of pyrethroid pesticides would not have a substantial adverse effect on food supply for salmonids.

Terrestrial insects in flight at the time of a ULV application could be killed by the pyrethroid, along with the adult mosquitoes, who would then drop dead onto the surface of the water and potentially be eaten by juvenile salmon predators in these freshwater streams. An adverse effect to nontarget predators (food web transfer of applied chemical) would require the consumption of adequate numbers of contaminated pests to reach a concentration in the predator that would be toxic. In the food web constructs, predators consume prey items that are smaller in size and mass. This is the basis for the hierarchy inherent in the classical ecological food web. This process requires consumption of adequate numbers (mass) of contaminated prey items to exceed the dose known to result in adverse effects or mortality. To result in the bioaccumulation of chemical in an insect predator (including fish) sufficient to reach a level of sensitivity, the consumer species would have to consume very large numbers of contaminated insects. Given the specificity of pesticide toxicity to potential predators (see Table 6-1 in Appendix B of the PEIR), and the relative infrequency of District applications in any particular area, it would not be likely that consumer species, including salmonids, would be adversely affected as a result of chemical transfer from the consumption of insects killed by Program use of pyrethroids.

The conclusion of the Weston et al. study (2015) further supports the PEIR's conclusion that properly selected pesticide applications can be effective against target mosquitoes while not resulting in unacceptable adverse impacts to nontarget species. The low levels of pesticides used by the District, combined with the careful application restrictions embodied in the District BMPs, results in the effective, yet environmentally compatible treatment for mosquitoes and other vectors. All pesticide applications are subject to several BMPs including the following:

> District will avoid use of surfactants when possible in sites with aquatic nontargets or natural enemies of mosquitoes present such as nymphal damselflies and dragonflies, dytiscids, hydrophilids, corixids, notonectids, and ephydrids. Surfactants are the only tool used to treat sources of pupae to prevent adult mosquitos' emergence. The District will use a microbial larvicide (Bti, Bs) or insect growth regulator (e.g., methoprene) instead or another alternative when possible. (BMP H2)

> Materials will be applied at the lowest effective concentration for a specific set of vectors and environmental conditions. Application rates will never exceed the maximum label application rate. (BMP H3)

Furthermore, the CEQA conclusions of less-than-significant impacts are based not only on the BMPs but on application methods (including methods recommended by the product label, which were developed through the product's EPA registration process to minimize adverse ecological impacts) and the concentration and type of chemical materials used. All of these factors, and including the physical context in which the applications occur (that subject the treatments to sunlight, air, and soil conditions that minimize persistence and facilitate breakdown) support the Draft PEIR conclusions that the effects are not substantial or adverse enough to be characterized as significant, i.e., a less-than-significant impact, not that there is a conclusion of zero or no impact. There could be a loss of some individual insects on occasion during an application of permethrin or pyrethroid product, but the loss would not be substantial for reasons cited above.

Response 3

The commenter is concerned about additive effects in the aquatic environment, the existing degraded salmon habitat conditions, and the synergistic effects of legacy pesticides. Another way of stating this is posing the question of "Is the District's ongoing use of pyrethroids under the Chemical Control Alternative interacting with other existing chemicals in surface water and sediments in a manner harmful to salmon?"

A study cited by the commenter was a thesis presented for partial fulfillment of a Master's degree and not a peer reviewed publication (Gonzales 2006). The objective of this unpublished thesis was to attempt to quantify the insect diets, caloric value, and estimates of prey consumption of salmon using computer modeling and some in-situ testing of selected streams in northern California. While the author provides some interesting information about the range of numbers of salmon (and biomass) in the testing segments of the rivers, he reports that the range varied considerably between test creeks, between years and months and ranged from an estimated 1.45 Coho salmon/m^2 to approximately 0.070 salmon/m^2 (approximately a 20 fold). Along with the salmon densities, he reports that the insect prey available also varied greatly. Gonzales further reports that the survival rates varied similarly from 9 to 75 percent across months and years evaluated. In his summary of his investigation, Mr. Gonzales suggests that *"*differences between summer and fall rearing potential arising from variation and availability of prey for juvenile Coho salmon bearing streams are likely secondary in importance to the amount of available winter habitat in regulating smolt production."

Because of this large variation in prey biomass, it is unlikely that impacts to prey items, regardless of the sources, would adversely impact the population of salmon in the streams and creeks used in the Gonzales study. For the reasons discussed in Response 2, the District's use of chemicals would not have the potential to remove sufficient prey so as to have a substantial adverse impact on salmonids.

Concerning additive or synergistic effects of pyrethroids with other materials the District could use, these materials are not applied at the same time. Section 6.2.2.2 contains the following discussion: "Concerning the application of multiple chemical treatments in the same area, such as larvicides followed by adulticides, or the application of multiple pesticides at the same time in a specific area, the following information applies:

> "Most products sold as herbicides and pesticides are evaluated herein both for the active ingredient and for the adjuvants and surfactants used to make the product more useful. When multiple products are used in a vector control application, the impacts are weighed against the proximity and timing of each application. When two approved products are used that contain two active ingredients, this scenario is possible, but the product usually already contains two active ingredients. If products with similar or even different active ingredients are applied simultaneously, it is likely that the net effect could be the sum of the effects of the active ingredients to impact 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 vectors (mosquitoes) have not been sufficiently killed would the District go back into the area and reapply a pesticide." (Page 6-15)

The question is more appropriately a cumulative impact concern about the District's use of pesticides in combination with pesticides used by others (including homeowner use involving liquid spray and granular products; agricultural use on row crops, vines, and trees; and past/present/future use) that have affected surface waters and potentially aquatic species such as salmon. The Draft PEIR discusses the issue of pelagic organism decline in Section 13.2.1.2 and concluded that the Chemical Control Alternative does not contribute substantively to chemical loads in salmonid habitats. This conclusion is supported by the 2 years of monitoring work done under the Statewide NPDES Vector Control Permit, described under Response 1 above. While overall use of pesticides throughout the Program Area may be considered cumulatively significant, the District's incremental contributions to this impact are not cumulatively significant given use of District BMPs and permit requirements.

There are many confounding factors contributing to the decline of salmon, and pesticides may be one of these factors, especially where discernible amounts have been documented leading to water quality impairment of specific water bodies. However, for the reasons stated in the PEIR and these responses to comments, the District is not having an individually significant impact or cumulatively considerable contribution to impacts to salmonids, which may be caused by other pesticide users as well as other environmental factors such as ocean conditions, access to habitat and streamflows.

Response 4

The commenter argues that persistence of pyrethroids in the environment specifically its "half-life" is greater than that that cited in the PEIR, based on local conditions in the Russian River and CDPR data.

Although the commenter suggests that the half-life of permethrin is greater in the region of the Russian River, the commenter has not provided monitoring or sampling information to validate the claim that it is different from the published literature. Without providing the necessary detailed and appropriate monitoring data, the permethrin half-life in the Russian River watershed should be assumed to track the published data and USEPA-designated chemical and environmental characteristics. Since the comment does not identify the "certain conditions that are frequently present in the Russian River and tributaries" to result in longer half-lives, so a more specific response is not possible.

By design, few chemicals used as pesticides have half-lives greater than a week and are further degraded by the environmental conditions of the application area. When pesticides get into soil, or water, or are taken up by plants and animals, the half-life characteristics are altered. The environmental fate of pesticides depends on the physical and chemical properties of the pesticide, particularly the pH of the medium, modifying how likely it is to travel through soil (soil mobility), how well it dissolves in water (water solubility), and how likely it is to become airborne (volatility) (USEPA 1993). From several sources of data relating the half-life of pyrethroids, although there are numerous ranges reported, a reasonable estimate of the half-life as published by USEPA and the National Pesticide Information Center (NPIC), should be approximately 12 to 13 hours in water and soil surfaces. While these are typical values, the range of half-life values reported for pyrethroids can range from a few hours to days or weeks because the half-life is dependent on the physiochemical characteristics of the media to which it is applied (pH, temperature etc.). The process of degradation is driven primarily by sunlight and other exogenous factors, but these values provide a defensible basis for a typical estimate of half-life under most conditions (National Pesticide Information Center 2014). The reported longer half-life values are generally associated with a lack of sunlight

More important considerations in the evaluation of the possible impacts of the use of pyrethroids by the District are the following:

1. The applications are conducted using ULV techniques that employ very low concentrations (considerably lower than urban or agricultural uses) of chemical applied to focused sites using BMPs designed to further reduce the likelihood of chemical exposure to unwanted areas;
2. The contribution of chemicals, including pyrethroids, is substantially greater from agricultural sources than all others. Evaluation of the pyrethroid concentrations in field studies must acknowledge the individual, specific sources; and
3. Laboratory studies relating the toxicity of pyrethroids to test species provide the basis for relative sensitivity and toxicity and it is clear that the concentrations required to result in toxicity to salmon are substantially higher than the likely chemical concentrations reaching waterways potentially affected by Program use. This was verified in a study conducted in situ to evaluate the potential adverse effects of pyrethroids reaching the river watershed in which mortality and sublethal effects to salmon were not observed (Wilson et al. 2015).

The best available evidence supports the PEIR's determination that the District's use of pyrethroid pesticides would not have a significant impact on salmonids, and the commenter has not provided any evidence that would refute that determination.

Response 5

The comment is that the Draft PEIR is deficient because it did not properly analyze potential significant impacts to ESA listed salmon and fails to mitigate these impacts.

The PEIR preparers considered substantial evidence in preparing the Draft PEIR, including studies on the effects of pyrethroids that were evaluated in the context of the material's application procedures and concentration to be effective for vector control along with District BMPs. The PEIR preparers considered the comments and studies cited by Mr. McEnhill in the responses above, which conclude the comments provide no relevant information about impacts to salmonids or salmonid prey that could be linked to District activities.

The Draft PEIR's conclusion that pyrethroid use by the District for vector control does not have significant impacts on salmon remains unchanged. Clearly, there is public controversy over the issue of pesticide use, and specifically the pyrethroids of concern to RRK. There is a difference of opinion between the commenter and the Draft and Final PEIR conclusions of less-than-significant impact. The additional information evaluated in the process of addressing these comments does not refute conclusions of less-than-significant impact and does not invalidate the PEIR or require recirculation of the PEIR.

The Draft PEIR correctly analyzed the impacts associated with the District's Proposed Program, and additional information is provided herein to support the original conclusions as well as document consideration of information provided by the commenter. The information above provides clarification of material contained in the PEIR and addresses specific questions raised in comments for this Final PEIR. None of the comments identified substantial evidence of a new significant impact that was not considered in the Draft PEIR, and no Draft PEIR impacts need to be changed from less-than-significant to significant; thus a recirculated Draft PEIR is not required. Disagreement among experts is not a sufficient reason to invalidate conclusions reached by technical experts involved in EIR preparation.

The technical qualifications of all of the preparers of the District's PEIR are summarized in Chapter 16, Preparers. Furthermore, the principal author of the responses on pesticide use herein, both insecticides and herbicides, and the ecological and human health impact conclusions and related material in the Draft PEIR, is Bill A. Williams, PhD, a toxicologist with over 30 years of experience and the educational and experiential background as an expert on pesticides and their use in aquatic and terrestrial environments. A summary of Dr. Williams' qualifications to evaluate the scientific literature and to consider where and how the pesticides are being used specifically by the District for vector control, in order to draw conclusions of impact significance to humans and to nontarget species, are provided below. The highlights of his extensive experience presented are from Dr. Williams' technical resume.

Dr. Williams has more than 30 years of experience and expertise in environmental risk assessment and toxicology, including CERCLA, NRDA, NEPA, and CEQA projects ranging from upland to sediment to freshwater/marine projects. Dr. Williams has been a member of numerous international, National Academy, and federal committees and workshops to define risk assessment guidelines, test procedures, field study approaches, and avian and mammalian test protocols, and to provide other technical assistance utilized by US EPA regulators. He helped develop US EPA's Framework for Ecological Risk Assessment and US EPA's risk assessment of 2,3,7,8 TCDD (tetrachlorodibenzo-p-dioxin or dioxin). He was a charter member of the Avian Dialogue Group, convened by the Conservation Foundation (RESOLVE) to bring industry, academia, and government regulators together to resolve conflicts between the groups. Dr. Williams has led and supported dozens of successful projects that were acceptable to the Washington Department of Ecology, Oregon Department of Environmental Quality, Oregon Department of Fish and Wildlife, US Environmental Protection Agency, Regions 2, 9, 10 and numerous other USEPA regions nationwide. Dr. Williams has served on several Oregon DEQ advisory science committees and workshops. He has been a member of several national and regional EPA Science Advisory Panels, including the National Science Advisory Panel on endocrine disruptors, uncertainty in risk assessments, and the panel on use of laboratory data in estimates of risk to wildlife.

Of particular relevance to his role on the CEQA documents for mosquito and vector control agencies is that Dr. Williams recently provided strategic and scientific support in the development of an Integrated Pest Management (IPM) system for use by the Mid-Peninsula Open Space District in the San Francisco Bay Area. The IPM is tailored to the vectors of concern, the pesticides and herbicides used by the District, and potential risk to the nontarget aquatic and terrestrial species. Pesticides incorporated into the IPM were based on evaluations of the use of more than 20 herbicides (with emphasis on use of glyphosate in regional wildland areas for control of over 60 invasive plant species), dozens of insecticides, structural and nuisance agricultural and urban pests, and selected regional wildlife pests. The IPM developed for the District included control of ants, cockroaches, wasps and flies, ticks, and mosquitoes. The IPM plan included recommendations for establishing and conducting pest identification, conducting damage assessments, and establishing tolerance levels and several tiers of proposed vector control that addressed top to bottom elements of implementation strategies.

Dr. Williams also provided scientific reviews and risk assessments addressing the potential adverse effects of CAL FIRE herbicide use to reduce the potential for and mitigation of wildfires in California. The Vegetation Treatment Program (VTP) project included evaluation of potential adverse impacts of herbicides used in forestry and rangeland to control brush and grasses and for maintenance of areas that have been previously cleared of heavy vegetative fuels. The primary herbicides of concern in the evaluation were the numerous products containing glyphosate as the active ingredient.

Dr. Williams has participated in numerous workshops as a speaker or panel member on ecological risk assessment addressing such topics as uncertainty analysis in ecological risk assessments, ecotoxicological principles for avian field studies, population ecology and wildlife toxicology of agricultural pesticide use, and environmental effects assessment. He has published numerous peer-reviewed studies in scientific journals and presented abstracts in scientific meetings, including the following (of more than nine book chapters, 55 peer reviewed studies and more than 105 meeting abstracts):

- Williams, B.A., J.Q. Word, and W. Gardiner. 2007. Detecting the Presence and Effects of Pharmaceuticals and Personal Care Products in Water Samples. WEFTEC Annual Conference October 11-17 September, 2007. San Diego, CA.
- Williams, B.A., J.Q. Word, and W. Gardiner. 2007. Reducing Effects of Endocrine Disrupting Compounds: Effluent Blending. WaterReuse Assoc. Conference July 29-30, 2007. Providence, RI.
- Williams, B.A., L.J. Kennedy, J.A. Nedoff, and T. Fuji. 2005. "Risk Assessment as a Tool for Emerging Contaminants and Water Quality Decisions." PNW AWWA Meeting, Portland, OR, 4-6 May 2005.
- Bahe, A., B.A. Williams, L.J. Kennedy, and J.A. Nedoff. 2004. "Do Residual Levels of Pharmaceuticals Contribute to Endocrine Disruption?" 25th Annual Mtg. SETAC, Portland, OR, 14-18 November 2004.
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- Kapustka, L.A., B.A. Williams, and A. Fairbrother. 1996. "Evaluating Risk Predictions at Population and Community Levels in Pesticide Registration - Hypotheses To Be Tested." Environ. Toxicol. & Chem. 15(4), 427-431.
- Williams, B.A., et al. 1994. "Assessing Pesticide Impact in Birds. Final Report of the Avian Effects Dialogue Group (1988-1993)." Resolve, 156 pp., Washington, DC.
- Williams, B.A., et al. 1991. "Assessing Pesticide Impact in Birds. Discussions of the Avian Effects Dialogue Group (1989–1991)." Resolve, Washington, DC.

The substantial evidence contained in the Draft PEIR and in the Final PEIR compiled by Dr. Williams and the best professional judgment exercised by Dr. Williams in the context of this CEQA evaluation of vector control alternatives is defensible and sufficient.

Response 6

The North Coast Regional Water Quality Control Board received the NOA and the Draft PEIR on CD from the State Clearinghouse. The National Marine Fisheries Service office in Santa Rosa was on the PEIR mailing list for the NOA and was included in the list of federal agencies in Section 1.4.4. The list included in the Summary was of state responsible and trustee agencies only.

Response 7

The District's Proposed Program is an IVMP. District policy is to identify those species that are currently vectors, to recommend techniques for their prevention and control, and to anticipate and minimize any new interactions between vectors and humans and domestic animals. The District's IVMP employs integrated pest management (IPM) principles by first determining the species and abundance of mosquitoes/vectors through evaluation of public service requests and field surveys of immature and adult mosquito/vector populations and, then, if the populations exceed treatment guidelines, using the most efficient, effective, and environmentally sensitive means of control. This approach minimizes the potential for chemical use. Based on the experience and technical knowledge of District staff, pyrethroids are an important option for use to control adult mosquitoes; and based on the information contained in the PEIR, they can be used without a significant impact on salmonids. The District's Board will consider these and other comments prior to certifying the PEIR and then deciding on the Program to approve for implementation.

Additional References

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Gonzales, E. 2006. Diet and Prey Consumption of Juvenile Coho Salmon (*Oncorhynchus kisutch*) in Three Northern California Streams. Master's Thesis, Humboldt State University.

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October 2, 2015

Via Email

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Re: Comments on Marin and Sonoma Mosquito and Vector Control District Integrated Vector Management Program Draft Programmatic Environmental Impact Report; State Clearinghouse No. 2012052066

Dear Mr. Smith:

On behalf of Pesticide Free Marin by 2016, Turning Green, Coast Action Group, Sustainable TamAlmonte, and Mary Fraser we submit the following comments on the Draft Programmatic Environmental Impact Report ("DPEIR") for the Marin and Sonoma Mosquito and Vector Control District's ("MSMVCD's") Integrated Vector Management Program, prepared pursuant to the California Environmental Quality Act, Public Resources Code §§ 21000 *et seq.* ("CEQA").

PROJECT DESCRIPTION

CEQA requires than an EIR include "an accurate, stable and finite project description" for the action being reviewed. *County of Inyo v. City of Los Angeles* (1977) 71 Cal.App.3d 185, 192; California Code of Regulations, Title 14 ("Guidelines") § 15124. "A curtailed or distorted project description may stultify the objectives of the reporting process. Only through an accurate view of the project may affected outsiders and public decision-makers balance the proposal's benefit against its environmental cost, consider mitigation measures, assess the advantage of terminating the proposal (i.e., the 'no project' alternative) and weigh other alternatives in the balance. An accurate, stable and finite project description is the *sine qua non* of an informative and legally sufficient EIR." *County of Inyo* at 192-193. The project description for the Integrated Vector Management Program ("Program") fails to satisfy CEQA's requirements in numerous ways.

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For example, CEQA mandates that the DPEIR identify the "precise location and boundaries of the proposed project . . . on a detailed map," yet the DPEIR entirely fails to do so – in both the text and on the provided map. Guidelines § 15124(a); DPEIR 2-1, 2-3. As the DPEIR admits, "the Program occurs in an area that is somewhat larger than the District's Service Area," because of the "potential for control activities within the Service Area to affect any adjacent jurisdictions." DPEIR 2-1. But the DPEIR fails to disclose what this larger "Program Area" comprises. *Id*. The adjacent jurisdictions are sizeable and the DPEIR fails to specify what portions of these adjacent counties comprise the Program Area. DPEIR 2-1. Indeed, the "Program Area " map provided as Figure 2-1 does nothing to shed light on this significant failure. DPEIR 2-3. This map identifies the "Service Area" and "adjacent counties" only: Again, there is no identification or depiction of the Program Area. 1

The description of the proposed Program activities also fails to pass CEQA muster. DPEIR S-5 to S-8, 2-5 to 2-41; Guidelines § 15124. The DPEIR describes the Program components as "Program alternatives." DPEIR S-5. 2-5 to 2-41. However, "alternatives." are a CEQA term-of-art used to describe potential activities that can be implemented *instead* of the Program to lessen significant impacts. Guidelines § 15126.6. Here, the Program activities are optional components of the Program, not alternatives to the Program as a whole. *Id.* CEQA alternatives to the entire Program are presented – albeit insufficiently – via the Reduced Chemical Control Alternative, the No Chemical Control Alternative, and the No Project Alternative. DPEIR 2-49 to 2-52, 15-2 to 15-8; Guidelines § 15126.6. The project components that the DPEIR erroneously terms "program alternatives," are actually just parts of the Program itself. DPEIR 2-5. The DPEIR's description of "Program 'tools' or components . . . as 'Program alternatives' for the CEQA process" is inaccurate, confusing and misleading. 2

Further, the Project Description indicates that existing Best Management Practices ("BMPs") will be used to reduce what would otherwise be potentially significant impacts caused by the Program. DPEIR S-5, 2-54. Again, the DPEIR misuses a CEQA term-of-art, creating an inaccurate and unstable project description. *Id*. Under CEQA, mitigation "describe[s] feasible measures which could minimize the significant adverse impacts" of a project. Guidelines § 15126.4(a)(1). The BMPs identified in the DPEIR are actually mitigation measures donning a false identity. As defined by the DPEIR, the BMPs are "measures to avoid, minimize, eliminate, rectify, or compensate for potential adverse effects." DPEIR 2-54. This is *exactly* what mitigation measures are supposed to do. Guidelines § 15370 (defining mitigation to include "[a]voiding," "[m]inimizing," "[r]ectifying," "[r]educing," "eliminating," or "[c]ompensating" adverse impacts). As mitigation measures, the BMPs violate CEQA because they are unenforceable and vague. Guidelines § 15126.4(a)(2). By analyzing these actions as BMPs rather than mitigation measures, the DPEIR undermines an accurate analysis of the Program's 3

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impacts, alternatives, and the applicability and effectiveness of mitigation measures *throughout the DPEIR*. *See* DPEIR §§ 3.2, 4.2, 5.2, 6.2, 7.2, 8.2, 9.2, 10.2, 11.2, 12.2, 13. The DPEIR's failure to adequately describe the Program sabotages the entire DPEIR analysis. 3

The DPEIR also treats the educational aspect of the Program as exempt from CEQA, but it is improper to segment a project into smaller pieces to avoid CEQA review. DPEIR 2-5, 2-41, 2-43; *Sierra Club v. West Side Irrigation District* (2005) 128 Cal.App.4th 690, 698 ("A public agency may not divide a single project into smaller individual projects in order to avoid its responsibility to consider the environmental impacts of the project as a whole"); Guidelines §§ 15165, 15378. If the educational aspect of the Program is part of the Project under review, it should be considered comprehensively in the DPEIR. 4

RANGE OF ALTERNATIVES

By conflating BMPs and mitigation measures, and thereby understating the Program's impacts, the DPEIR also fails to consider a reasonable range of alternatives that could minimize the Program's yet-unknown impacts. Guidelines § 15126.6. The two action alternatives that were considered – Reduced Chemical Control and No Chemical Control – are insufficient to address the numerous impacts that have not been adequately analyzed in the DPEIR, as discussed in more detail below. For example, the DPEIR must also consider alternatives that reduce the significant Program impacts to biological resources and water quality. Pub. Res. Code § 21002; Guidelines § 15126.6. Like the remaining sections of the DPEIR, the alternatives analysis is undermined by the failure to adequately describe and analyze the Program. 5

IMPACT ANALYSIS

I. Biological Impacts

A. Pollinators

The Program's chemical control components include pesticides that harm pollinators. The use of spinosad and pyrethroid-type insecticides (including but not limited to synthetic pyrethroids, permethrin, resmethrin, and etofenprox) directly imperils the health of these beneficial insects. Further, the vegetation management component's use of glyphosate has been shown to have sub-lethal effects on the European honeybee.[1] The DPEIR fails to properly account for the Program's pesticide-based pollinator impacts. 6

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[1] Lucila T. Herbert, Diego E. Vázquez, Andrés Arenas and Walter M. Farina, *Effects of field-realistic doses of glyphosate on honeybee appetitive behaviour*, JOURNAL OF EXPERIMENTAL BIOLOGY 217, 3457-3464 (October 2014).

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The DPEIR incorrectly assumes that BMPs it proposes will prevent *any* significant impacts to pollinators. But this assumption is flawed. First, these BMPs are mainly targeted at domestic honeybees, yet wild bees, moths, butterflies, and flies are important insect pollinators in MSMVCD's service area.[2] *E.g.* DPEIR 6-14 (BMP prevents applications over 0.25 acres "during day when honeybees are present and active or when other pollinators are active," with application instead "in areas with little or no honeybees or pollinator activity or after dark"). Yet many pollinating moths are active at night and would be subject to spraying under this BMP. The DPEIR must address this potentially significant impact. 7

Second, the DPEIR erroneously assumes that visual inspection prior to application will prevent post application harms. The DPEIR fails to acknowledge that pesticide residues will *remain* in toxic amounts for days or even weeks, endangering non-target insects long after application ceases. 8

Third, the DPEIR only addresses acute impacts of glyphosate use and assumes that it will have no impact on pollinators. DPEIR 5-50 to 5-51. Consequently, the BMP claiming that the Program "do[es] not apply pesticides that could affect insect pollinators . . . over large areas" does nothing to prevent the application of herbicides like glyphosate while pollinators are present. By ignoring the sub-lethal impacts of glyphosate, the DPEIR fails to account for all pathways and methods of harm to pollinating insects, and fails to mitigate those harms. 9

Each of these deficiencies must be corrected in a recirculated DPEIR. 10

B. Special Status Aquatic Species

The Program's chemical control components envision the use of a wide variety of pyrethroid type insecticides (including but not limited to synthetic pyrethroids, permethrin, resmethrin, and etofenprox) that are extremely toxic to aquatic species. Further, because these chemicals bind to soil, they accumulate in benthic sediment at levels known to be toxic to benthic invertebrates. Thus, their presence in the watershed poisons the bottom of the aquatic food-chain. Special precautions are necessary to ensure that these chemicals are not introduced into the aquatic environment, including wide buffers around storm-drains, drainage channels, and water bodies. Yet MSMVCD contemplates that its application of these chemicals to target mosquito adults *will* cause these toxics to enter water bodies. *E.g.* DPEIR 4-97 ("the amount of product encountering the water" is less than the total amount applied). 11

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[2] Janis Mara, *Marin volunteers stalk the wild pollinator on UC Extension's 100th birthday*, MARIN INDEPENDENT JOURNAL (May 8, 2014), available at http://www.marinij.com/general-news/20140508/marin-volunteers-stalk-the-wild-pollinator-on-uc-extensions-100th-birthday. Hummingbirds and bats also serve this important function. *Id.*

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MSMVCD's service area is important habitat for fish species listed as threatened or endangered under the Endangered Species Act ("ESA"), 16 U.S.C. section 1531 *et seq.*, and the California Endangered Species Act, Fish and Game Code sections 2050-2115, including but not limited to coho salmon, chinook salmon and steelhead.[3] 12

None of the BMPs specify the types of precautions necessary to prevent these classes of pesticides from entering the watershed. As such, the BMPs alone cannot prevent significant harm to special status aquatic species – through direct exposure and through the loss of prey and prey habitat – in MSMVCD's service area. The DPEIR's mistaken decision to ignore food-chain impacts (DPEIR 4-74 to 4-75, 5-37 to 5-38, 6-16) exacerbates its failure to address the chemical control component's significant effects on threatened and endangered salmonids and other special status fish species. 13

Lastly, the chemical control component contemplates the use of methoprene – an insect growth regulator – that it acknowledges is moderately toxic to fish and highly toxic to aquatic invertebrates. DPEIR Appendix B, 4-5. This chemical is applied to water bodies to alter the growth and development of mosquito larva, rendering them unable to mature. *Id.* The DPEIR mentions in passing that methoprene is potentially bioaccumulative. DPEIR 5-60. But it does not explain how applying a potentially bioaccumulative, toxic chemical to water will have no significant impacts to aquatic species. Absent any contrary explanation, logic dictates the opposite result. 14

The DPEIR's incorrect assumptions that the BMPs presented in Table 4-6 will suffice to prevent any harm, and that its use of these pesticides will not cause significant impacts, must be corrected with an accurate discussion of the harms that these chemicals will cause, and an explanation of how mitigation measures will avoid any significant effects. 15

C. California Red-Legged Frog

EPA evaluated whether permethrin is likely to impact both the aquatic and terrestrial phases of the California red-legged frog, which is listed as a threatened species under the ESA. EPA determined that permethrin *directly* kills California red-legged frogs during aquatic and terrestrial life-phases, and *indirectly* impacts them by killing both aquatic and terrestrial sources of prey.[4] Further, EPA determined that the use of permethrin would likely modify critical habitat 16

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[3] The DPEIR's narrative discussion of the impacts on special status species improperly omits coho salmon, although it is properly included in the chart of species present in the service area.

[4] http://www.epa.gov/espp/litstatus/effects/redleg-frog/permethrin/determination.pdf (Last visited September 30, 2015).

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for the California red-legged frog. *Id.* EPA likewise evaluated the impacts of glyphosate on the California red-legged frog, and determined that it is likely to adversely affect the terrestrial phase through direct and indirect effects following a reduction in prey and habitat, and is predicted to modify the critical habitat.[5] The Recovery Plan for the California red-legged frog,[6] which indicates that Roundup-brand glyphosate contains surfactants that are much more hazardous that glyphosate alone, raises concerns that its use near California red-legged frog habitat should be prohibited. 17

The DPEIR acknowledges that use of many of the pesticides associated with its chemical control and vegetation management components would be subject to an injunction to prevent harm to the California red-legged frog, but for the Program's purpose of vector control. DPEIR 4-42. But whether the vector control purpose exempts the MSMVCD from this injunction is a *separate* issue from whether the Program is likely to have a significant impact on the California red-legged frog. The DPEIR should present a clear examination of these risks. 18

Instead of addressing this issue, however, the DPEIR assumes that the BMPs presented in Table 4-6 will suffice to prevent any harm, and that its use of these pesticides will not cause significant impacts. *See e.g.* DPEIR 4-52 to 4-54, 4-75, 4-104. Just as with special status fish species, however, none of these BMPs adequately address and prevent run-off, through storm drains or otherwise, to protect the California red-legged frog from pesticide exposures. The DPEIR explicitly acknowledges that MSMVCD's territory includes California red-legged frog habitat. Its failure to specifically address and mitigate potentially significant impacts to this species must be corrected. 19

D. Ecological Health and Glyphosate

On July 7, 2015, the Marin Municipal Water District ("MMWD") "Board of Directors were given a standing ovation by a packed room of residents after they voted to approve Staff's recommendation to remove herbicides from further consideration in MMWD's DRAFT Wildfire Protection and Habitat Improvement Plan." Sharon Ruston, *The Marin Post, MMWD Board of Directors Votes to Remove Herbicides From Further Consideration!*, July 8, 2015.[7] It did so 20

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[5] http://www.epa.gov/espp/litstatus/effects/redleg-frog/glyphosate/transmittal-ltr.pdf (last visited September 30, 2015).

[6] U.S. Fish and Wildlife Service, Recovery Plan for the California Red-legged Frog (May 2002) pp. 122-123. https://www.fws.gov/arcata/es/amphibians/crlf/documents/020528.pdf (last visited September 30, 2015).

[7] Available at https://marinpost.org/blog/2015/7/8/mmwd-board-of-directors-votes-to-remove-herbicides-from-further-consideration (as visited October 1,

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both due to community opposition and because the World Health Organization recently classified glyphosate as a probable human carcinogen. *See id.* 20

Glyphosate threatens human health and environmental harm in several ways ignored by the DPEIR.[8] Glyphosate is extremely persistent, and can be detected at application levels months after application. Because glyphosate attacks the ability of plants and bacteria to synthesize aromatic amino acids, Monsanto has patented its use as an antimicrobial agent; its use interferes not only with target plants but also with soil bacteria (and bacteria inside anything that accidentally ingests its residue).[9] Healthy soil bacteria should be preserved, not jeopardized by glyphosate.[10] Yet the DPEIR does not mention these significant ecological risks in its discussion of the vegetation management component. 21

The DPEIR also downplays glyphosate's risks to human health. In March 2015, the World Health Organization's International Agency for Research on Cancer ("IARC") determined that glyphosate is "probably carcinogenic to humans."[11] It is suspected to cause miscarriages and abnormal fetal development, promote cell growth in breast-cancer cells, impact hormone levels, and interfere with cytochrome P450 oxidase in the intestine and liver, and can impair the normal balance of intestinal microbes. The DPEIR's failure to consider these potentially significant human health risks must be corrected. 22

2015).

[8] Indeed, given glyphosate's toxicity, it is possible that an unintended consequence of its use will be an increase in mosquitos in MSMVCD's service area, as it *removes mosquito predators* from the food-chain.

[9] N. de María, et al., New insights on glyphosate mode of action in nodular metabolism: Role of shikimate accumulation, *J. Agric Food Chem.* (April 5, 2006) 54(7):2621-8; Monsanto Technology LLC, Missouri. Glyphosate formulations and their use for the inhibition of 5-enolpyruvylshikimate-3-phosphate synthase. 2010. US Patent number 7771736 B2. https://www.google.com/patents/US7771736.

[10] *See e.g.* McNear Jr., D. H. (2013) The Rhizosphere - Roots, Soil and Everything In Between. *Nature Education Knowledge* 4(3):1 (at the discussion of "Plant Growth Promoting Rhizobacteria (PGPR)"). Available at: http://www.nature.com/scitable/knowledge/library/the-rhizosphere-roots-soil-and-67500617 [accessed October 1, 2015].

[11] *See* Joint FAO/WHO Meeting on Pesticide Residues (JMPR). Available at: http://www.who.int/foodsafety/areas_work/chemical-risks/jmpr/en/ [accessed October 1, 2015].

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II. Water Quality

Many of Marin and Sonoma County's watersheds are impaired for pesticides, and as the DPEIR acknowledges, the Basin Plan establishes a total maximum daily load ("TMDL") for pesticide-related toxicity in urban creeks that is *not* specific to any particular pesticide. DPEIR 9-12 to 9-13. However, the DPEIR fails to explain how the chemical control and vegetation management components avoid exceeding the TMDL. Indeed, as discussed above, the BMPs fail to establish a clear buffer for storm drains and gutters or provide specific discussion of ways that run-off will be avoided. For chemicals that bind to the soil, the DPEIR fails to address the mobilization of sediment after pesticide applications. Further, the DPEIR fails to discuss with any clarity the potential quantity and concentrations of pesticides that could be used under the chemical control or vegetation management components. The DPEIR's claims that the BMPs will prevent significant water quality impacts are unsupported and incorrect. 23

III. Air Quality

The DPEIR admits that the Chemical Control component of the Program "could be *potentially significant*" because it "could subject people to objectionable odors." DPEIR 10-32, emphasis in original. Yet it erroneously claims that a single voluntary and unenforceable mitigation measure would "reduce the impact to less than significant." DPEIR 10-32, emphasis omitted. CEQA requires more. The DPEIR must analyze and implement *feasible* and *effective* mitigation measures to reduce these air quality impacts. § 21002; Guidelines § 15126.4.

Mitigation measures AQ-25a, AQ-25b, and AQ-25c are neither mandatory nor effective. DPEIR 10-32. This failure must be remedied. For example, the DPEIR could strengthen the individual mitigations, and *require* implementation of "any one of" the three where application of a malodorous chemical occurs within a certain distance of residences or human population centers. The DPEIR could also require notification to residences and offer resources for those who will be impacted. In any event, the DPEIR must do more to mitigate this impact than the vague, voluntary, and unenforceable mitigation measures it currently proposes. DPEIR 10-32. 24

Furthermore, the voluntary and vague nature of mitigation measures AQ-25a, AQ-25b and AQ-25c conflicts with the DPEIR's "less than significant" conclusion, and any future reliance on that conclusion. DPEIR 10-32. As discussed below, MSMVCD must either commit to preparing EIRS for future Program activities, or include much greater specificity now. Without greater specificity, MSMVCD cannot presume that air quality impacts will be mitigated now, or during implementation of future site-specific Program activities.

IV. Cumulative Impacts

The DPEIR's cumulative impacts analysis is plagued by many of the same defects as the 25

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remainder of the DPEIR. DPEIR 13-1 to 13-19. Again, the DPEIR's conflation of BMPs and mitigation measures makes it impossible for decisionmakers and the public to understand the severity of the Program's cumulative impacts and subsequently, the potential for and effectiveness of any mitigation measures. *Environmental Protection Information Center, Inc. v. Johnson* (1985) 170 Cal.App.3d 604, 625; *County of Inyo*, 71 Cal.App.3d at 192; Guidelines §§ 15130, 15355; DPEIR 13-1. 25

Many of the DPEIR's resource-specific cumulative impact analyses are also deficient. For example, the DPEIR's discussion of the Program's cumulative impacts on pollinators suffers from several serious flaws. First, it contains a largely irrelevant and factually inaccurate discussion of colony collapse disorder's association with neonicotinoid pesticides when it should instead be focusing on the contribution of the Program's chemical use to the existing decline in pollinator populations. DPEIR 13-8. The DPEIR attempts to shift the focus from the cumulative impacts of pesticides on pollinators to a discussion on whether neonicotinoid pesticides cause colony collapse disorder instead of simply killing bees. DPEIR 13-8. But whether a study on colony collapse disorder can be replicated is irrelevant to the questions whether neonicotinoid pesticides *harm* bees and whether the Program has cumulative impacts. DPEIR 13-8. Indeed, there is scientific consensus that neonicotinoid pesticides harm bees, and this is why EPA mandates that all neonicotinoid pesticides state "Do not apply this product while bees are foraging. Do not apply this product until flowering is complete and all petals have fallen . . . ."[12] Likewise, as discussed above, EPA recognizes that the Program's chemicals are likely to harm bees. Because the cumulative impacts analysis focuses solely on colony collapse disorder, the larger picture of pollinator impacts is ignored. 26

Second, the DPEIR improperly attributes urbanization and urban limitations on beekeeping as a significant impact on pollinators in the Program area. While urban growth and regulations limiting beekeeping can also impact bees, the regulations and land use patterns in MSMVCD's service area do not appear to be a significant limitation on beekeeping. In Marin County, only Mill Valley has adopted a complete ban on beekeeping; it is allowed outright in unincorporated areas and some municipalities, though some require permits.[13] Sonoma County likewise permits beekeeping.[14] While Santa Rosa explicitly bans *commercial* beekeeping, no 27

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[12] http://www2.epa.gov/pollinator-protection/new-labeling-neonicotinoid-pesticides

[13] *See, e.g.*, Marin County Department of Agriculture, Weights and Measures, Frequently Asked Questions, General Information, "*I want to keep bees, what do I need to do?*" available at http://www.marincounty.org/depts/ag/faqs (last visited September 29, 2015).

[14] Sonoma County Code https://www.municode.com/library/ca/sonoma_county/codes/code_of_ordinances?searchRequest={%22searchText%22:%22beekeeping%22,%22pageNum%22:1,%22resultsPerPage%22:25,%2

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municipality in Sonoma County explicitly prevents backyard beekeeping. Indeed, Petaluma, Cloverdale, Rohnert Park, and Windsor allow beekeeping, according to their websites or municipal codes. But pesticide applications in the MSMVCD can occur in much more diverse areas that those urban islands where beekeeping is regulated. By overstating the impact of urban beekeeping regulations, the DPEIR understates the Program's cumulative impacts. 27

Third, the DPEIR completely ignores the significant role of wild pollinators, such as native bumblebees, butterflies and moths. Like its analysis of direct impacts, the DPEIR conflates domesticated honeybees with *all* pollinators. DPEIR 13-8. But, as discussed above, pollination is performed by a variety of other insects, including wild native bees, butterflies, moths, and flies, as well as hummingbirds and bats. Unexamined impacts on these non-honeybee pollinators include the loss of non-target insects caused by use of spinosad and pyrethroid type insecticides (including but not limited to synthetic pyrethroids, permethrin, and etofenprox). This loss of non-target insects can reduce populations of insect pollinators and also diminish an important food supply for bats. Because the DPEIR declines to address food-chain impacts, it does not analyze whether localized loss of insect populations will harm insectivores, including pollinating bats. 28

Similarly, the DPEIR's cumulative water quality analysis is sorely lacking. DPEIR 13-16. As discussed above, the DPEIR fails to show that the chemical control and vegetation management components will not enter impaired waterways. Its statement that MSMVCD's "use of these 'impairment chemicals' is contributing in less-than-significant amounts" is wholly unsupported by the facts and analysis CEQA requires. DPEIR 13-16. CEQA mandates that the EIR contain information sufficient to allow the public to trace the agency's analytical path from evidence to conclusion. *Laurel Heights Improvement Association v. Regents of University of California* (1988) 47 Cal.3d 376, 404. Moreover, under CEQA, even a "de minimis contribution" to an existing cumulative impact may be significant. *Communities for a Better Environment v. California Resources Agency* (2002) 103 Cal.App.4th 98, 117-121; *see also* Pub.Res.Code § 21083(b)(2) ("individually limited" impacts may still be "cumulatively considerable"); Guidelines § 15065(a)(3) (same). 29

Without the required adequate groundwork, the DPEIR cannot accurately determine the Program's potential cumulative impacts, and therefore it cannot mitigate them. As discussed above, the DPEIR's cumulative impacts discussion is fatally flawed in numerous respects. This must be remedied in a recirculated DPEIR. Guidelines § 15088.5. 30

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SCOPE OF ANALYSIS FOR FUTURE SITE-SPECIFIC PROGRAM ACTIVITIES

"A program EIR is an EIR which may be prepared on a series of actions that can be characterized as one large project and are related" to each other. Guidelines § 15168(a). However, "[s]ubsequent activities in the program must be examined in the light of the program EIR to determine whether an additional environmental document must be prepared." Guidelines § 15162(c). "Certainly, a program EIR will better fulfill its purpose of reducing the need for subsequent environmental review the more comprehensive and specific the analysis it provides." *Center for Biological Diversity v. Department of Fish and Wildlife* (2015) 234 Cal.App.4th 214, 234. "When an activity is within the scope of the program reviewed in the program EIR but the environmental impacts of the activity are not evaluated, *a further tiered CEQA analysis must be completed* before the activity may be approved." 1 Kostka & Zischke, Practice Under the California Environmental Quality Act (Cont.Ed.Bar 2d ed. 2014) § 10.16, p. 10–23 ("Kostka"), emphasis added, *citing Center for Sierra Nevada Conservation v. County of El Dorado* (2012) 202 Cal.App.4th 1156.

In order to determine whether future site-specific program activities fall within the scope of the program EIR, "the agency should evaluate the site and the activity to determine whether the environmental effects were covered in the program EIR and document its findings by a checklist or other means." Kostka, § 10.16, p. 10–22. Here, however, MSMVCD glosses over this important program EIR requirement, while conceding that it does not have site-specific or project-specific information. DPEIR 1-22 to 1-27. The DPEIR admits that its analysis is limited to "the activities and materials [that] can be identified at present," and that CEQA requires additional analysis for activities not adequately covered in the program EIR. DPEIR 1-22, 1-23. Yet the DPEIR concludes that "[a]ll pesticides in current use have been evaluated in the PEIR" and that "[f]uture formulations are likely to include ingredients already evaluated," presumptively dismissing the need for future CEQA evaluation despite the lack of site-specific information or knowledge of how future formulations of pesticides and herbicides would react when applied together. DPEIR 1-23. The DPEIR's attempt to preemptively dismiss any need for CEQA review of future Program activities subverts the purpose of CEQA, and the streamlining goals of tiering EIRs. Pub.Res.Code §§ 21002, 21100; Guidelines §§ 15121, 15151, 15165, 15168. 31

DPEIR CITATIONS AND REFERENCES

The DPEIR relies on numerous references that do not stand up to scrutiny. DPEIR 17-1 to 17-15. First, the DPEIR repeatedly references the Bay Delta Conservation Plan ("BDCP") in its analysis of biological impacts. DPEIR 4-47 to 4-49, 5-28, 17-2. However, reliance on that document is misplaced. The DPEIR relies on a draft document that is already out of date, and indeed, was out of date at the time the DPEIR was published. *Id.* Despite the DPEIR's claim 32

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that the BDCP is "being developed as a 50-year habitat conservation plan," that has not been the case since April of 2015, four months prior to publication of the DPEIR.[15] Reliance on the outdated draft BDCP to identify the Project's impacts and alternatives, and shape its mitigation measures, is improper and must be remedied. *County of Amador v. El Dorado County Water Agency* ("*County of Amador*") (1999) 76 Cal.App.4th 931, 949 (reliance on growth projections from a *draft* general plan violates CEQA). 32

The DPEIR also cites unreliable sources, such as Wikipedia – the "free [online] encyclopedia that *anyone can edit*."[16] CEQA intends for the DPEIR to be an informational document, and reliance on an open-source website does not "provide decision makers with information which enables them to make a decision which *intelligently* takes account of environmental consequences." Guidelines §§ 15151 (quote, emphasis added), 15121. The resources relied upon in making determinations in the DPEIR must be from accurate and reputable sources. 33

The DPEIR's reference list also includes numerous website links that are either broken or direct the reader to an incorrect page. *E.g.* DPEIR 17-1 (Bay Area Air Quality Management District 2009), 17-2 (Bay Delta Conservation Plan 2014), 17-4 (California Environmental Data Exchange Network 2013), 17-6 (Corte Madera Planning Department 2009), 17-7 (Healdsburg Planning Department 2011), 17-9 (National Oceanic and Atmospheric Administration 2008), 17-10 (Northern Sonoma County Air Pollution Control District 2012, Northern Sonoma County Air Pollution Control District 2014, Ross Planning Department 2011, Ross Planning Department 2007, San Anselmo Planning Department 2011, San Anselmo Planning Department 1989), 17-11 (Solano County 2008, Solano County Water Agency 2012, Sonoma County 2008, Sonoma County 2009, Sonoma County 2014, Sonoma County undated), 17-12 (Tiburon Planning Division 2005, Underwriters Laboratories LLC 2012, United States Environmental Protection Agency 1991b), 17-13 (United States Environmental Protection Agency 2009c), 17-14 (United States Environmental Protection Agency 2014c, World Health Organization 1989). These errors must be corrected. 34

CONCLUSION

For the reasons outlined above, the DPEIR must be significantly revised to include a

[15] Bay Delta Conservation Plan, DWR Announces Modified Preferred Alternative, available at: http://baydeltaconservationplan.com/2015news/15-04-30/DWR_Announces_Modified_Preferred_Alternative.aspx

[16] Wikipedia Slogan, available at: www.wikipedia.com/wiki/wikipedia

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proper scope of analysis, project description, range of alternatives, and impact analysis.

Respectfully submitted

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Comment Letter O-VOL

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Response 1

Figure 2-1 does precisely show the boundaries of the entire Program Area on a detailed base map. CEQA requires that the project area include the area where all potential impacts could occur. The Draft EIR states that any of the adjacent jurisdictions to the Service Area counties could be affected by the Proposed Program if the District was asked by the adjacent county vector control agency or vector control district to provide assistance in their county, and the Program Area includes the counties that are adjacent to the immediate Service Area counties of Marin and Sonoma most likely to request assistance. These are shown on Figure 2-1, along with Marin and Sonoma counties. Mosquitoes may travel long distances, and their movement is not limited by jurisdictional boundaries. For example, the salt marsh mosquito (species *Aedes dorsalis*) is an aggressive biter that may travel 20 miles for a blood meal. Also, because the District has an airboat, adjacent districts could ask the District to provide assistance to areas most accessible by airboat. Thus, the analysis conservatively assumes that an entire adjacent county could be affected, but most impacts would be concentrated in Marin and Sonoma counties. Of greatest concern would be a vector population originating in an adjacent county where Service Area residents and recreationists could be affected.

Response 2

The alternatives terminology referenced in this comment is explained further and clarified herein. Traditionally, CEQA documents have the resource chapters examine the entire program/project for environmental impacts based on applicable environmental topics or concerns. Then, alternatives to the proposed program/project that would reduce or avoid any significant impacts and the no program/no project alternative are discussed in a separate chapter that may be supplemented by an appendix on the alternatives selection process explaining how the proposed program/project was developed. This traditional format is followed in the District's document. Chapters 3 through 12 discuss the environmental impacts associated with the Proposed Program in its entirety, while alternative programs are described in Chapter 15. The explanation below clarifies these two uses of the word "alternative", "Program alternative" and "alternative Programs".

The proposed project is a continuation of the District's ongoing Program for mosquito and vector management. The District currently employs a Program consisting of six alternatives, which the Draft PEIR characterizes as "tools" or "components" of the overall Program, that are implemented as necessary and appropriate based on the Program needs and objectives. These Program alternatives are groups of related or similar activities by type. The District has approximately 20,000 sources that it monitors on a regular basis for mosquito abundance, species, and life cycle. It also responds to complaints and requests for service at other sites as well. At each site where actual treatment is needed, the District has to determine quickly which of the alternative components within its Program is best suited to dealing with the mosquito or other vector problem. As described in the Draft PEIR, the District's management practices emphasize the fundamentals of integrated pest management (IPM), specifically integrated vector management (IVM), which involves the use of multiple tools, including source reduction (physical control), habitat modification (vegetation management), and biological control using mosquitofish, when appropriate before using pesticides. So on a site-specific basis, the District selects from its nonchemical control alternatives first, then from its chemical control alternative, if necessary. Site conditions, including the potential for special-status species to be present and proximity to human activities, affect the alternative(s) selected.

The PEIR's use of the term "alternatives" in the context of the project description is described in Chapter 2, Program Description, as alternative components of the proposed Integrated (Mosquito and) Vector Management Program (IVM Program or Program). The role of these alternative components in the Program is described in Chapter 2, Section 2.3, page 2-5, which explains:

> "The District has, for at least the past 2 decades, taken an integrated systems approach to mosquito and vector control, utilizing a suite of tools that consists of public education, surveillance, source reduction (e.g., physical control, vegetation management, water management), biological, and chemical controls. These Program "tools" or components are described in the subsequent subsection as "Program alternatives" for the CEQA process (except for public education, which is exempt from CEQA)."

Section 2.3, page 2-6, further explains:

> "The District's Program consists of the following alternatives, which are general types of coordinated and component activities, as described below: surveillance, physical control, vegetation management, biological control, chemical control, and nonchemical control/trapping. The Proposed Program is a combination of these alternatives with the potential for all of these alternatives to be used in their entirety along with public education."

Thus, the contention that the PEIR's use of "alternatives" in the context of the project description and environmental analysis suggests the program components "are separate from one another when they would be combined into one comprehensive alternative" is not correct. These Program components are distinguished as alternatives in separate sections of each impact chapter to ensure that they are fully evaluated on a comparable basis, in similar depth, and so that impacts are explained clearly for each resource or environmental topic. This approach was selected because the various components of the Program (e.g., Vegetation Management, Water Management, etc.) differ in their objectives, method, and potential impacts. Each resource chapter considers the environmental impacts of the same Program alternatives or "components." This way the impacts of each Program component can be compared against those of the other components and in total to promote the District's informed decision regarding which "alternative" or components to use in a particular situation. While the District could have referred to its suite of proposed tools as "components" rather than "alternatives," that choice would not have changed the analysis nor would it have affected the District's separate evaluation of CEQA mandated alternatives to the project that would avoid or substantially lessen the significant environmental impacts of the project, which was provided in Section 15.

CEQA alternatives to the Proposed Program are thoroughly addressed in Chapter 15, Alternatives, which describes CEQA requirements, the process used for screening alternatives (Section 15.1), alternatives that were considered but rejected from further consideration (Section 15.2), impacts of the No Program Alternative (Section 15.3), and alternatives that would avoid or substantially lessen the significant environmental effects of the Program (Section 15.4). Two such alternative Programs were identified: the Reduced Chemical Control Alternative Program (Section 15.4.1) and the No Chemical Control Program (Section 15.4.2). The impacts of the Proposed Program and these "alternative programs" were compared (Section 15.5), and the environmentally superior alternative was identified (Section 15.6). Thus, all of the CEQA requirements for "alternatives" were addressed.

Response 3

The comments that the use of BMPs makes the project description inaccurate and unstable and that these actions are actually mitigation measures that are unenforceable and vague are incorrect. Further information on the origin of these BMPs and their use by the District is provided below.

The District has been engaged in vector control since 1915. The current Program is being evaluated as the Proposed Program along with additional activities or chemical treatments that the District would like to have available or is considering for use in the future. The BMPs have evolved over many years of practice and coordination with wildlife refuge managers, water district staff, CDFW biologists, and USACE engineers on previous agency permits including measures to minimize disruption to special-status species and their habitats. They help to meet overall Program objectives. In some cases, not all, the BMPs are less specific than similar mitigation measures would be in order to provide for flexibility in dealing with a variety of sites and different chemical treatments as a form of adaptive management to deal with changing physical and biological conditions. In other cases, they are very specific; i.e., do not allow for deviation from product application label requirements. Pesticide label restrictions cover application rates and methods, storage, transportation, mixing, and container disposal that have become part of the District's ongoing practices.

The District has developed and adopted these BMPs, is using them in the current Program, and will consider modifications as requested by USACE, CDFW or other resource agencies. In short, the BMPs are an integral part of the District's current Program, are to be continued into the future, and are properly treated as part of the proposed Program being evaluated in the PEIR. Ignoring the effect of these ongoing practices would mischaracterize the Program being evaluated, resulting in misleading and inaccurate impact analyses.

It is possible District BMPs could be modified over time to meet resource agency requirements or site conditions. For example, the process for renewing the District's 5-year regional permit with the USACE and its Supplemental Use Permit for vector control on USFWS lands may identify more specific requirements. The USACE permit application is submitted to CDPH, who then sends it to the resource agencies including CDFW. The District will continue to coordinate with CDFW on possible future refinements to BMPs to address specific habitat or site conditions, including provisions for vegetation and sediment removal in drainage channels and ongoing responsibilities for maintenance of the affected areas.

By contrast, mitigation measures are typically new measures added to a project to reduce impacts. For example, in Mitigated Negative Declarations, mitigation measures are new requirements added to the Project to avoid, minimize, eliminate, rectify/compensate for, or otherwise reduce significant impacts from the project under evaluation. They are then incorporated into the project description to indicate the project proponent has committed to implementing these measures. There are also numerous examples of EIRs where project features are similar to mitigation measures and are, therefore, considered in conducting the environmental impact analysis. Examples include both the programmatic and project-specific environmental impact documents for restoration of the San Joaquin River prepared by the Bureau of Reclamation (e.g., San Joaquin River Restoration Program) and the Department of Water Resources and State Lands Commission (combined CEQA/NEPA documents).

The PEIR fully evaluates all potential impacts of the Program, and the commenter has not explained how the inclusion of the BMPs resulted in the PEIR failing to identify or accurately evaluate any particular potential Program impacts. In short, the BMPs do not result in avoiding analysis of a potential impact.

Response 4

Treating the educational aspects of the Program as exempt from CEQA is not an example of segmenting the project. Rather, as explained in Chapter 2, Section 2.4, pages 2-41 to 2-43, educational programs such as those conducted by the District are exempt from CEQA, and the subsequent sections try to explain the educational activities that are exempt, as well as where CEQA review is needed. Actions that are categorically exempt from CEQA because they have been determined not to have a significant effect on the environment are listed in Article 19, Categorical Exemptions, of the CEQA Guidelines. These include educational or training programs that involve no physical alteration in the area affected (CEQA

Guidelines § 15322). The types of activities that are used by the District that meet this definition are described on page 2-43 as follows:

> "An excellent mosquito/vector prevention program includes good public education and outreach as key components. The District's education program teaches the public how to recognize, prevent, and suppress mosquito/vector breeding on their property. This part of the project is accomplished through the distribution of brochures, fact sheets, newsletters, participation in local events and fairs, presentations to community organizations, newspaper and radio advertising, public service announcements, social media postings, District website postings, and contact with District staff in response to service requests. Such activities involve negligible use of office supplies, and any vehicle trips are covered by the estimated equipment usage under surveillance and other nonchemical control activities. Public education also includes a school program that teaches future adults to be responsible by preventing and/or eliminating vector breeding sources and educates their parents or guardians about District services and how they can reduce vector-human interaction. Where activities designed to prevent or eliminate vector breeding sources are consistent with the activities performed by the District under the Program alternatives, they may be covered sufficiently for environmental impact in this PEIR." (page 2-43)

The literature, local events, and training through public presentations to schools and community groups is described above and are covered under the education exemption. The potential secondary effects of its education process are also either exempt from CEQA or adequately described in the PEIR. One example is a homeowner or property owner making a request for service at an existing facility, and the District then advising the property owner to modify their landscaping to avoid ponding/improve drainage, reduce stagnation of water in ornamental ponds, or modify their structure to block access points by rodents. The District's use of equipment is covered under the Surveillance Alternative or under Physical Control Alternative. Maintenance of existing landscaping and minor alteration of existing public or private structures, facilities, mechanical equipment, or topographical features, involving negligible or no expansion of use is exempt from CEQA under CEQA Guidelines Section 15301, Existing Facilities. If the property is abandoned, and there is an abandoned swimming pool or ornamental pond, the District will abate the mosquito-breeding problem most likely under the Biological Control Alternative. For potential major alterations of the physical environment at a site, the Draft PEIR states the following:

> "Educational activities also include making recommendations on specific property development and land and water management practices or proposals, in response to ongoing or proposed developments or management practices that may create sources of mosquitoes/vectors. To ensure that the District does not indirectly encourage environmental impacts without CEQA review, the District informs landowners and others who might modify the physical environment in response to educational programs that they have specific environmental obligations, including compliance with CEQA and permit requirements. The District is not a permitting agency and it is not responsible for implementing or approving the control recommendations on specific property development; therefore, property owners or developers are required to prepare and submit their own documents for projects, which may require CEQA review." (page 2-43)

In summary, parts of public education are covered by different exemptions contained in the CEQA Guidelines. The PEIR text has been modified on page 2-41 to clarify the applicable exemptions (shown below).

> Public education is a key component of the District's IVMP that is used to encourage and assist reduction and prevention of vector habitats on private and public property. <u>This component includes educational or training programs that involve no physical alteration in the area affected.</u> While this component is a critical element of the District's Program,

> public education activities are categorically exempt from CEQA review (CEQA Guidelines Section 15322) based on a finding by the State Secretary of Resources that these activities do not have a significant effect on the environment. ~~Therefore, these educational activities will not be further reviewed in this document.~~ Under Article 19, Categorical Exemptions, maintenance of existing landscaping and minor alteration of existing public or private structures, facilities, mechanical equipment, or topographical features, involving negligible or no expansion of use is covered in Section 15301, Existing Facilities. A discussion of exempt and nonexempt educational activities is provided in the following paragraphs.

There was no intent to segment the Program into smaller pieces to avoid CEQA review, and the commenter has not identified any potentially significant impacts that the PEIR failed to consider as a result of the determination not to evaluate the public education component of its Program.

Response 5

Please refer to Response 3 regarding the use of BMPs and Responses 6 through 30 regarding the adequacy of the impact analysis. The commenter has not provided substantial evidence documenting that additional significant impacts would occur beyond the air quality impact associated with the Chemical Control Alternative, and the two alternatives addressed in Chapter 15 would both reduce this impact to less than significant. No significant impacts on biological resources and water quality would occur; thus, no additional alternatives are required. There is a difference in opinion on what a significant impact is and what is not in this PEIR between the commenter and the PEIR preparers. See Response 15 below on the use of best professional judgment by PEIR preparers with the appropriate technical qualifications to evaluate the impacts of ecological concern.

Response 6

There have been numerous reports on the possible toxicity of some pesticides to insects, including some beneficial insects such as pollinators. Of particular interest are use of spinosad and pyrethroid-type insecticides (including but not limited to synthetic pyrethroids, permethrin, resmethrin, and etofenprox). As with all pesticides (where the purpose is to reduce populations of insects), the toxicity varies by species and chemical. Each chemical registered is supported by a large database directly addressing the direct and sometimes indirect toxicity. These data are available in the USEPA databases that include all available physiochemical characteristics and toxicology data for a spectrum of terrestrial and aquatic vertebrate and invertebrate species. In a typical chemical (pesticide) toxicity database, the results of tests on numerous species provide a comparison of relative sensitivity to each chemical listed. The information in the database includes the results of tests on several potential routes of exposure and both acute and sub-lethal effects on many nontarget species, and it was used to consider the possible unwanted effects of a vector control product and what restrictions, if any, might be considered for use in the District's BMPs and in preparing the Draft PEIR.

The District's objective is to reduce or minimize the possibility of unwanted nontarget effects in the local environment while addressing the need for vector control. These considerations and how unwanted effects can be eliminated or reduced are embodied in the Program objectives and in each of the applicable BMPs and guide all pesticide applications. By restricting chemical applications to times when nontarget insects are not active and using care to treat only vector larvae and adults in locations where they are concentrated (i.e., population is high enough to warrant control), impacts to other species are eliminated or substantially reduced.

In situations where inadvertent exposure to other, beneficial insects might occur, the impact to a few individuals will not adversely impact the population(s), which can recover quickly to original population levels (Emlen et al. 2003; Andrewartha 1972).

Furthermore, the vegetation management option of using glyphosate has been shown to be one of the safest herbicide products for over 40 years. Claims that glyphosate impacts bees are based on a report by Herbert et al. 2014 that conducted simulated "field tests" to evaluate the effects of glyphosate on honeybee behaviors. These authors designed their study to determine what impact exposures to glyphosate might have on honeybee foraging and hive identification behaviors. Although the hypothesis of these authors predicted that honeybee behaviors would be adversely impacted after exposure to the herbicide glyphosate, the behaviors they studied were not adversely affected by the exposures and their conclusion was "no effect on foraging related behavior was found in these behavioral studies". The PEIR considered the impact of glyphosate on bees in Chapter 6, Ecological Health, under the Vegetation Management Alternative, Section 6.2.5.1.1 (page 6-20).

There are many credible theories as to the causes of the reduction in bee numbers (where they occur), including the effect of drought on the flora sources, the rise of parasites, fungi, and other classic bee diseases, and it is likely that these sources of stress are the most important adverse effects on bee colonies.

Response 7

First, the commenter mischaracterizes assumptions affecting conclusions under CEQA regarding pollinators. The comment that the DPEIR "incorrectly assumes that BMPs it proposes will prevent *any* significant impacts to pollinators" is misleading. In particular the District uses the following BMP H12 for pesticide applications that is contained in Table 2-6 in Section 2.9:

> "Do not apply pesticides that could affect insect pollinators in liquid or spray/fog forms over large areas (more than 0.25 acres) during the day when honeybees are present and active or when other pollinators are active. Preferred applications of these specific pesticides are to occur in areas with little or no honeybee or pollinator activity or after dark. These treatments may be applied over smaller areas (with hand held equipment), but the technician will first inspect the area for the presence of bees and other pollinators. If pollinators are present in substantial numbers, the treatment will be made at an alternative time when these pollinators are inactive or absent." (page 2-69)

The District BMPs are in place now, and have been used effectively, because there is no evidence to show harm to pollinators and the plants they affect from District activities in the District's Service Area, which contains important agricultural resources such as vineyards that are dependent on pollinators. For example, the District routinely treats several tidal, brackish, and fresh water mosquito habitats along the Petaluma River corridor, which attract birds but also create abundant mosquito populations. Nearby agricultural grazing lands for dairy cattle and vineyards thrive and show no discernible effects of insufficient pollination. The District does not receive complaints from these property owners. Furthermore, the CEQA conclusions of less-than-significant impacts are based not only on the BMPs but on application methods and the concentration and type of chemical materials used. All of these factors, and including the physical context in which the applications occur (that subject the treatments to sunlight, air, and soil conditions that minimize persistence and facilitate breakdown) support the Draft PEIR conclusions that the effects are not substantial or adverse enough to be characterized as significant, not that there is a conclusion of zero or no impact. There could be a loss of some individual insects on occasion during an application, but the loss would not be substantial for reasons cited below and in Response 6 above.

Adverse impacts to non-bee pollinators (including nocturnal moths) or insect predator populations have not been reported (by adjacent landowners or wildlife refuge managers) as a result of focused applications of District pesticides. (Nocturnal moths pollinate nocturnal flowers with pale or white flowers heavy with fragrance and copious dilute nectar.) In fact, pollinator populations fluctuate over time and are affected by many different contributing factors. It is not possible to definitively link use of vector control products by the District (at levels established by the USEPA and according to additional District BMPs) to a long-term decline or one that would adversely impact the pollinator or predator population of interest. It is well known in population biology that every population can adequately respond and recover to a loss of large percentages of individuals based on their intrinsic reproductive vigor. Populations with very short reproductive gestation periods (most insects and some small mammals) will recover much faster than populations with long reproductive cycles (large mammals and some birds) (Andrewartha 1972). In fact, there are many current theories about how many individuals in a population can be lost before the likelihood of significant impact or extinction may occur, but some experts suggest the total population of animals (and insects) with very short reproductive cycles (gestation times) can lose as much as 30 percent of the population and still experience complete recovery to pre-stress numbers (Emlen et al. 2003). In the case of insect predators, even a fraction of this number would suffice to replenish the population to pre-exposure numbers. Furthermore, the overwhelming majority of the District's adulticide applications are site specific applications using hand held and/or backpack equipment. These applications are performed as necessary to reduce substantial populations of adult mosquitoes in the interest of public health. Annually, a considerable portion of the District's adult mosquito applications are performed in conjunction with contained, anthropogenic sources such as septic tanks and water and/or sewage leaks beneath buildings. When an adult mosquito population(s) is reduced, adulticide applications are no longer required at a given site, unless there is an additional occurrence at another point in time. With the exception of a small number of especially problematic sites (e.g. sewage treatment plants) adult mosquito control applications are performed infrequently at a given site. Overall, on an annual basis and considering the District's service area, adult mosquito control applications are small scale and relatively infrequent.

Response 8

Visual inspection of the area to be treated prior to treatment is a prudent and practical approach to evaluate the possible presence of potential nontarget species of concern including pollinators. The practice of visual inspection of a site *prior to* application of the pesticide indicates the care given by the District to reduce or minimize potential impacts to readily identifiable nontarget species such as bees and butterflies. Visual inspection is done to avoid applying pesticides when pollinators are observed flying.

The concern stated in the comment that visual inspection will not prevent "post application harms" and "pesticide residues will remain in toxic amounts" is misleading and is really a question about persistence of the active ingredient in pesticides used by the District. The persistence of pesticide products is dependent on the physical/chemical conditions of the soils and vegetation treated. The persistence of the chemicals used by the District for vector control after an application to soils or sediment is reduced markedly by the characteristics of the surface soils and/or vegetation.

The persistence of all chemicals registered by the USEPA for use in vector control is documented and included in the guidance and label instructions, both of which are summarized in the chemical MSDS (now SDS) documents. For instance, the persistence of glyphosate in soil and sediment has been studied since its development in the early 1970s. The characteristics of glyphosate have been studied and validated over decades. Every organic chemical has a physical/chemical degradation characteristic termed "half-life" (a metric used to describe the elapsed time for a chemical to reach ½ of its initial concentration). Each organic chemical, whether toxic or not, decays in both activity and toxicity over time. For some chemicals, the half-life can be hours, days, or weeks and few chemicals used as pesticides have half-lives normally greater than a week due to degradation by environmental conditions. When pesticides get into soil, or water, or are taken up by plants and animals, the half-life characteristics are altered. The environmental fate of pesticides depends on the physical and chemical properties of the pesticide, particularly the pH of the medium, modifying how likely it is to travel through soil (soil mobility), how well it dissolves in water (water solubility), and how likely it is to become airborne (volatility) (USEPA 1993).

Once a pesticide has been released into the environment, it is broken down by exposure to sunlight, (photolysis), exposure to water (hydrolysis), exposure to other chemicals (oxidation and reduction), microbial activity (bacteria, fungi, and other microorganisms), and other plants or animals (metabolism). Pesticide labels set out safety and use guidelines that usually focus on three aspects: rates of application (single and cumulative) for registered crops and pests, timing of application, and restrictions on areas of application (including required buffer zones).

The environmental fate of pesticides used by the District for vector control is influenced by their chemical properties and by the environmental conditions in which they are applied. The Draft PEIR's Appendix B, Ecological and Human Health Assessment Report, provides a detailed description of the fate and transport in air, water, and soil for each of the active ingredients applied by the District. For example, a summary of the potential uses of glyphosate products by the District is included in Appendix B Table 6-1 and the narrative in Section 4.6.2 of Appendix B. Many second-and third-generation insecticides are formulated to act quickly and then dissipate quickly in the environment, often through photolysis or microbial breakdown. Others bind to soils and sediments where they are degraded abiotically or by soil organisms. These effects, the potential for mobilization after pesticide application and the methods used to minimize exposures to nontarget ecological receptors, are considered in the discussion of the Vegetation Management and Chemical Control Alternatives (see Sections 9.2.5 and 9.2.7 of the PEIR).

There are numerous pesticide products that include inert and/or chemically different additives to enhance the spray characteristics, adhesion properties, and efficacy. Many of those products have been specially tested for toxicity and registered with the USEPA for specific vector control purposes (National Park Service 2016). Although some of these mixture products have been associated with increased toxicity, numerous studies have demonstrated that the increase in toxicity may be due to a surfactant additive. In most instances, these special formulations of pesticide products are intended to reduce the potential for adverse effects or to specifically be used for aquatic environments, e.g. a glyphosate product, Accord, is a formulation of glyphosate which has been shown to be safer to aquatic wildlife than some of the other formulations of glyphosate (Brodman et al. 2010).

All chemicals can cause adverse effects or even become be toxic at levels exceeding individual species "tolerance" levels. However, the sensitivity and tolerance levels are determined by the USEPA and other regulatory agencies using laboratory tests with numerous species of concern that are estimated to be potentially exposed to an application. The results of these tests on each chemical are published in numerous publically available USEPA documents summarizing the testing results with metrics such as the LD_{50}, LC_{50} and maximum estimated tolerance levels. For the pesticides used by the District for vector control, these metrics are indicated in detail in Appendix B of the PEIR, with information on a current species of interest (honeybee). In several studies, one, for instance, (Frasier and Jenkins 1993) indicate that both technical and formulated glyphosate are practically nontoxic to honeybees with a contact LD_{50} value greater than 100ug/bee (applied directly to the thorax with a saturated Q-tip), which is considerably greater exposure than likely in the environment where applications could occur.

The half-life and other physiochemical characteristics of the chemicals used by the District for vector control are listed in Table 6-1 of the PEIR Appendix B.

Response 9

Glyphosate is an herbicide that is relatively stable to chemical and photo decomposition. The primary pathway of glyphosate degradation is soil microbial action, which yields the minimally toxic breakdown product AMPA and glyoxylic acid. Both products are further degraded to carbon dioxide. Glyphosate adsorbs tightly to soil so that its residues are relatively immobile in soil (USEPA 1993). This characteristic results in the chemical (when it is in the soil) being less available as a route of exposure and would require direct ingestion of the soil or sediment, which is not likely by insect pollinators who focus on flowers.

Although the term sub-lethal effect is often misused outside the scientific community, it defines the effects of a stressor (pesticide in this case) that is less than mortality. It includes evaluation of the potential effects on physiological and behavioral systems that may occur over time or result in a deficit of a physiological function. Although important in the determination of the potential adverse impacts of the pesticide, it is the “endpoint” most susceptible to confounding, outside, environmental factors. Adverse effects that are categorized as sub-lethal are also often confused with the concept of chronic effects, which include low level effects that are continued over long periods of time and usually associated with constant exposures to a stressor. Because this condition is not typical of District vector control applications of chemical (generally single localized applications) it is not relevant to the evaluation of District use of pesticides or herbicides.

However, one of the sub-lethal effects considered by the scientific community is evaluation of behavioral responses to chemical exposures. This was the focus of the work by Herbert et al. discussed in detail in Response 6. The conclusion of this study, which was designed to evaluate the very subtle behavioral responses to a pesticide exposure, was “no effect on foraging related behavior was found in these behavioral studies.” Regardless of their negative behavioral results, the authors suggested that the bees may have been able to carry pesticide to the hive (which was not and is not a measurable endpoint) as a reason for the reduction in the number of bees (which was also not observed in their studies). This study provides no support to the authors’ hypothesis of behavioral deficit after exposure to the pesticide in the study.

Claims suggesting pesticide applications have clear sub-lethal adverse effects on bees and bee colonies are not supported by the preponderance of relevant scientific publications. Most of the reports of reduced bee numbers and colony collapses do not include consideration of the numerous confounding factors that impact the bee colonies, diminishing their evidentiary value. The effects of drought, disease, parasites, viruses, and predation all play a role when impacts to bees are reported.

In conclusion, the District’s applications of pesticides for vector control are done in strict compliance with USEPA, manufacturer, and BMP guidance, which are designed to minimize exposure to pollinators. District application methods and chemical characteristics of the products used and proposed for use make the potential for long-term (chronic) exposure to insect pollinators unlikely. Finally, the comment presents no substantial evidence that application under the Program will result in substantial adverse sublethal effects to pollinating insects, and the available scientific literature also does not support such claims.

Response 10

As discussed in Responses 6 through 9, the Draft EIR correctly analyzed the impacts associated with the Proposed Program, and additional information is provided herein to support the original conclusions as well as consideration of information provided by the commenter. The information above provides clarification of material contained in the PEIR and addresses specific questions raised in public comments for this Final PEIR. None of the comments identified substantial evidence of a new significant impact that was not considered in the Draft PEIR, and no Draft PEIR impacts need to be changed from less-than-significant to significant; thus a re-circulated Draft PEIR is not required. Also see Response 15 below on the technical qualifications of the principal toxicologist who worked on the Draft PEIR and prepared responses to many of the questions raised herein on the chemical treatments. The technical qualifications of all of the preparers of the District’s PEIR are summarized in Chapter 16, Preparers.

Response 11

Some of the chemicals used for vector control include the pyrethroid insecticides such as permethrin, resmethrin, and etofenprox that are used as adulticides by the District. While these chemicals are not very toxic to terrestrial species of mammals and birds (they are below the EPA LOC for most uses) they can be toxic to aquatic species at high concentrations. The toxicity of these pesticides is species specific, and the thresholds provided by the USEPA guidance indicate that it should not be introduced to aquatic systems. As with all chemicals, the exposure (dose) is the primary factor resulting in potential toxicity, and care is taken by the District to reduce or minimize the possible introduction into water bodies. As stated on page 9-35:

> "The use of adulticides to control mosquitoes is the method of control in the bottom tier of the District's IVM program. Adulticides are only applied when other tools are not available or applicable and when specific criteria are met, including species composition, population density, proximity to human populations, and/or human disease risk. The active ingredients currently in use have been deliberately selected for lack of persistence and minimal effects on nontarget organisms when applied in strict conformance to label instructions for ULV mosquito control. Adulticides are applied following District BMPs, using ground application equipment or applied in the future using rotary and/or fixed wing aircraft, and used in strict conformance with label requirements and the District's PAP."

Further discussion is provided on page 9-37:

> "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 would have a less-than-significant impact on surface water or groundwater, including their limited use near septic systems, when applied following District BMPs and using ULV techniques, and when used in accordance with label requirements and the District's PAP."

The characteristics of these chemicals reduce the likelihood of exposure to nontarget species because they bind to soil, making them less likely to be available. Because they are known to be toxic to some of the aquatic species, applications are conducted using ULV techniques and with strict adherence to the product labels as determined by the USEPA guidance (USEPA 2009). Special precautions and BMPs are used to ensure that they are not introduced into the aquatic environment in amounts that would impact nontarget species, including benthic invertebrates. The statement on page 4-97 that product could encounter water means it is possible that a small amount could reach the water surface, not that it is actually applied to the water. Furthermore, adulticides are meant to encounter the adult mosquito in the air or resting on vegetation. The verbal context in which the few words were extracted and misrepresented by the commenter is provided below:

> "For example, the maximum application rate of an adulticide that could be used is 0.87 ounce/acre, although maximum application rates are generally not required. The concentration of the active ingredient is 5 percent or less of this volume. This translates into a water concentration of 1.04 µg/L if the water is one foot deep or 4.14 µg/L if the water is three inches deep. This assumes all of the product contacts the water. Aerial applications are made over vegetated areas preferred by adult mosquitoes, so the amount of product encountering the water is generally a fraction of this." (page 4-97)

This USEPA guidance is one of the factors used to develop the BMPs for pesticide applications, including the requirement to maintain adequate buffers between the application area and the edge of the water body for some materials. By following these USEPA recommendations, the likelihood that the pesticide will result in adverse aquatic impacts is very low.

Where it becomes necessary to treat storm drains with pyrethroids to eradicate localized infestations, care is taken to document the treatment, and as noted, all treatment is performed using ULV techniques and with strict adherence to the product labels as determined by the USEPA guidance, which has been documented not to result in toxicity. Treatment of storm drains with pyrethroids to combat infestations is considered to be appropriate where there is the potential for adverse impacts on public health. However, storm drains are most often a problem when garbage and sediment from local streets prevent storm water from draining quickly, leaving stagnant underground pools or ponds resulting in mosquito breeding. Most often, storm drains in residential areas are treated with larvicides. Street sweeping and trash removal are physical methods of control employed by the affected jurisdictions and homeowners to minimize stagnant water under local streets; unfortunately, these practices do not occur sufficiently in every neighborhood.

Response 12

The Draft PEIR identified Chinook salmon and steelhead habitat in the Program area. Coho salmon have been added to the following paragraphs under the Physical Control Alternative (Section 4.2.4.1.1 on page 4-80), and Vegetation Management Alternative (Section 4.2.5.1.1 on page 4-87):

> "Because their rapid currents do not provide suitable habitat for mosquitoes, creeks and rivers generally do not support substantial numbers of mosquitoes, although, some mosquitoes can be found in slow eddies and back channels, or in pools isolated on the banks as flows recede. Creeks and rivers may support special-status species including steelhead, Chinook salmon, Coho salmon, foothill yellow legged frog, California red legged frog, California freshwater shrimp, and other species, as indicated in Table 4-1. Isolated ponds and back channels may provide habitat for mosquito larva, but these areas may also provide excellent rearing habitat for young fish and amphibians, as they provide warmer water temperatures, higher primary productivity and protection from predaceous fish."

Response 13

The comment repeats the assertion that the BMPs are not adequate to prevent harm to special-status aquatic species such as salmonids and other fish. This assertion is contradicted by the substantial evidence and analysis in the Draft PEIR and additional clarifications provided herein. Furthermore, the comment that food chain impacts would exacerbate a "failure to address significant impacts" is misleading. Rather, the commenter disagrees with the Draft PEIR's conclusion that impacts would be less-than-significant but does not provide any substantial evidence to refute the material analyzed in the Draft PEIR, which includes the references cited in the PEIR Chapter 17, the references cited in each Appendix, and the additional references cited here in this responses to comments including attachments.

The Draft PEIR disclosed a broad range of issues associated with chemical methods of vector control and made a reasonable good faith effort to address those issues in a manner understandable to the public by PEIR preparers with the appropriate qualifications. The issue of loss of prey and prey habitat, as well as the potential impact to contaminated prey, was addressed in the Draft PEIR and further considered by a senior toxicologist and addressed in the extensive response below to support the material in Section 4.2.2.6 or the Draft PEIR and the following statement in the Draft PEIR on page 4-75 on predator populations:

> "Mosquitoes are part of the food web and their loss may reduce the food base for some predators. Although mosquitoes serve a role as one of many types of prey items for some fish, avian insectivores, bats, and small reptiles and amphibians, the reduction of mosquito

> abundance over a small area will not affect the predator populations overall, as other prey sources are available."

Because of the selective nature of the vector control products for mosquitoes, any claimed potential adverse impact to insect predators associated with District applications (as nontarget exposures) would be temporary and inconsequential in the impact to those populations of predator species. Even in the event of ancillary exposures, the recovery of such populations occurs rapidly to maintain the general level of individuals in their populations. The relative higher sensitivity of the target vs nontarget (less sensitive predator) species provides an adequate measure of safety to maintain the balance of predator populations.

Studies evaluating the toxicity of spinosad in control of *Lepidoptera*, for example, included the relation of pesticide treatment to the insect predators in the food chain. These authors reported that their studies revealed the relative safety of spinosad to natural insect predators that would likely be associated with *Lepidoptera* predation while being highly effective against the target *Lepidoptera*: "spinosad is highly active against *Lepidoptera* but is practically nontoxic to insect natural enemies." As a verification of the relative sensitivity to insects and insect predators, these authors further state that "very large direct doses of spinosad in laboratory setting were toxic to nontarget insect predators, while low doses did not exhibit the same level of toxicity to nontargets and was relatively safe against the bulk of the insect predators". (Williams et al. 2003)

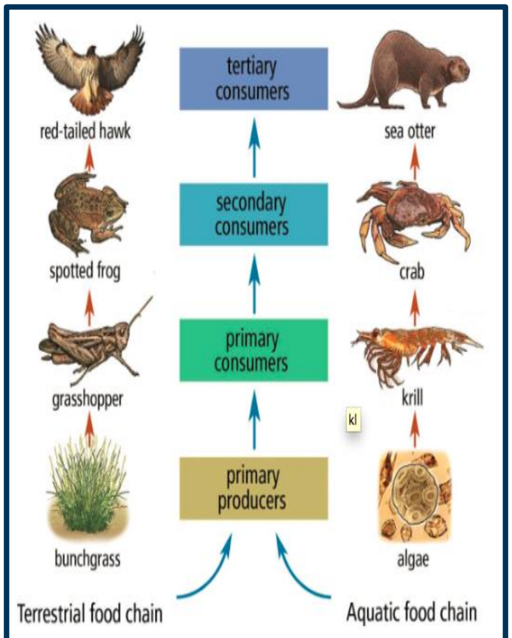
It is clear that there are dramatic species differences in sensitivity to chemicals where chemicals could be applied, but one of the concerns voiced by the public about the safety of glyphosate (and other pesticides) is based on possible adverse effects or toxicity occurring as a result of bioaccumulation (uptake and sequestering of chemical in tissues) of chemical in the target species and subsequent food web transfer to nontarget predators. The processes of bioaccumulation and biomagnification (where the chemical actually becomes more concentrated in the exposed animal than the media) are processes seen primarily in the higher food web trophic levels. These processes are more typical of transfer of chemical to tissues of larger predator species and not particularly relevant to District vector control operations with pesticides and herbicides focused on insect vectors and their habitats.

An adverse effect to nontarget predators (food web transfer of applied chemical) would require the consumption of adequate numbers of contaminated pests to reach a concentration in the predator that would be toxic. In the food web constructs, predators consume prey items that are smaller in size and mass. This is the basis for the hierarchy inherent in the classical ecological food web. This process requires consumption of adequate numbers (mass) of contaminated prey items to exceed the dose known to result in adverse effects or mortality. An example of a purposeful impact using the process in the food chain is the baiting of small mammals to reduce the numbers of large pest species (coyotes, ground squirrels, etc.). In these instances, very large quantities of the poison are introduced into the bait animal carcass where the quantity of chemical is known to cause mortality in the predator. To result in the bioaccumulation of chemical in an insect predator, the consumption of large numbers of contaminated insects would be needed to reach a level of sensitivity in the predator. Given the specificity of pesticide toxicity to the mosquito prey of potential predators (see Table 6-1 in Appendix B of the PEIR), it would not be a likely route of chemical transfer.

The approach used to address potential food web transfer (uptake) of chemicals and contaminated prey is the ecological risk assessment (EcoRA), which is a series of calculations that take into account the concentration of the exposure media, potential ingestion rates of the prey items and the predators, and the concentrations of the sources of exposure. The series of parameters used in the EcoRA food web analysis require information about each of the species of interest, the contaminants (pesticides) of interest, and demographic information for each affected species (target and nontarget). Using these data an estimate of the likelihood and amount of transfer of contaminant can be estimated. As it is obvious that there is little if any bioaccumulation of chemical in target insects, for example, the transfer to the predator would be minimal. If the target insects in this scenario are killed as planned, the minuscule amount of chemical on the insect could be ingested by the predator. However, to reach a toxicity threshold that would result in adverse impacts to a predator bird, very large numbers would be needed: for glyphosate, for example, 2000-4000 mg of chemical would be required. This equates to approximately 800 to 1600 fully saturated (with chemical) mosquitoes and since each mosquito is not “100% chemical”, this scenario suggests that secondary toxicity is not likely.

To address the possible food web implications of pesticide applications requires the knowledge about the specific species of concern, the habitats being treated, and the concentrations of the pesticides as they are applied and on the vegetation and/or insects after application. This complex combination of parameters and the values associated with them are not usually available, so food web risk assessments are based on available demographic data, assumptions, and the numerous uncertainties associated with each. There are hundreds of possible combinations of food web interactions but the concern about the impact of insect prey on predator populations can be illustrated by the figure in the insert below depicting a simple hypothetical web at the low trophic levels.

One other food web issue is the potential to remove substantial numbers of mosquitoes (as prey items) that are required for upper trophic level species. This is roughly illustrated in the figure insert below in which the grasshopper holds the approximate terrestrial trophic position representing the terrestrial insect species and the krill represents an aquatic salt water insect species. Although it does not directly represent the food web for insects, this figure provides a graphic representation of the hierarchy of the trophic levels in a food web. Some food web depictions include dozens of interactions in a complex series of connections. In the figure depiction of a food web relationship, it is clear that removal or substantial reduction in one trophic level of the web can impact the demographics of a higher, lower, or equal trophic species. Recovery of the species impacted is dependent primarily on the reproductive replacement potential, which is rapid for the insects. Discussion of the impact of removal of the target insect species by pesticides should acknowledge the recovery potential. In most scenarios, most impacts are temporary. However, since the purposeful removal of mosquito adults and larvae at a location is the objective of vector control, the possible impact to predators must be contrasted with the objective of maintaining the public health.



A terrestrial and aquatic food chain to show the flow of the food web

Several studies have been conducted that demonstrate the likelihood that some pesticide uses are not harmful to nontarget species while showing toxicity and efficacy for the target species. In a study to compare the relative sensitivity of a pesticide to target vs nontarget species, Lawler and Dritz (2013) suggest that spinosad is an effective treatment for insect larvae that, at appropriate doses, is safe to the predators and nontarget species. While this relative toxicity study focused on spinosad, it illustrates the selective toxicity that is similar for many pyrethroids. The results reported by these authors suggest that while the impact on the target mosquito larvae was appropriately effective, the potential impact on nontarget insect populations would be minimal to inconsequential, because the doses that are effective against mosquito larvae are below levels that would even marginally impact nontarget insect populations. Even with a possible minimal impact on some of the nontarget insects, the impact would not be sufficient to adversely impact them overall. The study conclusion further supports the PEIR’s conclusion that properly selected pesticide applications can be effective against target mosquitoes while not resulting in unacceptable adverse impacts to nontarget species. The low levels of pesticides used by the District, combined with the careful application restrictions embodied in the BMPs, results in the effective, yet environmentally compatible treatment for mosquitoes.

Moreover, inadvertent reduction of mosquito predators in a population as a result of pesticide applications conducted for vector control is a nontarget species issue only if a significant portion of the predator population is removed for an extended time. Any impact on some individuals in an insect predator population would be short lived, and population recovery would be rapid (Emlen et al. 2003). The number of insect predators impacted, when compared to the total population(s) of the predators, would be inconsequential in the long term. The relative impact on target insects versus the nontarget predators of a pesticide has been demonstrated in other studies as well. Davis et al. (2007) and Davis and Peterson (2008) evaluated the relation of target versus nontarget predators in tests using methoprene. Although these authors were evaluating methoprene, the demographics are similar as the lower toxicity to the predators would likely not have adverse species level or food web effects. Similar to the results of the studies by Davis et al. (2007) and Davis and Peterson (2008), adverse effects to a few of the individuals in a nontarget predator population as a result of typical glyphosate applications would be inconsequential.

Response 14

The concept implied in the comment that bioaccumulation always leads to toxicity is flawed. Not all pesticides bioaccumulate. Bioaccumulation is a phenomenon associated with numerous chemicals and pesticides based on extensive, long-term exposures of a product to several laboratory test species using measures of tissue concentration before and after exposures to the chemical. Additional work is often conducted in a field situation to increase the understanding of the role bioaccumulation plays in modifying the laboratory toxicity. These studies are usually conducted in the laboratory as a requirement for chemical registration, but the metabolism of methoprene in the environment reduces the amount of parent chemical available in soils (Schooley et al. 1975). Accumulation and the degree of bioaccumulation of methoprene can vary widely according to the characteristics of the exposure and the environmental conditions at the time of application.

It is correct to suggest that methoprene has been shown to be toxic to some aquatic species. It has been shown to be moderately toxic to some fish (rainbow trout); but in three studies on bluegill sunfish, the observed effects ranged from moderate to very high toxicity. It is moderately toxic to crustaceans such as shrimp, lobsters and crayfish, and freshwater invertebrates. However, these results occurred at much higher exposures of methoprene than would occur in field applications of methoprene for mosquito control. The potential adverse impact of methoprene to these aquatic species can be minimized or ameliorated by the prudent use of strict application guidelines combined with its characteristic degradation characteristics (degraded by sunlight and/or microorganisms) in the environment. Exposure of aquatic organisms will be limited by the low solubility (0.51 ppm) of methoprene in water and by its rapid degradation in aquatic environments; therefore, the impact is less than significant.

Although some of the characteristic metrics of toxicity might be of concern, the impact of methoprene in water at the diluted concentrations resulting from application for mosquito control make the potential adverse effects less likely to be of concern because the toxicity to aquatic animals occurs at levels in the parts per million range, rather than the parts per billion level that are found in likely realistic applications, including those that occur under the Program. The District’s use of methoprene is not expected to result in exposures harmful to aquatic invertebrates because methoprene is short-lived in the aquatic environment, and it does not have a particularly high potential for bioaccumulation (EXTOXNET 1995). In a multi-year study conducted in wetlands, researchers found no long-term negative impact on nontarget insects apparent after 8 years of treatment, but effects were found in some years. In some years some chironomid groups were affected, but there was no detectible difference in total chironomid biomass due to treatment over 8 years in the treated vs. nontreated wetlands (Hershey et al. 1997).

"Water analyses in field and laboratory conditions and a comparison of reported Altosid (a methoprene product) use with reported frog deformities in Minnesota demonstrate that a connection between frog deformities and Altosid use is unlikely" (Henrick et al. 2002). These results indicate that factors other than s-methoprene and its degradation products are contributing to the recent outbreak of frog deformities (Henrick et al. 2002).

Response 15

This conclusory comment that BMPs are inadequate and pesticide use discussions are inaccurate, and that significant impacts will result, is a summary statement by the commenter. Preceding responses on the use of BMPs (Response 3) and on chemical use by the District provide clear and substantial evidence that the conclusions of less-than-significant impacts from the District's chemical control are technically defensible and appropriate. Additional literature was reviewed in preparing these and other responses to comments, and some of this literature review is attached to this response as Attachment A. Furthermore, the author of the responses on pesticide use herein, both insecticides and herbicides, and the ecological and human health impact conclusions and related material in the Draft PEIR, is Bill A. Williams, PhD, a toxicologist with the educational and experiential background as an expert on pesticides and their use in aquatic and terrestrial environments.

A summary of Dr. Williams' qualifications to evaluate the scientific literature and to consider where and how the pesticides are being used specifically by the District for vector control in order to draw conclusions of impact significance to humans and to nontarget species are provided below. The highlights of his extensive experience presented are from Dr. Williams' technical resume, which is attached to the end of these responses to your comments (Attachment B). This resume has been reduced from his master resume in order to focus on the most relevant aspects of his career dealing with pesticides and risk assessments, excluding his accomplishments at NASA as a Program Scientist and Payload Scientist/Astronaut (1969-1986).

Dr. Williams has more than 30 years of experience and expertise in environmental risk assessment and toxicology, including CERCLA, NRDA, NEPA, and CEQA projects ranging from upland to sediment to freshwater/marine projects. Dr. Williams has been a member of numerous international, National Academy, and federal committees and workshops to define risk assessment guidelines, test procedures, field study approaches, and avian and mammalian test protocols, and to provide other technical assistance utilized by USEPA regulators. He helped develop USEPA's Framework for Ecological Risk Assessment and USEPA's risk assessment of 2,3,7,8 TCDD (tetrachlorodibenzo-p-dioxin or dioxin). He was a charter member of the Avian Dialogue Group, convened by the Conservation Foundation (RESOLVE) to bring industry, academia, and government regulators together to resolve conflicts between the groups. Dr. Williams has led and supported dozens of successful projects that were acceptable to the Washington Department of Ecology, Oregon Department of Environmental Quality, Oregon Department of Fish and Wildlife, US Environmental Protection Agency, Region 2, 9, 10 and numerous other USEPA regions nationwide. Dr. Williams has served on several Oregon DEQ advisory science committees and workshops. He has been a member of several national and regional EPA Science Advisory Panels, including the National Science Advisory Panel on endocrine disruptors, uncertainty in risk assessments, and the panel on use of laboratory data in estimates of risk to wildlife.

Of particular relevance to his role on the CEQA documents for mosquito and vector control agencies is that Dr. Williams recently provided strategic and scientific support in the development of an Integrated Pest Management (IPM) system for use by the Mid-Peninsula Open Space District in the San Francisco Bay Area. The IPM is tailored to the vectors of concern, the pesticides and herbicides used by the District, and potential risk to the nontarget aquatic and terrestrial species. Pesticides incorporated into the IPM were based on evaluations of the use of more than 20 herbicides (with emphasis on use of glyphosate in regional wildland areas for control of over 60 invasive plant species), dozens of insecticides, structural and nuisance agricultural and urban pests, and selected regional wildlife pests. The IPM developed for the District included control of ants, cockroaches, wasps and flies, ticks, and mosquitoes. The IPM plan included recommendations for establishing and conducting pest identification, conducting damage assessments, and establishing tolerance levels and several tiers of proposed vector control that addressed top to bottom elements of implementation strategies.

Dr. Williams also provided scientific reviews and risk assessments addressing the potential adverse effects of CAL FIRE herbicide use to reduce the potential for and mitigation of wildfires in California. The Vegetation Treatment Program (VTP) project included evaluation of potential adverse impacts of herbicides used in forestry and rangeland to control brush and grasses and for maintenance of areas that have been previously cleared of heavy vegetative fuels. The primary herbicides of concern in the evaluation were the numerous products containing glyphosate as the active ingredient.

Dr. Williams has participated in numerous workshops as a speaker or panel member on ecological risk assessment addressing such topics as uncertainty analysis in ecological risk assessments, ecotoxicological principles for avian field studies, population ecology and wildlife toxicology of agricultural pesticide use, and environmental effects assessment. He has published numerous peer-reviewed studies in scientific journals and presented abstracts in scientific meetings, including the following (of more than 9 book chapters, 55 peer review studies, and more than 105 meeting abstracts):

> Williams, B.A., J.Q. Word, and W. Gardiner. 2007. Detecting the Presence and Effects of Pharmaceuticals and Personal Care Products in Water Samples. WEFTEC Annual Conference October 11-17 September, 2007. San Diego, CA.

> Williams, B.A., J.Q. Word, and W. Gardiner. 2007. Reducing Effects of Endocrine Disrupting Compounds: Effluent Blending. Water Reuse Assoc. Conference July 29-30, 2007. Providence, RI.

> Williams, B.A., L.J. Kennedy, J.A. Nedoff, and T. Fuji. 2005. Risk Assessment as a Tool for Emerging Contaminants and Water Quality Decisions. PNW AWWA Meeting, Portland, OR, 4-6 May 2005.

> Bahe, A., B.A. Williams, L.J. Kennedy, and J.A. Nedoff. 2004. Do Residual Levels of Pharmaceuticals Contribute to Endocrine Disruption? 25th Annual Mtg. SETAC, Portland, OR, 14-18 November 2004.

> Williams, B.A., L.J. Kennedy, and J.A. Nedoff. 2003. Uncertain About Uncertainty in Environmental Risk Assessment. NorCal SETAC, Berkeley, CA, 6-7 May 2003.

> Kapustka, L.A., B.A. Williams, and A. Fairbrother. 1996. Evaluating Risk Predictions at Population and Community Levels in Pesticide Registration - Hypotheses To Be Tested. Environ. Toxicol. & Chem. 15(4): 427-431.

> Williams, B.A., et al. 1994. Assessing Pesticide Impact in Birds. Final Report of the Avian Effects Dialogue Group (1988-1993). Resolve, Washington, DC.

> Williams, B.A. et al. 1991. Assessing Pesticide Impact in Birds. Discussions of the Avian Effects Dialogue Group (1989-1991). Resolve, Washington, DC.

The substantial evidence contained in the Draft PEIR and in the Final PEIR compiled by Dr. Williams and the best professional judgment exercised by Dr. Williams in the context of this CEQA evaluation of vector control is defensible and sufficient.

Response 16

California has designated more than 1.7 million acres as critical habitat for CRLF. The District has a commitment to consider mosquito surveillance and control cautiously within CRLF critical habitat (as an effort to avoid impacts to special-status species) and to monitor and avoid/minimize chemical applications in areas that might impact them. The District's policy is to apply all pesticides according to label requirements. Although there is a potential for the applications of permethrin (or any other adulticide used), in the vicinity of unlined storm drains or as a ULV fog over wetlands, to infringe on an area of

CRLF habitat, the basic issue in all cases is not what the potential toxicity may be, as most of those data are developed in studies that purposely provide extreme levels of exposure to the chemical of interest, but whether toxicity is reasonably foreseeable under the circumstances of the proposed application. Typical methods of testing for toxicity in the laboratory are most often not representative of the potential for exposure in the field, or thus of the potential for real world impacts. The USEPA designations of toxicity are based, for the most part, on the results of these highly unrealistic laboratory exposures and serve only as guidance for use patterns and labeling to address the safety measures needed to minimize chemical exposure to nontarget species such as the CRLF. Also, permethrin use would be limited to adult insects (adulticiding), either mosquitoes or wasps/ticks. The potential for the product to actually contact CRLF is remote. Most of the District's chemical treatments are to mosquito larvae and pupae using highly targeted (rather than broad spectrum) products.

Any chemical can become toxic if the exposure (dose) is high enough to exceed the receptor's threshold sensitivity to that chemical. For many chemicals, the threshold to exhibit toxic effects is very high; for others, the threshold may be low. Since these characteristics are species and chemical specific, USEPA provides the relative toxicity data for thousands of chemical products. Tests with permethrin at high levels in the laboratory suggest that it can, at high doses, adversely affect the aquatic and terrestrial phases of the CRLF. However, the concern about this pesticide should be compared to the potential for exposure in the actual field conditions and habitat and identification of the confounding factors that can contribute to the adverse effects in the CRLF. CRLF can occur in any freshwater aquatic habitat, including stagnant ponds and roadside ditches. This is primarily for juvenile and adult frogs. This species can move a considerable distance (2 miles or more) away from breeding habitats so could occur in aquatic habitats other than breeding habitats. Eggs and larvae are unlikely to be present in small ditches or stagnant ponds unless other breeding habitat is not available and if water quality is suitable.

Peer reviewed and published reports that suggest a link between permethrin applications and CRLF survival or impacts include confounding factors that cannot be ruled out as part of any observed effects (Kiesecker et al. 2001). Rather, the concerns for this endangered amphibian are linked to indirect relationships that are subject to numerous confounding factors (Kiesecker et al. 2001) that also may contribute to adverse effects to the species at early life stages (Johanssen et al. 2006). Clearly, water quality issues and other environmental conditions provide a substantial number of other factors that may impact the CRLF populations (Adams et al. 2013). Amphibian populations are known to be adversely impacted by viral infections and parasites as illustrated by studies of amphibians in pristine, elevated regions far from the potential impact of these chemicals.

The USFWS has identified and documented the following nonpesticide confounding factors that adversely affect the CRLF. The following confounding factors in the interpretation of adverse impacts to CRLF are provided by the California Department of Fish and Game (CDFG 2002):

- In Coastal lagoons, the most significant mortality factor in the pre hatching stage is water salinity.
  - 100 percent mortality occurs in eggs exposed to salinity levels greater than 4.5 parts per thousand.
  - Larvae die when exposed to salinities greater than 7.0 parts per thousand.
- Predation is an important factor. Bitterns (*Botaurus lentiginosus*) and Black Crowned Night Herons (*Nycticorax nycticorax*) are likely predators of adult frogs. Juvenile frogs, which are more active diurnally, and less wary than adults, may be more susceptible to predation by diurnal predators, such as the Great Blue Heron (*Ardea herodias*) and several species of garter snakes (*Thamnophis* sp.), including the endangered San Francisco Garter Snake (*Thamnophis sirtalis tetrataenia*).

These confounding factors make establishing pesticide causality nearly impossible, especially at the potential exposure that could result from the District's use under the Program.

For a discussion of potential chemical effects on prey, see Response 13. When considered in light of the evidence and analysis in the PEIR, there is no substantial evidence that the occasional application of permethrin in accordance with label requirements and BMPs would have a substantial adverse effect on individual CRLFs or CRLF populations in general, either directly or as a result of changes to CRLF critical habitat.

Response 17

Some reports cited by the public suggest that the potential impact of glyphosate and glyphosate products includes adverse impacts to several life stages of amphibians and their habitats. These reports are not directly relevant to the potential impact of glyphosate on the CRLF in the environment as the data presented is based primarily on toxicity in laboratory studies using both high doses and several sequential lower doses in a laboratory setting. The toxicity of glyphosate to dozens of species are listed in Table 6-1 of Appendix B.

While the addition of some surfactants to glyphosate products may make the products more toxic to some biota, the primary concern for red-legged frog is toxicity based on studies using high, continuous exposures to the products in laboratory tests. The exposures in the laboratory studies are clearly not representative simulations of the potential exposures in field applications because the laboratory studies involve captive test species, unable to choose uncontaminated food or habitat. Many laboratory tests are designed and conducted to determine the 'worst-case" exposure to a chemical and then to lower the test concentrations slowly until a test concentration shows no adverse effect to the test animals (USEPA 2012a; Williams et al. 1994). In this way, the concentrations that produce exposures with little or no adverse response can be documented and used to define the applications that should be safe to the animals and environment. As in all of the relevant laboratory toxicity studies, the exposures in laboratory conditions are essentially 100 percent with no ability to choose areas of lessor concentrations, and use of nonrepresentative exposures.

The primary causes identified by the US Fish and Wildlife Service as leading to an adverse impact on the status of the threatened California red-legged frog are loss of habitat and overwhelming predation, invasive species, and competition for foraging items (National Wildlife Federation listings). The potential impact of glyphosate on the CRLF is marginal and only applicable in situations of excess exposure to incorrectly treated areas. The toxicity and adverse effects reported in laboratory studies would not be expected to occur as a result of the District's potential herbicide applications for mosquito or invasive species control in the field, because of the much lower potential exposures and the District's adherence to its BMPs. Special care is taken to avoid applications where CRLF have been identified and reported by resource agency personnel or District biologists and technicians based on observations and database investigations.

Reports on the effects of glyphosate to amphibians and other nontarget wildlife using mesocosms (outdoor studies in confined ponds) is intended to extend the results of the laboratory studies to more realistic environmental conditions by providing exposures in outdoor pond systems. However, even in these reports, the exposure parameters far exceed the possible exposure (dose) that would be received by amphibians in a real environmental applications by the District that are far below these concentrations. An example of mesocosm studies, the report "The Lethal Impact of Roundup on Aquatic and Terrestrial Amphibians" by Rick A. Relyea published in Ecological Applications, 15(4), 2005, pp. 1118–1124, provides "more realistic" exposures, but the potential effects to CRLF suggested by this author are neither appropriate to the CRLF habitats nor to the spatial and temporal exposures that would occur in the environment. The exposures used were based on direct overspray of the mesocosm units, which is completely unrealistic if the author intends to extrapolate the results to reasonably foreseeable field exposures. The applications used in the Relyea report resulted in considerably more potential exposure to the test species than would be expected with typical District applications. The direct overspray of the mesocosm is in sharp contrast to the targeted, hand applications that are typical of the more focused and directed herbicide applications utilized by the District than the broad area applications used in agricultural operations.

In response to the concerns about the potential impact of glyphosate and its product formulations on the CRLF, the USEPA developed a comprehensive risk assessment for all of the potential application scenarios that might encounter the CRLF or its habitat. Using the most conservative (high) applications and several typical (more realistic) application scenarios, the USEPA has reported that glyphosate "may affect" the CRLF if they are exposed at very high concentrations of glyphosate (and also its formulation ingredients, including surfactants). This determination is based on computer models that use assumptions of application rates from the highest known (generally industrial and some urban uses) to the rates likely more appropriate for District uses. The risk assessment produced by the USEPA was published in "Risks of Glyphosate Use to Federally Threatened California Red-legged Frog (*Rana aurora draytonii*)" in 2008. In this 180-page exercise, the potential effects of glyphosate were modeled and risk estimates generated for almost every conceivable exposure to the CRLF and its prey items and habitats. The results of this comprehensive computer study suggest that at high rates of application (well above the rates used by the District) some adverse impacts may be possible, but the overall conclusions about the potential risks suggest that the nominal rates used by the District are likely to result in minimal to no effects. For example, some of the conclusions provided in the report by the USEPA include the following:

> **Direct Effects:** When used for habitat modification (vegetation control) the acute and chronic Level of Concern (LOC) for freshwater invertebrates are not exceeded for glyphosate, its salts or formulations. In addition, the analysis indicates that the probability of an individual effect and the percentage effect to the freshwater invertebrate population prey base would be very low.

> **Indirect Effects:** The acute and chronic LOCs for freshwater invertebrates are not exceeded for glyphosate, its salts or formulations. In addition, the analysis indicates that the probability of an individual effect and the percentage effect to the freshwater invertebrate population prey base would be very low, and the field monitoring data available are considerably lower than the modeled concentrations utilized in the risk assessment.

> **Terrestrial prey items, riparian habitat:** For terrestrial invertebrates, the upper bound Risk Quotients (RQs) for small insects exceed the LOC for listed terrestrial invertebrates for all uses and for nonlisted terrestrial invertebrates at very high (much higher than used by the District) application rates above about 8 lbs active ingredient (a.i.)/Acre. In other words, the guidance and risk estimates are based on estimates of worst-case exposures that are well beyond the applications used by the District. However, at the lower upper bound USEPA derived RQ (<0.01 with 0.4 lbs a.i./Acre), the chance of an individual effect is less than 1 in 9×10^{18} (eighteen zeros) and about a chance of less than 1×10^{-17} (that is seventeen zeros) percentage effect to the terrestrial invertebrate prey base. These calculations by the USEPA support the contention that chances for an adverse impact are nearly zero.

> **All other uses** at application rates below about 4 lbs a.i./Acre have no effect designation: (according to the USEPA risk assessment, this applies to all crops, forestry and impervious surfaces at lower rates, rangeland, residential, rights of way at lower rates and turf).

All chemicals can cause adverse effects or even become toxic at levels exceeding the tolerance and sensitivity levels for that species. However, the sensitivity and tolerance levels are determined by the USEPA and other regulatory agencies using laboratory tests with numerous species of concern that are estimated to be potentially exposed to an application. The results of these tests on each chemical are published in numerous publically available USEPA documents summarizing the testing results with metrics such as the LD_{50}, LC_{50} and maximum estimated tolerance levels. For glyphosate, these metrics are indicated in detail in Appendix B (Section 4.6.2) of the PEIR and support the fact that District use levels are far below those that could result in an adverse impact.

While the referenced USEPA risk assessment for glyphosate provides some valuable information about the potential for adverse effects to CRLF, the conclusions include identification of the numerous areas where there are uncertainties (and the risk assessment uses large uncertainty or safety factors). However, it clearly indicates that the use of glyphosate and its formulations should be considered relatively safe to the CRLF if care is taken in the selection of areas for application, use of the recommended application rates, and prudent prior assessment of areas that may contain CRLF or its habitat.

Response 18

The comment maintains that while vector control programs are exempt from the injunction, this is a separate issue from whether the Program is likely to have a significant impact on CRLF. Specifically, for applications of a pesticide for purposes of public health vector control under a program administered by a public entity, the injunction does not apply.

The injunction is part of the regulatory setting for the aquatic and terrestrial biology chapters of the PEIR. It should be included in the environmental setting because it shows that use of the chemicals of concern to CRLF may be reduced, which is important in addressing cumulative impacts. Some previous users of these materials may switch to other nonlisted pesticides rather than comply with the no-use buffer zones established under the injunction. For those other users that do comply, the buffer zone is an effective measure for minimizing the effect of the active ingredients on CRLF. The presence of the injunction does not require a determination of significant impact because the vector control applications must be considered in the context of their use. The listed pesticides do not include permethrin; esfenvalerate and methoprene are the only listed materials included in the District's IVMP. The text on page 4-42 has been corrected as indicated below.

> Of the 66 pesticides listed in the injunction, the District may employ esfenvalerate~~,~~ and methoprene, ~~and permethrin~~ for vector control. Esfenvalerate may be used for yellow-jacket and wasp control in response to public complaints. Methoprene is used for larval mosquito control ~~and permethrin is may be used for adult mosquito control~~. However, vector control programs are exempt. Specifically, for applications of a pesticide for purposes of public health vector control under a program administered by a public entity, the injunction does not apply. The District may use the following herbicides listed in the injunction: glyphosate, imazapyr, and triclopyr. Where used for vegetation management for control of mosquito-breeding habitat, the injunction would not apply.

Esfenvalerate is a Type 2 pyrethroid that would be used by the District only for yellow jacket wasp and ticks primarily in recreation areas. Because these applications do not occur in areas where CRLF may be significantly exposed, esfenvalerate use under the Program would not pose a risk to CRLF or other amphibians. More information about esfenvalerate is included in Appendix B, Section 4.1.6. Methoprene is a mosquito larvicide/insect growth regulator discussed in detail in Appendix B, Section 4.3.4 and in the PEIR Section 6.2.7.1.2 that is widely used by the District for mosquito control but used at rates that do not present a significant toxicity risk to aquatic species, including amphibians. See also Response 14.

Response 19

The commenter is concerned about pesticide runoff from vector control applications, through storm drains or otherwise, resulting in significant toxicity to CRLF. To reduce potential pesticide contributions to urban and/or industrial drains and collector ponds/catch basins from vector control applications, the District follows an integrated pest management (IPM) approach that strives to minimize the use of pesticides and their impact on the environment while protecting public health. Storm drains become a mosquito-breeding problem when water is trapped and stagnates, not during the rainy season when the drains are flushed frequently. Also see the portions of Response 11 and Response 16 addressing storm drain management.

As discussed in Section 2.3 of the PEIR, the District employs IPM principles by first determining the species and abundance of mosquitoes/vectors through evaluation of public service requests and field surveys of immature and adult mosquito/vector populations and, then, if the populations exceed predetermined criteria, using the most efficient, effective, and environmentally sensitive means of control. For all mosquito species, public education is an important control strategy for minimizing or avoiding mosquito-breeding conditions on private property. In some situations, water management or other physical control activities can be instituted to reduce mosquito-breeding sites. In some cases, the District can also use biological control such as the planting of mosquitofish in ornamental fish ponds, water troughs, water gardens, fountains, and unused swimming pools. When these nonchemical approaches are not effective, or are otherwise deemed inappropriate, then pesticides are used to treat specific vector-producing or vector-harboring areas.

When pesticides are applied, the District implements label requirements and BMPs to reduce adverse effects to surface-water and groundwater resources during and following pesticide applications. For example, some pesticide labels restrict applications within 24 hours following rain events or in areas where intense or sustained rainfall is forecasted to occur within 24 hours following application. In such cases, the District would not apply pesticides until weather conditions are appropriate. Adulticides are never applied when it is raining because the mosquitoes are not as active and the droplets do not stay suspended, limiting the effectiveness of the product. The adulticide is not applied directly to the water but in micron sized droplets above the water's surface, which minimizes the amount of active ingredient that actually reaches the water surface. See Draft PEIR Section 9.2.7.2 on this issue of adulticides and water quality. For the larvicide methoprene, which may be applied in liquid or granular forms directly to wetlands or aerially (from the ground) to reach larvae in the water, see Section 9.2.7.1.2 of the Draft PEIR.

The mobility and environmental fate of a particular pesticide is influenced by its chemical properties and by the environmental conditions in which it is applied, and these factors influence potential exposure in the field to nontarget organisms. The PEIR's Appendix B, Ecological and Human Health Assessment Report, provides a detailed description of the fate and transport in air, water, and soil for each of the active ingredients in products applied by the District (as well as some others not used by the District). Many second- and third-generation insecticides are formulated to act quickly and then dissipate quickly in the environment, often within hours or days. Others bind to soils and sediments where they are degraded abiotically or by soil organisms. These effects, the application methods used for vector control, and the potential for mobilization after pesticide application, are considered in the discussion of the Vegetation Management and Chemical Control Alternatives, which conclude that all of the active ingredients included in the Proposed Program would not significantly impact surface water or groundwater (see Sections 9.2.5 and 9.2.7 of the PEIR), or aquatic species (Sections 4.2.5 and 4.2.7 of the PEIR). For each of the pesticides used by the District there is minimal movement of pesticides in sediments or soils into water bodies due to the binding and half-life characteristics of the chemical used.

Response 20

Please refer to Response 22 below.

Response 21

The persistence of glyphosate is dependent on the physical/chemical conditions of the soils and vegetation treated, and the impact of the chemical on the rhizomes and the plant root system is not continual or at levels of contact that would result in the suggested toxicity to the root system. The paper by McNear 2013 is a good introductory compendium of the role and structure of typical root systems, but has no clear relation to the potential toxicity of chemicals such as glyphosate after an application to the surface soils and/or vegetation. The results of studies on the root systems exposed after glyphosate application suggest that the complexity of a root system may possibly be impacted by direct exposure (Barberis et al. 2013), but this is neither a typical nor likely exposure based on the District's potential uses of glyphosate products because the District would be directly applying the material to the above ground foliage. The applications target the unwanted vegetation, not indiscriminate application. It would be the exception that the District would be involved in a large scale application (e.g., dozens of acres). If the District were to be involved in an herbicide application, it would most likely be small scale and using hand equipment, truck or ATV based equipment. Regardless of this potential toxicity, there is no clear, direct association to toxicity to the root systems when glyphosate is applied for vector management according to District uses. Direct exposures in laboratory studies do not provide realistic exposures when a chemical is applied in the field (Williams et al. 1994).

For decades, scientists have demonstrated and validated that every organic chemical has a physical/chemical degradation characteristic termed "half-life" (a metric used to describe the elapsed time for a chemical to reach ½ of its initial activity). Each organic chemical, whether toxic or not, decays in both activity and toxicity over time. For some chemicals, the half-life can be hours, days, or weeks. By design, few chemicals used as pesticides[1] have half-lives greater than a week and are further degraded by the environmental conditions of the application area. When pesticides get into soil, or water, or are taken up by plants and animals, the half-life characteristics are altered. The environmental fate of pesticides depends on the physical and chemical properties of the pesticide, particularly the pH of the medium, modifying how likely it is to travel through soil (soil mobility), how well it dissolves in water (water solubility), and how likely it is to become airborne (volatility).

Once a pesticide has been released into the environment, it can be broken down by exposure to sunlight, (photolysis), exposure to water (hydrolysis), exposure to other chemicals (oxidation and reduction), microbial activity (bacteria, fungi, and other microorganisms), and other plants or animals (metabolism). Pesticide labels set out safety and use guidelines that usually focus on three aspects: rates of application (single and cumulative) for registered crops and pests, timing of application, and restrictions on areas of application (including required buffer zones).

The environmental fate of pesticides used by the District are influenced by their chemical properties and by the environmental conditions in which they are applied. The PEIR's Appendix B, Ecological and Human Health Assessment Report, provides a detailed description of the fate and transport in air, water, and soil for each of the active ingredients applied by the District (and other active ingredients as well). A summary of the potential uses of glyphosate products by the District is included in Appendix B Table 6-1 and the narrative in section 4.6.2 of Appendix B. Many second-and third-generation pesticides are formulated to act quickly and then dissipate quickly in the environment, often through photolysis or microbial breakdown. Others bind to soils and sediments where they are degraded abiotically or by soil organisms. These effects, the potential for mobilization after pesticide application and the methods used to minimize exposures to unwanted receptors, are considered in the discussion of the Vegetation Management and Chemical Control Alternatives (see Sections 9.2.5 and 9.2.7 of the PEIR).

There are numerous herbicide products (such as Roundup) using the active ingredient glyphosate as its primary constituent, but many of these products use inert and/or chemically different additives to enhance the spray characteristics, adhesion properties, and efficacy. Many of those products have been specially tested for toxicity and registered with the USEPA for specific vector control purposes, including vegetation control (National Park Service 2008). Although some of these mixture products have been associated with increased toxicity, numerous studies have demonstrated that the increase in toxicity may be due to a surfactant additive. In most instances, these special formulations of pesticide products are intended to reduce the potential for adverse effects or to specifically be used for aquatic environments (e.g., Accord, which has been shown to be safer to aquatic wildlife (Brodman et al. 2010)).

Many reports suggest that exposure to glyphosate may be toxic at sub-lethal levels, negatively impacting the basic physiological systems of animals in several trophic levels. However, most studies directed specifically at these systems have resulted in unequivocal results without clear causal effects. In one study on the effects of several (six) concentrations of glyphosate on growth rate and aflatoxin B1 (AFB1) production by Aspergillus section Flavi strains under different water activity (aW) on maize-based medium. In general, the authors report that at high concentrations glyphosate significantly increased the growth of all Aspergillus section Flavi strains. Aflatoxin B1 production did not show noticeable differences

[1] The term "pesticides" includes herbicides used for destroying weeds and other unwanted vegetation.

among different pesticide concentrations assayed at all aW in both strains. This study has shown that these Aspergillus flavus and A. parasiticus strains are able to grow effectively and produce aflatoxins in high nutrient status media even at a large range of glyphosate concentrations under different water activity conditions thereby indicating no negative effect. (Barber's et al. 2013)

Glyphosate has been shown to have a half-life of a few days in some conditions to longer in some soils. The generally accepted, conservative, half-life for soils is reported to be approximately a month to 42 days, depending on the soil type, pH, and other characteristics of the soils. Vegetation residues of glyphosate have been measured in numerous studies, and it is typical that the measurable residue of glyphosate in target vegetation diminishes rapidly after incorporation into the plant tissue (Zhang et al. 2015). Glyphosate changes from the primary chemical to the lessor resulting product chemicals. The half-life denotes the time for the parent compound to decrease in detectable concentration by ½ the application concentration essentially halving the exposure concentration available. When applied to typical areas targeted for vegetation management, glyphosate is transformed to less toxic and different chemical constituents in normal soil within a few days, or even quicker when used for most general uses such as those by the District. It can be rapidly bound to soil particles and inactivated, and the unbound glyphosate can be degraded by bacteria.

Response 22

Comment 22 asserts the Draft PEIR of "downplays glyphosate's risks to human health." The PEIR preparers (including Dr. Williams) evaluated numerous studies on glyphosate, the World Health Organization (WHO) report, and scientific reviews of the WHO report in determining that potential use by the District poses a less-than-significant impact on human health. The WHO report is the result of a "panel discussion" (IARC) about the potential for selected chemicals and products that have achieved some level of public interest and concern but may or may not be supported by the data and information available. The panel is comprised of several European scientists and government organizations reporting to the WHO (a scientifically conservative advocacy agency) sponsored by the UN. This group is known to generally follow the "precautionary principle" that is used by some members of the public to argue against chemical use. The precautionary principle is a concept generally rejected by the scientific community that demands that unless one can prove there is or can be no adverse impacts of a substance, the substance should be considered hazardous (Precautionary Principle objective). To those with scientific training, this suggests that one must "prove a negative" which is essentially impossible in any statistical sense of a defensible scientific process.

The IARC has been criticized by dozens of technical experts who evaluated the process used by the panel to list glyphosate as a probable carcinogen. It has been demonstrated that IARC rejected the 800 studies / 3,000 documents that gave glyphosate a positive safety result, basing their decision of "probably carcinogenic" on only eight studies, of which three actually included results that were themselves arguably insignificant. After the WHO publication listing glyphosate as a probable carcinogen, dozens of practicing scientists in the mainstream scientific community (including European Food Safety Administration, the German Federal Institute for Risk Assessment (BfR) and the lead author of one of the studies used by IARC to draw its conclusions) have criticized and disputed the results of the IARC for using a poor methodology and inadequate research. The conclusions drawn by the IARC about the potential adverse effects of glyphosate were based on studies that are not relevant to actual, potential exposures and on studies that were based on high exposures to petri dish cells and in vitro laboratory conditions. Once again, the precautionary principle requires "proof of a negative" which requires that the studies disprove any possible negative effect in order to accept the results of a study.

In most of its reported reviews, the UN IARC has advocated the precautionary principle (WHO 2015). Subsequent to the declaration regarding glyphosate, this panel stated that bacon and other animal products are "possibly carcinogenic;" again, the declaration was challenged by several scientists who reiterated that there was no credible research that was clear enough to make such a claim (WHO 2015; Mink et al. 2012).

Glyphosate exposure was not associated with cancer incidence overall or with most of the cancer subtypes studied by de Roos et al. (2005). Given the widespread use of glyphosate, and the paucity of information providing significant and relevant causality amid the nonscientific claims that glyphosate exhibits numerous low-level or sub-lethal adverse effects (Seneff nd), Dr. Williams concluded that there have been no demonstrated significant adverse health effects (even in pesticide applicators). The studies reporting potential human health effects are associated with extreme exposures to applicators during misuse scenarios and spills and/or working in the preparation of the commercial products (Mink et al. 2012). These conditions and potential exposure conditions are neither typical nor likely in the use and applications by trained District staff. All application directions include detailed procedures to deal with a spill. Glyphosate remains a reliable and safe product for use in the numerous situations where control of vegetation is needed for habitat management (for vector control or for invasive species control). Importantly, it has been demonstrated that herbicides are a different class of chemicals than those classified as insecticides that have specific, demonstrated autonomic effects. The media reports about the hazards of glyphosate and its several commercial products have not been clearly associated with human health. The numerous reports about “possible” connections to metabolic processes and subtle effects also include confounding factors that make scientifically defensible claims impossible. Where there are reports of adverse subtle effects, they are usually based on laboratory studies of cell lines etc., at exposures far above any possible actual human exposure.

USEPA continually reviews the available scientific data and other relevant information in support of the registration of glyphosate (i.e., commercial product Roundup for weed control) and has indicated that there are sufficient data to assess the hazards of and to make a determination on aggregate exposure for glyphosate including exposure resulting from the tolerances established by continued USEPA evaluations. USEPA’s assessment of exposures and risks associated with glyphosate are clearly indicated in the numerous studies used to develop the guidance for use. Using these data, the EPA has set maximum safe exposure levels for both humans and animals (tolerances) of pesticide residues for crops based on the huge number of scientific studies and complex risk assessment approaches provided in support of the active ingredient in the products. These tolerances are hundreds of times higher than estimated toxic values using total exposure values to pesticides (including safety levels to protect children and others who may be vulnerable). The USDA tests crops each year to make sure tolerance levels are not exceeded. Very few pesticides are found above the tolerance levels (despite some unsubstantiated media reports). The exposures that were used in the WHO evaluation and studies were not reasonable examples of the exposures that might be encountered by humans, including those who might be potentially exposed as a result of the District’s use of glyphosate under the Program. US Environmental Protection Agency (USEPA) 1993 and National Pesticide Information Center, Oregon State University 2011. There are occasionally media reports of studies linking glyphosate to cancers of various types, but these are generally results from cultured cells in the laboratory. Extrapolation of these very high dose laboratory studies to animals and humans are not reliable indicators of potential adverse effects outside a controlled laboratory study.

Response 23

This comment suggests that chemicals, including those that bind to soils and exhibit subsequent mobilization and those that run off from urban storm drains and gutters after vector control applications, and would cause TMDL exceedances for some Pesticide-Related Toxicity in Urban Creeks.

The Basin Plan (SFBRWQCB 2015) establishes a water quality attainment strategy and TMDL for some pesticides and pesticide-related toxicity in the San Francisco Bay Region’s urban creeks, including actions and monitoring necessary to implement the strategy. The TMDL notes that pesticides “enter urban creeks through urban runoff. Most urban runoff flows through storm drains owned and operated by the

Region's municipalities, industrial dischargers, large institutions (e.g., campuses), construction dischargers, and the California Department of Transportation (Caltrans)." The TMDL further notes that "pesticide use by structural pest control professionals and use of products sold over the-counter can be among the greatest contributors of pesticides in urban runoff." Rather than establish mass loads for pesticide contributions, the TMDL establishes concentration-based numeric targets, expressed in concentration units, and states that "the numeric targets, allocations, and implementation plan described [in the TMDL] are intended to ensure that urban creeks meet applicable water quality standards established to protect and support beneficial uses." The TMDL's pesticide toxicity targets are expressed in terms of acute toxic units (TUa) and chronic toxic units (TUc) and require demonstration of a statistically significant observable effect. An undiluted ambient water or sediment sample that does not exhibit an acute or chronic toxic effect that is significantly different from control samples on a statistical basis shall be assumed to meet the relevant target. The TMDL implementation plan relies heavily on actions by the agencies with the broadest authorities to oversee pesticide use and pesticide discharges, including USEPA, the California Department of Pesticide Regulation, and the Water Board as well as adherence to integrated pest management (IPM) strategies. The TMDL notes that "regulatory and nonregulatory actions are needed to ensure that pesticide use does not result in discharges that cause or contribute to toxicity in urban creeks. Implementing these actions is expected to ensure attainment of the allocations. Many entities are already implementing these actions." The actions identified in the TMDL focus primarily on addressing water quality concerns through the pesticide registration process (through which label requirements are developed), and reducing the use of pesticides, including the potential for urban runoff to enter creeks, through integrated pest management. In particular, to prevent pesticide-related toxicity in urban creeks the TMDL states that mosquito and vector control agencies should "adopt IPM and less toxic pest control techniques so pesticide applications do not contribute to pesticide runoff and toxicity in urban creeks."

The District's Program is based on the principles of IPM and prioritizes nonchemical control over pesticide use. Furthermore, all District applications of chemicals are done in strict compliance with label requirements, BMPs (many of which have been developed in consultation with regulatory agencies) and applicable permit conditions (such as those contained in the Statewide NPDES Vector Control Permit (SWRCB 2011), by trained professionals. Thus, the District's existing and Proposed Programs implement the actions specified in the TMDL to ensure attainment of the TMDL's pesticide allocations. (Note that the District does not use pesticide products containing diazinon.) The District has, for at least the past two decades, taken an integrated systems approach to mosquito and vector control, utilizing a suite of tools that consists of public education, surveillance, source reduction (e.g., physical control, vegetation management, water management), biological controls, and chemical controls. As stated in PEIR Section 2.3, three core tenets are essential to the success of a sound Integrated Vector Management Program (IVMP).

- **First**, a proactive approach is necessary to minimize impacts and maximize successful vector management. Elements such as thorough surveillance and a strong public education program make all the difference in reducing potential human vector interactions.
- **Second**, long-term environmentally based solutions (e.g., water management, reduction of harborage and food resources, exclusion, and enhancement of predators and parasites) are optimal as they reduce the potential pesticide load in the environment as well as other potential long- and short-term impacts.
- **Lastly**, utilizing the full array of options and tools (public education, surveillance, physical control, biological control, and when necessary chemical control) in an informed and coordinated approach supports the overall goal of an environmentally sensitive vector management program.

To reduce potential pesticide contributions to urban and/or industrial drains and collector ponds/catch basins from vector control applications, the District follows the IPM approach and strives to minimize the use of pesticides and their impact on the environment while protecting public health. As stated in Response 19 above, unless specific vector control is required, based on surveillance results, to reduce adult mosquito populations, District applications of adulticides are not directed to urban storm drain systems. However, larvicides, per the product labels, may be applied to urban storm drains systems to control larval mosquitoes. Chemicals introduced to urban storm drains from runoff are usually the result of city, homeowner, or landscaper discharges within or near populated areas. In addition, buffers may be used between pesticide and herbicide use areas to address the potential migration of a pesticide and waterbodies. The product label may include specific, region or state specific buffers where they are required. The District adheres to all label requirements for its specific uses.

Further support, for the PEIR conclusions of less-than-significant impacts to water quality from adulticides and larvicides applied by the District, is provided in a 2-year monitoring study conducted for the State Water Resources Control Board by the Mosquito and Vector Control Association of California (MVCAC) monitoring coalition to determine whether vector control activities were contributing contaminants to state waters. The MVCAC monitoring coalition conducted chemical monitoring for adulticides at 61 locations during 19 application events in 2011 to 2012 and coordinated physical monitoring for 136 larvicide application events in 2012. Samples were collected from agricultural, urban, and wetland environmental settings in both northern and southern California. Adulticides evaluated included pyrethrin, permethrin, sumithrin, prallethrin, etofenprox, naled, malathion, and the synergist piperonyl butoxide. The monitoring study (MVCAC 2013) was conducted in accordance with the Statewide NPDES Vector Control Permit (SWRCB 2011) and had the following results:

- 1 out of 136 visual observations showed a difference between background and post-event samples;
- 108 physical monitoring samples showed no difference between background and post-event samples; and
- 6 out of 112 samples exceeded the receiving water monitoring limitation or triggers.

The report concluded that there was no significant impact to beneficial uses of receiving waters due to application of vector control pesticides in accordance with approved application rates. This is consistent with the primary mandate for vector control districts of protecting public health by reducing vector-borne diseases from mosquitoes and other vectors.

The State Water Resources Control Board evaluated the results of this study (MVCAC 2013) and a concurrent toxicity study conducted by researchers from UC Davis (Philips et al. 2013) and concluded that, based on the monitoring data, the application of pesticides in accordance with approved application rates does not impact beneficial uses of receiving waters (SWRCB 2014). Therefore, the monitoring and reporting program for the Vector Control Permit was amended in March 2014 to limit the required monitoring to visual observations, monitoring and reporting of pesticide application rates, and reporting of noncompliant applications.

Concerning pesticide quantities, the District monitors its pesticide application rates, records this information on pesticide application logs, and reports its product use to the Marin and Sonoma County Agricultural Commissioners. The District also reports its pesticide use and application rates to the State Water Resources Control Board. The PEIR reports on pesticide use quantities in Chapter 13 (Table 13-2) based on these submittals and in Appendix B, Attachment A.

Concerning concentration, BMP H3 states: “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.”

Response 24

This air quality comment questions the mitigation measures as being voluntary and not mandatory. The language excerpt is not quite accurate. This response will clarify the PEIR language and make appropriate text changes to page 10-32 and elsewhere.

First of all, the objectionable odors impact statement characterizes the impact as **potentially significant but mitigable**, while the comment incorrectly quotes the statement as just being *potentially significant*. This significance determination terminology is explained in Section 1.7 (page 1-21).

Second, the comment mischaracterizes the mitigation requirements established in the PEIR. On page 10-32, the PEIR states: "To mitigate Impact AQ-25, the District and its contractors may implement any of the following measures as applicable to the specific application situation to reduce drift towards human populations/residences from the ground and aerial application of odorous treatment compounds." This statement is followed by a description of Mitigation Measures AQ-25a, AQ-25b, and AQ-25c and the conclusion that "Use of any one of these measures would reduce the impact to **less than significant**." Therefore, implementing all of these mitigation measures is not mandatory, nor are they all required in a specific application situation in order to reduce the significant impact associated with objectionable odors to less than significant. Implementing any one of the measures would, however, be mandatory. There are 3 options to allow for what is most prudent to use for the specific application. The use of the phrase "may implement" refers to the ability of the District to choose the appropriate measure; it was not meant to imply that the District may choose to implement none of the measures, just any one of the measures is sufficient as a minimum. To be clear on the point, the words "may implement" and "any of" will be changed to "shall implement one or more of the following measures as applicable" to avoid the implication that the measures are all voluntary. At least one of the measures is required. The following text change on page 10-32 will be carried into Section 10.2.11 (page 10-41) and Summary Table S-2 (page S-15).

> "To mitigate Impact AQ-25, the District and its contractors ~~may~~ shall implement ~~any~~ one or more of the following measures as applicable to the specific application situation to reduce drift towards human populations/residences from the ground and aerial application of odorous treatment compounds:"

The mitigation measures are not vague or voluntary, nor are they unenforceable. Each measure includes a description of the procedures to be followed in order to minimize the potential for drift into populated areas, location where the mitigation measure would be implemented, monitoring/reporting action to ensure the measure is implemented appropriately, criteria to assess the effectiveness of the mitigation measure, agency responsible for implementing the measure, and timing of its implementation. Thus, sufficient detail is provided to ensure that the mitigation is applied in the appropriate location at the appropriate time and by the appropriate entity; and measures also are included to document the effectiveness of the mitigation. By providing defined measures to limit the time, location, method and drift of chemical applications, the mitigation is sufficient to support the PEIR's determination that the Program's use of chemicals, as mitigated, would not create objectionable odors affecting a substantial number of people.

The commenter suggests that the "DPEIR could also require notification to residences"; however, this would not specifically mitigate the impact. District staff are available to address complaints by the public, and the effectiveness criteria for each of the measures include "Document odor complaints from the public." The public calls the District to complain about mosquitoes, so if there were an odor problem at the time a District truck was in the area, then based on the District's experience, concerned residents would be likely to call the District if there was an odor problem not easily identified as a sewer, gas leak, or farm-related odor. The mitigation measures are therefore written appropriately, and no modifications are required.

Response 25

The comment asserts that the "conflation of BMPs and mitigation measures makes it impossible … to understand the severity of the Program's cumulative impacts and subsequently, the potential for and effectiveness of any mitigation measures."

Please refer to Response 3 above. In short, the BMPs are an integral part of the District's current Program, are to be continued into the future, and are properly treated as part of the Proposed Program being evaluated in the PEIR. To not consider them means the PEIR would overstate the impacts and be inappropriately speculative because there is no evidence that the District wants to abandon these procedures or that the responsible agencies who grant the District permits would want the District to abandon these practices in future permits, although some may be modified to respond to changing conditions. The cumulative impact analysis provided in the Draft PEIR is a thoughtful analysis of regional environmental concerns and whether any of the Proposed Program's less-than-significant impacts are cumulatively significant in the larger area context appropriate for a programmatic EIR.

Response 26

The comment that the discussion of cumulative impacts on pollinators is flawed because it contains "factually incorrect information on Colony Collapse Disorder (CCD)" is addressed first in the response below, followed by a discussion of the larger comment on coverage of pollinator impacts.

As an initial matter, the comment does not identify any specific factual assertions that it claims are incorrect, thus a specific response to the argument that the PEIR contains factually incorrect information on CCD cannot be provided. Although the District does not use neonicotinoid products, a discussion of the potential contribution of these products to cumulative impacts on pollinators, including possible CCD, was included in the PEIR because it is relevant to their potential role in a cumulative impact. CCD and the possible role of neonicotinoids in such a phenomenon, is a matter of public concern due to exaggerated and inaccurate representations in the media based on scientifically unconfirmed reports of CCD in Europe and the US (Hopwood et al. 2012; Arnason 2015). Much of the extrapolation to CCD for bees has been based on reports about the toxicity to bees of the neonicotinoid pesticides derived in laboratory "swab" tests in which the chemical is applied directly to the body of the bee at concentrations well above expected concentrations after vector control (Bradbury 2013). The label for the neonicotinoid pesticides does, in fact, suggest that all neonicotinoid pesticide products state: "Do not apply this product while bees are foraging. Do not apply this product until flowering is complete and all petals have fallen" as a requirement for the use of these pesticides in regions that contain active bee activity, both agricultural and associated urban hives. These label mandates have been developed to minimize the potential for bee exposures and have been on the labels since 2013 (Bradbury 2013).

USEPA recognizes the value of the neonicotinoid pesticides for agriculture and indicates that care must be taken when using these products. However, it is also clear that the reports in the media of "bee colony collapse syndrome" have not been tied solely to the use of these products (USEPA 2016). Rather, most of the reports of bee colony collapse syndrome have been exaggerated and/or inappropriately connected to pesticide use without considering the effects of loss of habitat, loss of flowering plants and trees due to development, mite infections, viruses, stress due to movement of the colony for agricultural pollination at different locations, and predators to the colony. Identification of the confounding factors associated with the CCD phenomenon has resulted in more care given to reduce the stresses and/or habitat losses that directly adversely impact bee survival and bee colony status. In contrast to some of the nonscientific and personal reports of possible bee deaths and CCD in the press and other media in Canada (Thomson and Ahluwalia 2015) and the US (Brown 2014; UC Master Gardener Program of Sonoma County 2016), according to information from apiary publications, reported cases of CCD have declined substantially in Canada over the last several years (MAAREC 2016). The number of hives that do not survive over the winter months – the overall indicator for bee health – has maintained an average of about 28.7 percent since 2006-2007, but dropped to 23.1 percent for the 2014–2015 winter. While winter losses remain somewhat high, the number of those losses attributed to CCD has dropped from roughly 60 percent of total hives lost in 2008 to 31.1 percent in 2013; and initial reports for 2014-2015 losses also appear to be on the decline.

On a broader scale, the existence or extent of a cumulative impact to pollinators by pesticides in general is unclear. A USEPA report, developed in conjunction with Environment Canada and California Department of Pesticide Regulation (*White Paper*: *In Support of the Proposed Risk Assessment Process* *for Bees*, USEPA et al. 2012), found that a definitive linkage of reported bee deaths primarily to pesticides cannot be established. Among the numerous conclusions and recommendations in the White Paper is a statement addressing this complexity:

> There are several challenges that exist when integrating the various exposure and effects data that can be used to assess potential effects of pesticides on honey bees and their colonies. For instance, different bees are expected to be exposed to pesticides at different magnitudes, depending upon their function in the colony. In addition, interpreting the impacts of mortality and sublethal effects on the ultimate survival of the colony is complicated by a lack of definitive understanding of the linkages between many of these endpoints.

A follow on review and critique of the White Paper by a select panel of scientists, both internal to the regulatory agencies and outside (representing universities, other federal agencies and commercial agricultural product companies), emphasized and validated the many questions associated with the linkage of specific pesticide exposure and the other confounding factors in the White Paper.

While pesticide toxicity to bees has been demonstrated and summarized by the USEPA, the toxicity data used in USEPA guidance is generated using bees in the laboratory. This test is conducted by using a pesticide-saturated cotton swab, applied firmly against the thorax, resulting in a contact exposure far greater than would be achieved in actual field conditions (USEPA 2012b; Fishel 2005). In contrast to this purposeful and artificially exaggerated laboratory contact exposure, the toxicity values reported in USEPA guidance are not typical of the more likely casual contact with any pesticide used in District vector control applications, which both due to the levels applied and compliance with BMPs designed to avoid or minimize exposure to pollinators, do not approach these potential exposure levels.

Seasonal impacts on bees and their colonies are common and typical for most areas in North America, where bees are raised commercially or as a hobby (MAAREC 2016). Further complicating the understanding of potential pesticide impacts to bees and other pollinators is the widespread urban use of many of these pesticides by homeowners, gardeners, and others who commonly use these chemicals. Urban use of insecticides can be a large percentage of total use nationally (Aspelin 2003). However, by following the practices that reduce potential exposure as indicated in the label guidelines and USEPA regulatory guidance, safe applications of pesticides can be practiced without substantial adverse effects to bee colonies.

As noted, the District does not use neonicotinoid products; thus, to the extent CCD is an actual impact caused by neonicotinoids, the District's Program does not contribute to this impact. For the products used or potentially used by the District, the District BMPs reflect an understanding of and adherence to guidance designed to minimize effects on bees and include additional recommendations limiting pesticide use only within the wind speed parameters on the product labels conditions. The guidance and the BMP approach is tailored to minimize the potential for direct bee exposure to any of the pesticides used for vector control by the District. Furthermore, the District uses the following BMP H12 for pesticide applications that is contained in Table 2-6 in Section 2.9:

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

As with all pesticides, the USEPA provides label guidance and mandates that have been developed to minimize the potential for exposure, and the labels are based on extensive laboratory and field tests of toxicity to bees that have been directly exposed to these chemicals to determine the worst case scenarios if the bees become directly coated with the pesticide (spraying) and if they are in direct, extended contact with contaminated vegetation. The mandated label restrictions are based on the following supporting information used to minimize the potential for direct exposure (USEPA 2012c):

USEPA (2012c) registration includes the following*:*

- Minimize exposure of this product to bees and other insect pollinators when they are foraging on pollinator attractive plants around the application site.
- Minimize drift of this product on to beehives or to off-site pollinator attractive habitat. Drift of this product onto beehives or off-site to pollinator attractive habitat can result in bee kills. Utilize Best Management Practices that reduce the likelihood of exposure, including application restrictions during potential drift conditions, proximity to known colonies and other information about the status and activity of the bees in the area of proposed applications.

Research reported for bees is also relevant to other pollinators. One way to consider the larger issue of impacts to pollinators (i.e., butterflies and moths in addition to bees) aside from CCD and pesticide use is to consider recent information from bee-keeper journals from Canada that honey production has improved. While agricultural and urban use of pesticides in Canada is similar to that of the US (Agriculture and Agri-Food Canada 2013, Crop Protection Survey), the impact on bees and bee colonies appears to be minor. In Canada, *Statistics Canada* reported that beekeepers produced 95.3 million pounds of honey, up from 85.5 million last year and 76.5 million in 2013. Alberta produced most of the production gain as beekeepers increased production by 7.3 million lb, from 35.5 million in 2014 to 42.8 million in 2015. Beekeepers produced more honey because bee colony numbers jumped 3.6 percent compared to 2014. Prairie bee colonies in 2015 had winter losses averaged 11 percent in Manitoba, Saskatchewan, and Alberta, much lower than losses of 20 to 40 percent in previous years. National honey yields were also up. Beekeepers averaged 132 lb. per hive, a gain of nine lb. over 2014. Because other insect pollinators do not produce honey, there is no similar method for showing increases in these pollinators. However, this information from Canada suggests that pesticide use is not a substantial contributing factor to adverse effects on bees and bee colonies.

Many reports of adverse effects of pesticides to Monarch butterflies and some moths have been provided in the press, with a link to the indirect effect of glyphosate on reduction of the milkweed plant that serves as a food source and provides habitat during foraging and migration. Some of the issues associated with loss of bees and butterflies is outlined in a recent *Science* article (B. Keim 2014) in which the author addresses the loss of flowering plants and environmental changes as likely causes of the perception that these species are in decline. Although the author suggests that some reported declines in bees and butterflies may be due to pesticides, numerous other factors contribute to this impact and he indicates that it is difficult to actually quantify adverse effects. In fact, in addition to the impact of viruses, parasites, and natural stressors, he suggests that pesticide impacts may be eclipsed by habitat loss since pollinator habitat is disappearing nationwide. Most of the reports of pollinator declines ignore the numerous confounding factors that are in play and make unsubstantiated extrapolations to chemical effects regardless of the likely actual exposures.

There is an annual native bee count in Sonoma County that will provide valuable data to researchers at UC Berkeley, who are able to discern information about the health of an ecosystem from the diversity of the bee population. They plan to publish their results in the journal *Conservation Biology*. Preliminary information suggests that native bee species have declined in the last year, which researchers attributed to the drought that has parched the region for two straight summers. (Brown 2014)

Pollinator populations fluctuate over time and are affected by many different contributing factors. Therefore, it is not possible to definitively link use by District (at levels established by the USEPA and according to additional BMPs) to a long-term decline locally. Although the USEPA provides summaries of the data on potential adverse chemical impacts to bees using direct thoracic exposures in laboratory tests (USEPA 2012b), one current theory about bee deaths has been casually associated with the use of pesticides, including the neonicotinoid pesticides, which the District does not use. Even so, USEPA has stated that it recognizes the value of pesticides for agriculture and its use by homeowners for pest management, and indicates that care (as described previously) must be taken when using these products. However, it is also clear that the reports in the media of "bee colony collapse syndrome" have not been tied solely to the use of any specific pesticide, including any of the District products in use or proposed for use (USEPA 2016*).* BMPs and application label requirements address both bees and other insect pollinators, and are implemented to avoid substantial harm to these insects within the District's Service Area by District activities. Other factors such as drought may be affecting declines in pollinator populations. Measures on the pesticide labels along with additional BMPs ensure the District's activities, including use of chemicals, are not having a significant impact on insect pollinators, nor are they contributing considerably to a cumulative impact considerably to a cumulative impact on insect pollinators. All these reasons support the analysis and conclusion in the Draft PEIR Section 13.3.1, page 13-8, that the Program's less-than-significant impacts on insect pollinators related to mosquito and yellow jacket abatement activities would not be cumulatively considerable or significant.

Also see Responses 7 and 27.

Response 27

The comment argues that urbanization and urban limitations on beekeeping are not having a significant impact on pollinators in the Program Area, that this impact is overstated, therefore the District's contribution to cumulative impacts are understated.

It is important to note that a discussion of cumulative impacts is intended to address all of the components or confounding factors that could be involved. Cumulative impacts may occur when several less-than-significant impacts contribute to an impact that is significant as a result of the aggregation of the incremental impacts. Urbanization most often results in a reduction in agricultural land, and agricultural land provides foraging opportunities for pollinators, especially for crops where flowering precedes the production of fruit such as vineyards and orchards. Limitations on beekeeping in urban areas would further contribute to a decline in pollinator populations. The issue is not whether urbanization itself has a significant impact on pollinator populations but whether it has any impact, even a less-than-significant one that may be contributing to a cumulative impact. That beekeeping is allowed in some residential areas in addition to the more extensive beekeeping activities associated with agricultural uses is a part of the issue but it does not cause an understatement of the District's potential contribution to cumulative impacts to pollinators. The PEIR provides an overview of the beekeeping industry and defines the wider range of bee activity and the possible source of bee exposures beyond the areas where the District applies chemicals for vector control. Although there have been numerous media reports that bees and bee colonies are being adversely impacted by pesticides, the available data suggests that any reported reduction in bee numbers or bee colonies are highly exaggerated and likely focused on the wrong sources of stress and exposure. Where reductions in bee numbers have been reported, one of the claims is pesticide poisoning. However, there are numerous reports suggesting and supporting the likely relationship of adverse environmental factors, disease, parasites, and unusual predation, as probable causes of the reduction of numbers of bees.

The foraging range of bees in pursuit of nectar is fairly closely tied to the location of the hives, including the artificial hives used for collection and sale of honey. Although there is some indication that bees may forage as far as several miles from the hive, a practical maximum distance from the hive has been summarized for several reports (Traynor 2002 and several other reports), and is said to be a maximum of approximately 3 to 4 miles when nectar is not readily available closer to the hive. The PEIR addresses the larger issue of urban development and loss of agricultural lands that had beekeeping associated with them to promote the fertilization of the numerous crops that depend on bees for fertilization. Loss of some agricultural land is also loss of habitat for bees and other insect pollinators.

As discussed above, most of the reports of bee colony collapse syndrome have been exaggerated and/or inappropriately connected to pesticide use without considering the effects of loss of habitat, loss of flowering plants and trees due to urban development, mite infections, viruses, stress due to movement of the colony for agricultural pollination at different locations, and predators to the colony. Identification of the confounding factors associated with the CCD phenomenon has resulted in more care given to reduce the stresses and/or habitat losses that directly adversely impact bee survival and bee colony status. In many cases, loss of honey productivity is not actually associated with decreased bee activity or the loss of bee numbers or the Colony Collapse Disorder reported by the media. In fact, one of the current impacts of lower honey productivity can be attributed to theft of thousands of beehives and displacement of the appropriate hive locations.

For additional information on bee population decline and other pollinators, see Responses 26 and 28.

Response 28

Adverse impacts to other non-bee pollinators and food web predator populations have not been reported as a result of focused applications of vector control pesticides. In fact, pollinator populations fluctuate over time and are affected by many different contributing factors. It is not possible to definitively link use of vector control products by the District (at levels established by the USEPA and according to additional BMPs) to a long-term decline or one that would adversely impact the predator population of interest. It is well known in population biology that every population can adequately respond and recover to a loss of large percentages of individuals based on their intrinsic reproductive vigor. Populations with very short reproductive gestation periods (most insects and some small mammals) will recover much faster than populations with long reproductive cycles (large mammals and some birds). In fact, there are many theories about how many individuals in a population can be lost before the likelihood of significant impact or extinction may occur.

References to some of the predators of mosquitoes can be found dating back more than 100 years and help form the basis for much of the research that has occurred since (Beutenmuller 1890; Felt 1904; Howard 1901, 1910: Mitchell 1907; Smith 1904; Underwood 1903; Weeks 1890). These selected publications (provided as an example among dozens of others) have not established a defensible concept of adverse impacts from localized mosquito control to predators and other related populations. Other factors such as drought may be affecting declines in pollinator populations. District BMPs and application label requirements address both bees and other insect pollinators, and are implemented to avoid substantial harm to these insects within the District's Service Area by District activities. Because of the selective nature of the vector control products for mosquitoes, any claimed potential adverse impact to insect predators (as nontarget exposures) associated with District applications would be temporary and inconsequential in the impact to those populations of predator species. Even in the event of ancillary exposures, the recovery of such populations occurs rapidly to maintain the general level of individuals in their populations. The relative higher sensitivity of the target vs nontarget (less sensitive predator) species provides an adequate measure of safety to maintain the balance of predator populations. As discussed in the PEIR and other responses to this commenter's comments, based on the available evidence it is reasonable to assume that District pesticide applications under the Program, using required limitations in application methods and rates as found on the product labels and in District BMPs, will not result in a significant impact to these populations or higher trophic level species that consume mosquitoes as part of their diet.

Also see Response 12.

Response 29

Potential water quality impacts to groundwater and surface water from application of vector control chemicals are analyzed in Sections 9.2.5 and 9.2.7 of the PEIR, the Vegetation Management and Chemical Control alternatives, respectively. Each of the active ingredients and adjuvants applied by the District were evaluated individually with consideration of pesticide's mode of action, persistence in the environment, toxicity, and environmental fate. Furthermore, the District's methods for application of the material, such as ULV techniques, were also considered. Based on this evidence and expert analysis, the Draft PEIR concludes that the vector control chemicals would have less-than-significant impacts to surface water and groundwater when applied consistent with the vector control application techniques, label requirements, and BMPs implemented by the District.

With respect to the cumulative impact assessment, the PEIR focuses on the actual effects the District's contribution will have on the environment at the cumulative level. Contrary to what is implied by the commenter, *Communities for a Better Environment v. California Resource Agency* (103 Cal. App 4th 98) does not require that the District find that any level of contribution to an existing cumulative impact be deemed cumulatively considerable, particularly when program and/or project effects are indirect or uncertain. As discussed in Section 13.7 of the PEIR, several studies have shown that specific vector control chemicals applied using ULV techniques do not accumulate in water or sediment following repeated applications. These studies have 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). Furthermore, the monitoring of pesticides used for vector control on waters throughout California has not detected impacts to beneficial uses, as described in Response 23 above. A two-year monitoring study conducted for the State Water Resources Control Board by the Mosquito and Vector Control Association of California (MVCAC) monitoring coalition to determine whether vector control activities were contributing contaminants to state waters supports the PEIR's conclusions that impacts to water quality from the District's IVMP are less than significant and that the District's use of vector control chemicals would not contribute considerably to an existing cumulative impact (from all other pesticide users' activities) to water quality in the Program Area and thus are not cumulatively considerable. (MVCAC 2013)

Also see Response 23.

Response 30

As discussed in Responses 25 through 29, the cumulative impact analysis is not deficient, and recirculation of the Draft EIR is not required. Material provided in these responses to comments provides sufficient clarification to be clear on points raised, and this material will be made public as part of the Final PEIR.

Response 31

The PEIR does not gloss over program EIR requirements, nor does it presumptively dismiss the need for future CEQA evaluation. Rather, Section 1.8, Use of This PEIR for Future CEQA Compliance (pages 1-22 through 1-27) clearly acknowledges that the analysis is limited to the activities and materials that can be identified at present. It notes that "Future activities not within the scope of the Program evaluated in the PEIR are considered "new actions" and may be subject to future environmental review under CEQA" (Section 1.8.1, page 1-23). It also clearly outlines the steps that would be followed in determining whether additional CEQA analysis would be required in the future. The specific process the District will follow to ensure CEQA compliance as it moves forward implementing its Program is explained in greater detail in Sections 1.8.1 and 1.8.2. The comment seems to suggest that the District make a determination now whether future activities would be subject to additional CEQA, but this is not feasible because they are not known. The CEQA Guidelines § 15144 notes that foreseeing the unforeseeable is not possible, but that an agency must use its best efforts to find out and disclose all that it reasonably can. This PEIR has done that, describing for example all pesticides in current use and a number of pesticides not currently in use but with the potential for use in the foreseeable future (Section 1.8.1.1, page 1-23). The CEQA Guidelines § 15145 do not require speculation, however, and the EIR has outlined the steps that would be taken to ensure compliance with CEQA in the future for both chemical and nonchemical treatments. One of the purposes of this PEIR has been to anticipate reasonably foreseeable vector control activities by the District in order to avoid use of the emergency action exemption provisions if there were a serious outbreak of vector-borne disease requiring immediate action, thus ensuring that, to the extent feasible, potential impacts have been evaluated and disclosed to the public and decision makers in advance of any action.

Response 32

Comment noted that the Draft BDCP is out of date. According to The Resources Agency website, information on the Bay Delta Conservation Plan (BDCP) and the supporting environmental review process can now be found at http://baydeltaconservationplan.com/. The discussions of the Bay Delta Conservation Plan have been deleted from Sections 4.1.4.5, 5.1.4.5 and Table 4-5 because, as the comment notes, this is no longer an HCP/NCCP. This plan's removal from these sections has no effect on the conclusions of the impact analyses or on the alternatives or mitigation measures that were developed. Therefore, this text change is not substantial and does not require recirculation of the Draft PEIR.

Response 33

The only time Wikipedia was cited was in the Land Use environmental setting Section 3.1.2 Public Lands, where it was used as a source of information for the number of square miles in Sonoma County and acreages in the San Pablo Bay National Wildlife Refuge. This is not substantive information for the impact analyses and has no bearing on the conclusions of the impact analysis. Most of the acreage information in the environmental setting was obtained from Marin County and Sonoma County.

Response 34

The correct links have been provided in the text changes section of this Final PEIR. All of the documents were obtained/downloaded when the PEIR was prepared, and these materials were available upon request during public review of the PEIR. Website links are provided for ease of reference but do change over time.

Below find current links as of May 24, 2016:1. http://www.baaqmd.gov/~/media/files/planning-and-research/ceqa/revised-draft-ceqa-thresholds-justification-report-oct-2009.pdf?la=en

- http://baydeltaconservationplan.com/Library/BDCPLibrary/WhatistheBDCP.aspx
- http://www.ceden. .waterboards.ca.gov/AdvancedQueryTool
- http://ci.corte-madera.ca.us/182/General-Plan
- http://www.ci.healdsburg.ca.us/354/General-Plan
- https://www.climate.gov/maps-data/dataset/average-wind-speeds-map-viewer
- http://sonomacounty.ca.gov/TPW/Air-Quality-Northern-Sonoma-County
- http://www.townofross.org/planning/page/climate-action-plan
- http://www.townofross.org/planning/page/general-plan
- http://www.townofsananselmo.org/DocumentCenter/Home/View/553
- http://www.townofsananselmo.org/index.aspx?nid=216

> http://www.co.solano.ca.us/depts/rm/planning /generalplan.asp

> http://www.scwa2.com/water-supply/habitat/solano-multispecies-habitat-conservation-plan

> http://www.sonoma-county.org/prmd/gp2020/osrce.pdf *and* http://www.sonoma-county.org/prmd/gp2020/wre.pdf

> http://www.sonoma-county.org/prmd/gp2020/lue.pdf

> http://sonomacounty.ca.gov/CAO/Public-Reports/About-Sonoma-County/Land-Use/

> https://www2.municode.com/library/ca/sonoma_county/codes/code_of_ordinances?nodeId=CH7BURE#!

> http://www.townoftiburon.org/206/General-Plan

> http://newscience.ul.com/wp-content/uploads/2014/04/Indoor_Air_Pollution_an_Overview.pdf

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> WHO 1989 is a book, the PDF of which is no longer available free of charge online.

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Attachment A – Literature Review

Evaluations of many of the studies cited in (or consulted for) the responses to public comments for the District's Final PEIR are provided below.

Adams MJ, Miller DAW, Muths E, Corn PS, Grant EHC, Bailey LL, et al. 2013. Trends in Amphibian Occupancy in the United States. *PLoS ONE* 8(5).

> These authors conducted an analysis of the rate of change in the probability that amphibians occupy ponds and other comparable habitat features across the United States. They report that overall occupancy by amphibians declined 3.7% annually from 2002 to 2011. Species that are of concern are said to have declined an average of 11.6% annually. Their computer modeling approach is used to suggest that amphibian declines may be more widespread and severe than previously realized. However, this report is based on extrapolation of probability to reach their conclusions.

Antunes-Kenyon, S. and G. Kennedy. 2001. Methoprene: A review of the impacts of the insect growth regulator methoprene on non-target aquatic organisms in fish bearing waters (Ver. 2.0). Prepared for Massachusetts Pesticide Board Subcommittee. August.

> Address limb regeneration and molting ability of a crustacean indicator species, Uca pugnax. A runoff event simulation with permethrin contaminated sediment found that U. pugnax experienced induction of hepatopancreas glutathione S-transferase activity while respiration and hemolymph osmolarity did not vary. This detoxification enzyme a generalist biomarker. Claims that chronic methoprene exposure at environmental concentrations caused increased male abnormal regenerative limbs and delays in proecdysis. Both male and female crabs displayed increased variability in water-soluble exoskeleton protein possibly affecting exoskeleton quality. In addition, males displayed methoprene and permethrin non-additive effects on total exoskeleton protein content, reduced body mass gain, reduced carapace width gain and overall body condition loss. Females displayed resilience by only experiencing reduced carapace size gain and increased respiration rate, possibly due to increased metabolic and biotransformation of both pesticides. Claims that inputs of insect growth regulators, pyrethroid insecticides or their mixture into coastal wetland environments pose a risk to crustacean physiology, fitness and sensitive growth processes.

Arnason, Robert. 2015. Beekeepers produce bumper honey crops. Statistics Canada. December. As also reported in *The Western Producer Bee Keeper Journal*.

> Bee keeper journal article intended for the use of commercial and other bee keepers about the status of honey production, possible bee impacts of pesticides and other factors.

Aspelin, A.L. Pesticide usage in the United States: Trends During the 20th Century. *CIPM Technical Bulletin* 105. February.

> Reports on the urban vector control applications, indicating that there are numerous sources of pesticides found in urban creeks including structural uses, ant control applications, and homeowner applications to lawns.

Barberis, C.L., C.S. Carranza, S.M. Chiacchiera, and C.E. Magnoli. 2013. Influence of herbicide glyphosate on growth and aflatoxin B1 production by Aspergillus section Flavi strains isolated from soil on in vitro assay. *Journal of Environmental Science and Health*, Part B, 48(12), 1070-1079. (on toxic fungi appearing in soil sprayed with glyphosate).

> These authors report on the effect of six glyphosate concentrations on growth rate and aflatoxin B1 (AFB1) production by Aspergillus section Flavi strains under different water activity (aW) on maize-based medium. In general, the lag phase decreased as glyphosate concentration

increased and all the strains showed the same behavior at the different conditions tested. They suggest that at high concentrations glyphosate significantly increased the growth of all Aspergillus section Flavi strains. Aflatoxin B1 production did not show noticeable differences among different pesticide concentrations assayed at all aW in both strains. This study has shown that these Aspergillus flavus and A. parasiticus strains are able to grow effectively and produce aflatoxins in high nutrient status media over a range of glyphosate concentrations under different water activity conditions.

Bradbury, Steven, Director OPP. 2013. Transmission letter from Fred Jenkins (FIFRA) on Pollinator Protection Labeling for Nitroquanidine Neonicotinoid Products. USEPA letter to registrants, August 15, 2013.

> Letter available from the USEPA head of Pesticides Programs to be aware of the potential for new restrictions about the use and availability of existing pesticides with neonicotinoid properties and the requirement to include new tests in the registration process.

Brodman, R., W.D. Newman, K. Laurie, S. Osterfeld, and N. Lenzo 2010. Interaction of an aquatic herbicide and predatory salamander density on wetland communities. *Journal of Herpetology* 44(1):69-82.

> Report suggesting that pesticides could have unintended impacts on amphibians These authors conducted a replicated field experiment in constructed ponds to test for both the effects of Accord and predator (Tiger Salamanders, *Ambystoma tigrinum*) density on amphibians and aquatic invertebrates. Herbicide treatment had significant density-dependent effects on Tiger Salamander growth, development, and survival. The survival of anurans and aquatic invertebrates was also affected by herbicide treatment and predator density. These results suggest that competition and predation may mediate indirect effects of this herbicide on the aquatic fauna. They conclude that exposure to Accord poses less of a risk to the ecology of amphibians than do other formulations of glyphosate-based herbicides.

Brown, Matt. 2014. Drought may be taking toll on bees in Sonoma. *The Press Democrat*, June 28. Available online at http://www.pressdemocrat.com/csp/mediapool/sites/PressDemocrat/News/story.csp?cid=237153 2&sid=555&fid=181.

> Publication in the newspaper (online) Press Democrat of Sonoma suggesting that the perceived loss of bees in the county and elsewhere may be related to the extreme drought conditions in California and particularly in the Sonoma area. The article was based on information in the UC Davis publication series on bees and agriculture. This is a hypothetical comment that is focused on the loss of bees reported associated with drought conditions in the agricultural communities of California.

California Department of Pesticide Regulation (CDPR) 1995. California State Plan for Protection of Endangered Species from Pesticide Exposure. September 13.

> The purpose of this plan is to protect federally listed endangered species in California from potentially harmful pesticide exposures, incorporating federal protection strategies or developing alternative local plans where needed. This Plan includes all federally listed species designated threatened, endangered, proposed threatened, proposed endangered and Category 1 candidate species in California and will address new listings on an ongoing basis. This plan includes all federally listed species designated threatened, endangered, proposed threatened, proposed endangered and other candidate species in California. This plan includes all pesticides registered for use in California and all types of registrations including new active ingredients, experimental use permits and emergency exemptions.

Canadian Council of Ministers of the Environment. 2007. Canadian Water Quality Guidelines for the Protection of Aquatic Life. Methoprene. Available online at http://ceqg-rcqe.ccme.ca/download/en/192.

> Listing of Methoprene target levels for risk… 0.09 target organism, and 0.53 management value.

Csondes, A. 2004. Environmental Fate of Methoprene. 6 pp whitepaper prepared by CDPR. Available online at http://www.cdpr.ca.gov/docs/emon/pubs/methofate.pdf.

> **Review of methoprene characteristics, physiochemical etc., includes tables of toxicity and properties.** Methoprene disrupts the insects' metamorphosis and life cycle, thus hindering their ability to reach adulthood and successful reproduction. Special slow-release formulations are commonly used for mosquito control, especially breeding in floodwater sites, rice cultivations, storm drains, ponds, and water treatment works.

Davis, R.S., R.K.D. Peterson, and P.A. Macedo. 2007. An Ecological Risk Assessment for Insecticides used in adult mosquito management. *Integrated Environmental Assessment and Management* 3 (3): 373–382.

> This author developed a deterministic ecological risk assessment focused on 6 common mosquito adulticides used in vector control, including 3 pyrethroids (dphenothrin, resmethrin, and permethrin), pyrethrins, and 2 organophosphates (malathion and naled). Piperonyl butoxide, a synergist for the pyrethroids, was also assessed. Both aquatic and terrestrial nontarget organisms were considered for acute and chronic exposures to the adulticides. Tier I exposure estimates were derived from ISCST3 and AERMOD for deposition and air concentrations affecting terrestrial organisms and PRZM-EXAMS for standard pond concentrations affecting aquatic organisms. Nontargets exposed to adulticides included small mammals, birds, as well as aquatic vertebrates and invertebrates in a pond subject to receiving the chemical via drift and runoff. Risk quotients were obtained by comparing exposures to toxic endpoints. All risk quotients were low indicating that risks to ecological receptors most likely were small.

Davis, R.S. and R.K.D. Peterson. 2008. Effects of single and multiple applications of mosquito insecticides on nontarget arthropods. *Journal of the American Mosquito Control Association* 24(2):270-280.

> These authors conducted two studies during the late summers of 2004 through 2006 at Benton Lake National Wildlife Refuge near Great Falls, MT. in 2004 and 2005 to assess acute impacts of mosquito adulticides (permethrin and d-phenothrin) and larvicides (Bacillus thuringiensis israelensis and methoprene) on nontarget aquatic and terrestrial arthropods after a single application. The second experiment was conducted in 2005 and 2006 to assess longer-term impacts of permethrin on nontarget terrestrial arthropods after multiple repeated applications. For aquatic samples, in the first study, no overall treatment effects were observed. Three response variables were associated with fewer individuals present in the insecticide-treated plots in a multivariate analysis. For the multiple-spray study conducted in 2005 and 2006, six of the response variables collected via sticky cards exhibited significant overall treatment effects, but none was associated with fewer individuals in the insecticide-treated plots. None of the responses collected using sweep-net sampling suggested overall treatment effects. No discernable pattern was evident. In general, nearly all of the responses evaluated indicated few, if any, deleterious effects from insecticide application.

Degitz, S.J., E.J. Durhan, J.E. Tietze, P.A. Kosian, G.W. Holcombe, and G.T. Ankley. 2003. Developmental toxicity of methoprene and several degradation products in *Xenopus laevis. Aquatic Toxicol.* June; 64 (1):97-105.

> Methoprene is an insect juvenile growth hormone mimic, which inhibits pupation and is used for the control of emergent insect pests such as mosquitoes. Some claims that methoprene use in US may be a contributing factor to the recent increase in malformed amphibians. However, little is known concerning the developmental toxicity of methoprene and its degradation products in amphibians. In these studies, the aqueous stability and developmental toxicity of methoprene and several degradation products (methoprene acid, methoprene epoxide, 7-methoxycitronellal, and 7-methoxycitronellic acid) were examined. Xenopus laevis embryos (stage 8) were exposed to the test chemicals for 96 h. Assays were conducted under static renewal (24 h) conditions and chemical concentrations in water were measured at the beginning and end of the renewal periods. **Methoprene exposure did not result in developmental toxicity at concentrations up to 2 mg/l, which is slightly higher than its water solubility**. Methoprene acid, a relatively minor degradation product, produced developmental toxicity when concentrations exceeded 1.25 mg/l. Methoprene epoxide and 7-methoxycitronellal caused developmental toxicity at concentrations of 2.5 mg/l and higher. 7-Methoxycitronellic acid was not developmentally toxic at a test concentration as high as 30 mg/l. The five test chemicals had differential stability in aqueous solution that was in some instances affected by the presence of test organisms. These data indicate that **methoprene and its degradation products are not potent development toxicants in X. laevis.** This, in combination with the fact that field applications of sustained-release formulations of methoprene result in methoprene concentrations that do not typically exceed 0.01 mg/l, suggests that **concerns for methoprene-mediated developmental toxicity to amphibians may be unwarranted.**

de María, N., J.M. Becerril, J.I. García-Plazaola, A. Hernandez, M.R. De Felipe, and M. Fernandez-Pascual. 2006. New insights on glyphosate mode of action in nodular metabolism: Role of shikimate accumulation. J. Agric Food Chem. April 5;54(7):2621-8.

> These authors tested the short-term effects of glyphosate on the growth, nitrogen fixation, carbohydrate metabolism, and shikimate pathway in leaves and nodules of nodulated lupine plants. All glyphosate treatments decreased nitrogenase activity rapidly (24 h) after application, even at the lowest and sublethal dose used (1.25 mM). This early effect on nitrogenase could not be related to either damage to nitrogenase components (I and II) or limitation of carbohydrates supplied by the host plant. These effects were accompanied by inhibition of the activity of phosphoenolpyruvate carboxylase (PEPC). There were rapid effects on the increase of shikimic and protocatechuic (PCA) acids in nodules and leaves after herbicide application. On the basis of the role of shikimic acid and PCA in the regulation of PEPC, as potent competitive inhibitors, this additional effect provoked by glyphosate on 5-enolpyruvylshikimic-3-phosphate synthase enzyme (EPSPS; EC 2.5.1.19) inhibition would divert most PEP into the shikimate pathway, depriving energy substrates to bacteroids to maintain nitrogen fixation. They suggest that these findings provide a new explanation for the effectiveness of glyphosate as an herbicide in other plant tissues, for the observed differences in tolerance among species or cultivars, and for the transitory effects on glyphosate-resistant transgenic crops under several environmental conditions.

De Roos, A.J., A. Blair, J.A. Rusiecki, J.A. Hoppin, M. Svec, M. Dosemeci, D.P. Sanler, and M.C. Alavania. cancer incidence among glyphosate-exposed pesticide applicators in the Agricultural Health Study, *Environmental Health Perspectives* Jan;113 (1).

> These authors evaluated associations between glyphosate exposure and cancer incidence in the Agricultural Health Study (AHS), a prospective cohort study of 57,311 licensed pesticide applicators in Iowa and North Carolina. Detailed information on pesticide use and other factors was obtained from a self-administered questionnaire completed at time of enrollment (1993–1997). Among private and commercial applicators, 75.5% reported having ever used glyphosate, of which > 97% were men. In this analysis, glyphosate exposure was defined as a) ever personally mixed or applied products containing glyphosate; b) cumulative lifetime days of use, or "cumulative exposure days" (years of use × days/year); and c) intensity-weighted cumulative exposure days (years of use × days/year × estimated intensity level). Poisson regression was used to estimate exposure–response relations between glyphosate and incidence of all cancers combined and 12 relatively common cancer subtypes. Glyphosate exposure was not associated with cancer incidence overall or with most of the cancer subtypes we studied. There was a suggested association with multiple myeloma incidence that should be followed up as more cases occur in the AHS.

Extension Toxicology Network (EXTOXNET). 1995. Pesticide Information Profile. Methoprene. Available online at http://pmep.cce.cornell.edu/profiles/extoxnet/haloxyfop-methylparathion/methoprene-ext.html.

> Information and suggested toxicity data used to determine the potential toxicology issues to outline the possible impacts of these pesticides on several species.

Fishel, F.M. 2005. Pesticide toxicity profile: neonicotinoid pesticides. UF/IFAS EDIS Document PI-80. Available online at http://edis.ifas.ufl.edu/pi087.

> This document provides an excellent, comprehensive and general overview of human toxicity, a listing of laboratory animal and wildlife toxicities, and a cross-reference of chemical, common, and trade names of many neonicotinoid pesticides registered for use in Florida. Along with the toxicity information of LD50, LC50 and dermal toxicity for five common neonicotinoids, he addesses humans and wildlife, the author has a section directed specifically to the issue of toxicity to bees and the perceptions of bee colonly collapse disorder (CCD). This document is PI-80, one of a series of the Pesticide Information Office, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida.

Henrick, C.A., J. Ko, J. Nguyen, J. Burleson, G. Lindahl, D. Van Gundy, and J.M. Edge. 2002. Investigation of the relationship between s-methoprene and deformities in anurans. 2002. *Journal of the American Mosquito Control Association* 18(3):214-221

> Reports on their acute toxicity tests that incorporated direct applications of methoprene to jugs of pondwater that resulted in unrealistic exposures when the test species was introduced to the jugs as the test medium. Reported that methoprene is toxic to amphibians, such as frogs, toads, and salamanders but at relatively high exposure concentrations. A comparison of reported Altosid use with reported frog deformities in Minnesota demonstrate that a connection between frog deformities and Altosid use is unlikely". These results indicated that factors other than s-methoprene and its degradation products are contributing to the recent outbreak of frog deformities. Their acute toxicity tests that incorporated direct applications of methoprene to jugs of pondwater resulted in unrealistic exposures when the test species was introduced to the jugs as the test medium. These authors report that methoprene is toxic to amphibians, such as frogs, toads, and salamanders but at relatively high exposure concentrations

Hershey, A.E, A.R. Lima, G.J. Niemi, and R.R. Regal. 1997. Bti and methoprene nontarget risks. An 8-year study in Minnesota wetlands. *Ecological Applications* 8 (1) 41-60.

> These authors presented the results of their studies that began in1997 (*Ecological Applications: Vol. 8, No. 1, pp. 41–60*) at the 2002 conference of the MAMCA where they reported the results of the effects of the mosquito larvicides methoprene and Bacillus thuringiensis israelensis (Bti) on the benthic macroinvertebrate communities of 27 wetland ecosystems in Wright County, Minnesota. These larvicides are generally considered safe for nontarget species. After 3 yr of preliminary investigations, including 2 yr of intensive sampling, larvicide treatments were applied during 1991–1993. Nine of the wetlands were experimentally treated with methoprene and an additional set of nine wetlands were treated with Bti. While nine wetlands were left untreated to serve as a control treatment. In general, insecticide treatment had minimal effects on nontarget groups during the first treatment year. They report that in 1992 highly significant reductions due to both methoprene and Bti were observed in several insect groups. Predatory insects were reduced on methoprene-treated sites but not Bti-treated sites in 1992. Effects were observed broadly across insect taxa, Diptera, were affected most strongly, especially the dipteran suborder Nematocera, which included Chironomidae. Minimal effects on non insect macroinvertebrates were observed. Bti- and methoprene-treated sites also showed a reduction in richness of insect genera and an increased tendency to be dominated by one or a few genera.

> These authors suggest that both indirect effects and direct toxicity likely contributed to the observed differences in the target and nontarget species. Bti is likely to be directly toxic only to nematoceran Diptera; thus effects of Bti on other insect groups may have resulted from disruption of the invertebrate food web. Methoprene is more broadly toxic; thus observed methoprene effects on non nematoceran groups may have been due to either direct toxicity or food web effects, or both. They suggest that the observed 2–3 yr lag time in response of nontarget insects to larvicide treatment may require longer term studies to evaluate the safety of these larvicides.

Hopwood, J,M. Vaughn, M. Shepherd, D. Biiddinger, E. Mader, S.H. Black, and C. Mazzacano. 2012. Are neonicotinoids killing bees. A review of research into the effects of neonicotinoid insecticides on bees, with recommendations for action. Xerces Society for Invertrebrate Conservation.Hopwood,

> A Xerces Society report on the condition and status of bees and bee colonies suggesting a connection of pesticides (especially neonicotinoids) to reductions in bee populations. They report that this class of pesticides can persist in soil for months after single application. They also suggest that residues can be found in pollen and nectar which are then consumer flower visiting insects such as bees in some situations concentrations of residues can reach me the levels if consumption is very high. They suggest that imidacloprid, clothianidin, dinotefuran and thiamethoxam are highly toxic to honey bees while thiacloprid and acetamiprid are only mildly toxic to bees. The report focuses on the numerous factora that can impact the potential toxicity of neonicotinoids to bees and other pollinators with suggestions on how to minimize the potential for adverse effects. The authors suggest that Colony Collapse Disorder (CCD) may involve pesticides, but do not provide direct causal evidence in this report.

Johansson. M., H. Piha, and K.H. Merila. 2006. Toxicity of six pesticides to common frog (*Rana temporaria*) tadpoles. *Environ Toxicol Chem*. Dec;25(12):3164-70.

> These authors tested the toxicity of six commonly used pesticides on Rana temporaria spawn and tadpoles. In acute tests, tadpoles were exposed to relatively high concentrations of azoxystrobin, cyanazine, esfenvalerate, MCPA ([4-chloro-2-methylphenoxy] acetic acid), permethrin, and pirimicarb for 72 h. Chronic exposure tests were performed from fertilization to metamorphosis with azoxystrobin, cyanazine, and permethrin at concentrations similar to those

found in surface waters in agricultural areas in Sweden. The most lethal pesticides in these tests of acute exposure were azoxystrobin, permethrin, and pirimicarb. They report negative effects at high doses on the growth of the tadpoles were observed with azoxystrobin, cyanazine, and permethrin. The chronic exposure at lower pesticide concentrations did not result in increased mortality or impaired growth. However, they report a positive effect of permethrin on growth and size at metamorphosis. The results suggest that the pesticides in these tests can inflict strong negative effects at high concentrations but have no or relatively weak effects on R. temporaria spawn or tadpoles at the low concentrations found in Swedish surface waters.

Kiesecker, J.K., A.R. Blaustein, and L.K. Belden 2001. Complex causes of amphibian population declines. *Nature* April 5; 410: 681-684.

> Amphibian populations have suffered widespread declines and extinctions in recent decades. These authors suggest that pathogen outbreaks in amphibian populations in the western USA are linked to climate-induced changes in UV-B exposure. Using long-term observational data and a field experiment, we examine patterns among interannual variability in precipitation, UV-B exposure and infection by a pathogenic oomycete, Saprolegnia ferax. They indicate that climate-induced reductions in water depth at oviposition sites may have caused high mortality of embryos by increasing their exposure to UV-B radiation and, consequently, their vulnerability to infection They further suggest that factors such as precipitation, and thus water depth/UV-B exposure, elevated sea-surface temperatures could be the precursor for pathogen-mediated amphibian declines in many regions.

Lawler, S.P. and D. Dritz. 2013. Efficacy of spinosad in control of larval *Culex tar*salis and chironomid midges, and its nontarget effects. *Journal of the American Mosquito Control Association* 29(4):352-357.

> These authors reported that spinosad is an effective treatment for insect larvae but that it also "kills mayflies and other non-target insects". They also reported that spinosad was effective against mosquitoes and midges for about a month and that spinosad caused mortality of mayflies and other nontarget insects. However, inspection of the results reported in this study indicate that spinosad was considerably less toxic to mayflies than to desired targets, and the minimal effects on mayflies were undetectable after 21 days

Lawler, S.P., D. Dritz, and T. Jensen. 2000. Effects of sustained release methoprene and a combined formulation of liquid methoprene and *Bacillus thuringiensis israelensis* on insects in salt marshes. *Arch. Environ. Contam. Toxicol.* 39:177-182.

> Such deliberate consequences have been possible by the discovery and use of Juvenile Hormone Analogs (JHAs), the synthetic chemicals that mimic JH action, which have also been utilized as insecticides for several decades. Although there is limited use of JHAs for insect pest control, the list of new insect species susceptible to these compounds has been expanding revealing the potential for future use of this class of insecticides. **The relatively fewer effects of JHAs on non-target insects and animals and favorable environmental fate of these compounds make them attractive insecticides.**

Mid-Atlantic Apiculture Research Report (MAAREC). 2005. Seasonal Cycles of Activities in Colonies. Available online at https://agdev.anr.udel.edu/maarec/honey-bee-biology/seasonal-cycles-of-activities-in-colonies.

> This is the publication of the MAAREC established with representation from the departments of agriculture, state beekeeping organizations, and land-grant universities from each of the following states: New Jersey, Maryland, Delaware, Pennsylvania West Virginia, and Virginia. Also participating in the task force is a representative of the USDA/ARS (Beltsville Bee Lab, MD). to identify research and extension priorities for apiculture in the Mid-Atlantic Region, review

proposals, monitor progress, and assist specialists in obtaining funding for apiculture extension and research efforts. The focus of MAAREC research has been on the identification of alternatives to chemical controls and promotion of less reliance on chemical pesticides for mite control. Some of the research objectives consider apiary inspector and beekeeper input and the use of tools such as beekeeper surveys to identify the most effective ways to assist beekeepers in understanding and making sound management decisions for mite and disease control.

McKenney, C.L. 2005. The Influence of insect juvenile hormone agonists on metamorphosis and reproduction in estuarine crustaceans. *Integr. Comp. Biol.* 45:97-105.

> Comparative developmental and reproductive studies on several species of estuarine crustaceans in response to three juvenile hormone agonists (pyriproxyfen, **methoprene** and fenoxycarb). Claims that l**arval development of the grass shrimp**, Palaemonetes pugio, was greater than two orders of magnitude more sensitive to disruption by methoprene and fenoxycarb than was embryonic development. Developing larvae of the mud crab, Rhithropanopeus harrisii, exhibited reduced metamorphic success at lower concentrations of methoprene and pyriproxyfen than grass shrimp larvae. The final crab larval stage, the megalopa, was more sensitive to methoprene and fenoxycarb exposure than earlier zoeal stages. Juvenile mysids released by exposed adults and reared through maturation without further exposure produced fewer young and had altered sex ratios (lower percentages of males) at lower parental-exposure concentrations than directly affected parental reproduction. These findings support using a functional approach as an appropriate screening procedure to evaluate **potential environmental endocrine-disrupting chemicals in aquatic environments.**

McNear Jr., D.H. 2013. The Rhizosphere - Roots, Soil and Everything In Between. Nature Education Knowledge 4(3):1 (at the discussion of "Plant Growth Promoting Rhizobacteria (PGPR)"). Available online at http://www.nature.com/scitable/knowledge/library/the-rhizosphere-roots-soil-and-67500617 [accessed October 1, 2015].

> This monograph report is a compendium of the workings and processes involved in the root system of plants. It provides a good overview of the root system components that may be impacted by chemicals but it does not provide any of the potential sites that would be sensitive to toxicity based on chemical mode of action.

Miles M. and R. Dutton. 2000. Spinosad—a naturally derived insect control agent with potential for use in glasshouse integrated pest management systems. *Meded. Fac. Landbouwkd. Toegepaste Biol. Wet. (Univ. Gent)* 65 (2A):393–400.

> Demonstrated the efficacy of spinosad and the lack of apparent significant impact on other aquatic organisms in their tests

Mink, P.J., J.S. Mandel, B.D. Sceurman, and J.I. Lundin. 2012. Epidemiologic studies of glyphosate and cancer: a review. *Regul Toxicol Pharmacol* Aug;63 (3): 440-452.

> These authors examined the potential risk of glyphosate in humans including a review of the epidemiologic literature to evaluate whether exposure to glyphosate is associated causally with cancer risk in humans. They also reviewed relevant methodological and biomonitoring studies of glyphosate. Seven cohort studies and 14 case-control studies examined the association between life estate and one or more cancer outcomes. Their review found no consistent pattern of positive associations including a causal relationship between total cancer in adults or children or any site-specific cancer and exposure to glyphosate. They further suggest that biomonitoring studies support the importance of exposure assessment and epidemiological studies and indicate that study should incorporate not only duration and frequency of pesticide use but also type of pesticide formulation. They suggest that generic exposure assessments usually lead to

exposure misclassification and recommend that exposure algorithms be validated with biomonitoring data.

Miyakawa, H., K. Toyota, I. Hirakawa, Y. Ogino, S. Miyagawa1, S. Oda1, N. Tatarazako, T. Miura, J.K. Colbourne, and T. Iguchi. 2013. A mutation in the receptor methoprene-tolerant alters juvenile hormone response in insects and crustaceans. Nature Communications 4, Article number:1856doi:10.1038/14 May.

> Most of the insects use juvenile hormone III as the innate juvenile hormone ligand. By contrast, crustaceans use methyl farnesoate. Despite this difference, the **process of this ligand transition is unknown**. A single amino-acid substitution in the receptor Methoprene-tolerant has an important role during evolution of the arthropod juvenile hormone pathway. Microcrustacea Daphnia pulex and D. magna share a juvenile hormone signal transduction pathway with insects, involving Methoprene-tolerant and steroid receptor coactivator proteins that form a heterodimer in response to various juvenoids. Juvenile hormone-binding pockets of the orthologous genes differ by only two amino acids, yet a single substitution within Daphnia Met enhances the receptor's responsiveness to juvenile hormone III. These results **indicate that this mutation within an ancestral insect lineage contributed to the evolution of a juvenile hormone III receptor system. This is a theoretical study and has not strong response to the toxicity of methoprene.**

Monsanto Technology LLC, Missouri. Glyphosate formulations and their use for the inhibition of 5-enolpyruvylshikimate-3-phosphate synthase. 2010. US Patent number 7771736 B2. Available online at https://www.google.com/patents/US7771736.

> This is a documentation of a Monsanto research on glyphosate and its effect on the inhibition of some plant root enzymes and is provided to inform one of the potential side effects of glyphosate formulations that are not pure glyphosate active ingredient. The implications are a reduction in root function if high exposures travel to the root system and are sequestered there.

Moreno, Polo. 2007. Notes on the Stipulation Injunction and Order for Protection of California Red-Legged Frog. Endangered Species Program, California Department of Pesticide Regulation.

> California DPR memorandum that specifies care in application of pesticides in areas that are known or suspected CRLF habitat.

Mosquito and Vector Control Association of California NPDES Permit Coalition. 2013. MVCAC NPDES Permit Coalition 2011/2012 Annual Report, NPDES Vector Control Permit (Order No. 2012-0003-DWQ).

> This is the documentation of the vector control guidelines and restrictions in the NPDES Permit issued to MVCAC.

National Park Service. 2008. Yosemite. Invasive Plant Management Plan for Yosemite National Park. ESA. Available online at http://www.nps.gov/yose/learn/management/invasive.htm.

> The Invasive Plant Management Plan Update is used by Park resource managers to control non-native invasive species. Adaptive management would allow the park to assess the safety and effectiveness of herbicides considered for protecting Yosemite's biodiversity. It provides a framework for decision making and prioritization strategies that based upon the time tested paradigms of Adaptive and Integrated Pest Management. Two herbicides, glyphosate and aminopyralid are currently used in the park. Following the 2009 Big Meadow Fire in Yosemite, the Interagency Fire Management Team recommended applying a pre-emergent herbicide that to prevent cheatgrass from overtaking the meadow after the late-season fire. Since this specific chemical was not considered and evaluated in the 2008 IPMP, the park was unable to use this

new tool. Successful aspects of the IPMP, such as annual work plans, prioritization, minimum tool analysis, and education, and outreach, would continue to be implemented.

North Carolina Partners in Amphibian and Reptile Conservation (NCPARC). 2009. Observations on Herbicide Choices & Amphibian Conservation. Available online at http://www.ncparc.org/pubs/Herbicide%20Choices%20&%20Amphibian%20Conservation.pdf.

> This group advocates for less chemical use in both agriculture and urban settings. They suggest that because glyphosate is a non-selective systemic herbicide widely used for vegetation control. It is considered relatively non-toxic to humans and most terrestrial wildlife and as such has been marketed for years as environmentally-friendly. The chemical kills plants by inhibiting the activity of certain enzymes that are present only in plants. Glyphosate is the active ingredient in Roundup, which was manufactured exclusively by Monsanto until 2000, when the patent expired. Since then many other companies have developed their own glyphosate formulations. Monsanto reported that aquatic species were much more sensitive to the formulated product than to the technical grade glyphosate that was used to make Roundup. The higher toxicity of the formulations was determined to be due to the presence of POEA (polyethoxylated tallow amine) surfactants. As a precaution to prevent harm to aquatic life, When these formulations are applied to upland sites according to label instructions, the risk to surfactant-sensitive species is considered important when exposing fish and amphibians.

Olmstead, A.W. and G. LeBlanc. 2001. Temporal and quantitative changes in sexual reproductive cycling of the *Cladoceran Daphnia magna* by a juvenile hormone analog*. J. Exp. Zool. July 1;290 (2):148-155.*

> Cyclic parthenogens, such as the cladoceran, Daphnia magna, utilize both asexual (parthenogenetic) and sexual reproduction. Experiments were conducted with the juvenile hormone analog methoprene to test the hypothesis that members of the insect juvenile hormone/vertebrate retinoic acid family of transcription factors are involved in the regulation of sexual reproduction in daphnids**. Neither methoprene, food reduction, or crowding independently stimulated entry into the sexual reproductive phase of the daphnids**. However, the combination of food deprivation and crowding stimulated entry into the sexual reproductive phase characterized by an initial high production of males and the subsequent intermittent production of haploid egg-containing ephippia. Exposure to 160 nM methoprene along with food deprivation and crowding caused a significant reduction in the percentage of males produced during the early phase of the sexual cycle and significantly increased the percentage of males produced during the later stages of the cycle. Methoprene concentrations as low as 6.4 nM significantly reduced the number of resting eggs produced and proportionately increased the production of parthenogenetically-produced neonates. These experiments demonstrate that methoprene uncouples the coordinate production of males and resting eggs during the sexual reproductive period of D. magna. **Methoprene stimulates male offspring production and defers their production to latter stages of the sexual reproductive period, while inhibiting the production of resting eggs and promoting the continuance of parthenogenetic reproduction**. J. Exp. Zool. 290:148-155, 2001.

Olmstead, A.W. and G. LeBlanc. 2001. Low exposure concentration effects of methoprene on endocrine regulated processes in the crustacean *Daphnia magna*. Toxicol. Sciences 62:268-273.

> Methoprene similarly may exert toxicity to crustaceans by mimicking or interfering with methyl farnesoate, a crustacean juvenoid. We hypothesized that methoprene interferes with endocrine-regulated processes in crustaceans by several mechanisms involving agonism or antagonism of juvenoid receptor complexes. In the present study, characterizing and comparing the concentration-response curves for methoprene and several endpoints related

to development and reproduction of the crustacean Daphnia magna. Methoprene has multiple mechanisms of toxicity and low-exposure concentration effects. Methoprene reduced the growth rate of daphnids with evidence of only a single concentration.

Olmstead, A.W. and G. LeBlanc. 2003. Insecticidal juvenile hormone analogs stimulate the production of male offspring in the crustacean *Daphnia magna. Environ. Health Perspect*. June;111(7):919-924.

> Juvenile hormone analogs (JHAs) represent a class of insecticides that were designed specifically to disrupt endocrine-regulated processes relatively unique to insects. Recently we demonstrated that the crustacean juvenoid hormone methyl farnesoate programs oocytes of the crustacean Daphnia magna to develop into males. We hypothesized that insecticidal JHAs might mimic the action of methyl farnesoate, producing altered sex ratios of offspring. Daphnids were exposed chronically (3 weeks) to sublethal concentrations of methyl farnesoate, the JHA pyriproxyfen, and several nonjuvenoid chemicals to discern whether excess male offspring production is a generic response to stress or a specific response to juvenoid hormones. Only methyl farnesoate and pyriproxyfen increased the percentage of males produced by exposed maternal organisms. As previously reported with methyl farnesoate, acute exposure (24 hr) to either pyriproxyfen or the JHA methoprene caused oocytes maturing in the ovary to develop into males. We performed experiments to determine whether combined effects of a JHA and methyl farnesoate conformed better to a model of concentration addition (indicative of same mechanism of action) or independent joint action (indicative of different mechanisms of action). Combined effects conformed better to the concentration-addition model, although some synergy, of unknown etiology, was evident between the insecticides and the hormone. These experiments demonstrate that insecticidal JHAs mimic the action of the crustacean juvenoid hormone methyl farnesoate, resulting in the inappropriate production of male offspring. The occurrence of such an effect in the environment could have dire consequences on susceptible crustacean populations.

Relyea, R.A. 2005. The lethal impact of roundup on aquatic and terrestrial amphibians. *Ecological Applications* 15(4): 1118–1124.

> This author assembled communities of three species of North American tadpoles in outdoor pond mesocosms that contained different types of soil (which can absorb the pesticide) and applied Roundup as a direct overspray. After three weeks, he reports that Roundup killed 96–100% of larval amphibians (regardless of soil presence). I then exposed three species of juvenile (post-metamorphic) anurans to a direct overspray of Roundup in laboratory containers. After one day, Roundup killed 68–86% of juvenile amphibians. These results suggest that Roundup, a compound designed to kill plants, can cause extremely high rates of mortality to amphibians that could lead to population declines. This statement is far from reality. The exposures used were DIRECT OVERSPRAY of the mesocosm units which is completely arbitrary and unrealistic if the author intends to extrapolate the results to field exposures.

Rexrode, M., I. Abdel-Saheb, and J.L. Andersen. 2008. Potential Risks of Labeled S-Methoprene Uses to the Federally Listed California Red-Legged Frog. Pesticide Effects Determination. USEPA Biopesticide and Pollution Prevention Division. February 20.

> One of the important frog papers following disproved:

- Based on the results of this assessment, the following hypotheses can be rejected: The labeled use of S-methoprene: growth and viability of juvenile and adult CRLFs.causing mortality or by adversely affecting growth or fecundity;
- indirectly affect by reducing or changing the composition of food supply;
- indirectly affect critical habitat by reducing or changing the composition of the aquatic plant

community in the ponds and streams comprising the species' current range and designated critical habitat, thus affecting primary productivity and/or cover;

- indirectly affect critical habitat by reducing or changing the composition of the terrestrial plant community (i.e., riparian habitat) and habitat in the ponds and streams comprising the species' current range and designated critical habitat;
- modify critical habitat changing breeding and non-breeding aquatic habitat (via modification of water quality parameters, habitat morphology, and/or sedimentation);
- modify the designated critical habitat of the CRLF by reducing the food supply required for normal growth and viability of juvenile and adult CRLFs;
- modify the designated critical habitat of the CRLF by reducing or changing upland habitat within 200 ft of the edge of the riparian vegetation necessary for shelter, foraging, and predator avoidance.
- modify the designated critical habitat of the CRLF by reducing or changing dispersal habitat within designated units and between occupied locations within 0.7 mi of each other that allow for movement between sites including both natural and altered sites which do not contain barriers to dispersal.
- modify the designated critical habitat of the CRLF by altering chemical characteristics necessary for normal response line, having a threshold of 12.6 nM.

> Molt frequency was reduced by methoprene in a concentration-dependent manner, at 4.2 and 0.21 nM a NOEC of 32 nM. Methoprene reduced fecundity 24 and <0.18 nM. Claim that methoprene elicits significant toxicity to endocrine-related processes in the 5–50 nM concentration range. Molting and reproduction were impacted at significantly lower methoprene concentrations, with a distinct concentration response and a threshold of <0.2 nM.

> The conclusion is that there is a "may affect", but "not likely to adversely affect" determination for the CRLF from the use of S-methoprene.

Seneff Stephanie. MIT Computer Laboratory. ND. Various Media submissions as nonpublished documents.

> Stephanie Seneff . is an Independent Scientist and Consultant, Computer Science and Artificial Intelligence Laboratory, MIT, Cambridge, MA 02139, USA. Critique on Dr. Seneff's views on the role of glyphosate in the production of diseases and the links to childhood problems. From other researchers "However she, has not actually performed any research into glyphosate. She is a Senior Research Scientist at the MIT Computer Science and Artificial Intelligence Laboratory." Therefore, it is misleading to cite her as a researcher and authority. She has published only speculations and gives many presentations, but has not created any new data.

Stark, J.D. 2005. A Review and Update of the Report "Environmental and health impacts of the insect juvenile hormone analogue, S-methoprene" 1999 by Travis R. Glare and Maureen O'Callaghan. Report for the New Zealand Ministry of Health.

> After ingestion by the target organisms the crystals dissolve and release the toxic proteins that then kill the organism.

> Conclusions of this report were: 1) although methoprene is toxic to 12 orders of insects and may have effects on other nontarget organisms, particularly other nontarget arthropods, methoprene is one of the least environmentally damaging mosquito control agents and poses little risk to human and animal health. 2) In fact, the concentrations of methoprene necessary to control mosquitoes (1 part per billion) are often much lower than the concentrations necessary to cause damage to populations of many nontarget organisms.

> Methoprene has a short half-life in the environment making it unlikely to accumulate in various environmental compartments. Although new literature has been published showing declines in insect biomass due to long-term use of methoprene and Bti in freshwater wetlands in Minnesota, USA, **no evidence for permanent damage to ecosystem function has been found.**

> Additionally, a concern discussed in the original assessment was the possibility that methoprene may be the cause of limb malformations being detected in frogs in the USA. Even though it has been six years since the last assessment, the causal agent(s) of frog deformities in the USA has still not been clearly elucidated. Some scientists believe that these deformities are caused primarily by a parasitic trematode, not methoprene. Others believe that a combination of several factors, such as trematodes, UV radiation and chemicals may be working synergistically to cause the observed malformations. It is my opinion that the conclusions reached by Glare and O'Callaghan in 1999 are still valid today and I would **recommend that methoprene be the first choice for control and eradication of introduced mosquito species.**

Thomson, J. and M. Ahluwalia. 2015. Bee-killing pesticides: The fight ramps up. CBC News. May 21

> A media report on the condition and status of bees and bee colonies suggesting a connection of pesticides (especially neonicotinoids) to reductions in bee populations. Reports that CCD cases have declined substantially in Canada over the last several years.

USDA Forest Service. 2003. Human and ecological risk assessment of nonylphenol polyethoxylate-based (NPE) surfactants in Forest Service herbicide applications. Unpublished report written by David Bakke, Pacific Southwest Region Pesticide-Use Specialist. May.

> Report summarizes some USFS risk assessment work on herbicides (report not provided by commenters, but it was retrieved from the internet posting of the USFS. The Forest Service uses herbicides with a common component nonylphenol polyethoxylate (NPE) found in these commercial surfactants at rates varying from 20 to 80%. Nonylphenol (NP) and NPE exhibit some estrogen-like properties although are much weaker than the natural estrogen estradiol. The author suggests that the low hazard quotients for accidental exposure scenarios exceed a level of concern. While the accidental exposure scenarios are not the most severe one might imagine they are representative of reasonable accidental exposures. The report further suggests that the expected chronic exposure levels, there is little risk to terrestrial wildlife at any application rate considered in this risk assessment. With the typical application rates, two scenarios represent a slight risk of effects to mammals: direct spray to a small mammal (assuming the skin affords no protection) and consumption of contaminated vegetation by a large grazing mammal, such as a deer. None of the other acute exposures at the typical rates of application represent a risk of effects to terrestrial wildlife.

US Environmental Protection Agency (USEPA).1991. RED Facts: Methoprene. Pesticides and Toxic Substances, Washington, DC. March.

> Source of pesticide information about toxicity, safety, handling and application guidance for Methoprene including all registration and testing information.

US Environmental Protection Agency (USEPA). 2012a. FIFRA: Risk Assessment Methods Process for pollinator risk assessment framework. USEPA Science Advisory Panel, September. Available online at http://www.epa.gov/pollinator-protection/fifra-peer-review-proposed-risk-assessment-methods-process.

> New test methods being developed to evaluate the effect of pesticides on pollinators with indications of new laboratory tests that may be incorporated into the FIFRA guidance.

US Environmental Protection Agency (USEPA). 2012b. Test Guidelines for Pesticides and Toxic Substances. Series 850 under FIFRA, TSCA, and FFDCA. June. Available online at http://www.epa.gov/test-guidelines-pesticides-and-toxic-substances/series-850-ecological-effects-test-guidelines.

> New test methods being developed to evaluate the effect of pesticides on pollinators are provided and the potential methods to be used with indications of new laboratory tests that may be incorporated into the FIFRA guidance.

US Environmental Protection Agency (USEPA) 2015. "Interim Use Limitations for Eleven Threatened or Endangered Species in the San Francisco Bay Area," "San Francisco Bay Area Endangered Species Litigation - Center for Biological Diversity v. EPA," "Court Issues Stipulated Injunction Regarding Pesticides and the California Red-legged Frog," "Endangered Species Case – Northwest Center for Alternatives to Pesticides v. EPA," and "Endangered Species Case - Washington Toxics Coalition v. EPA." Available online at http://www.epa.gov/endangered-species.

> A record of the proceedings in a court case suing EPA by two environmental activist groups indicating the EPA is not doing enough to protect the CLRF, especially the restrictions and de-listing of the pesticides that these activists suggest adversely impact the CLRF. The suit claims to provide additional guidance and potential regulatory limits on use numerous pesticides suggesting a potential causal adverse impact on the CRLF. USEPA sponsored reply and approach to address concerns about the CRLF but has little causal connection to actual pesticide uses.

US Environmental Protection Agency (USEPA). 2015. New Labeling for Neonicotinoid Pesticides / Protecting Endangered Species from Pesticides. Available online at http://www2.epa.gov/pollinator-protection/new-labeling-neonicotinoid-pesticides and http://www.epa.gov/espp/litstatus/effects/redleg-frog/permethrin/determination.pdf.

> New information and suggested restrictions and label changes that are intended to reduce the possible impacts of these pesticides on bees and bee colonies.

US Environmental Protection Agency (USEPA). 2016. Colony Collapse Disorder. Available online at http://www.epa.gov/pollinator-protection/colony-collapse-disorder.

> Describes the Colony Collapse Disorder as the phenomenon that occurs when the majority of worker bees in a colony disappear and leave behind a queen, plenty of food and a few nurse bees to care for the remaining immature bees and the queen. Once thought to pose a major long term threat to bees, reported cases of CCD have declined substantially over the last five years. The number of hives that do not survive over the winter months – the overall indicator for bee health – has maintained an average of about 28.7 percent since 2006-2007 but dropped to 23.1 percent for the 2014-2015 winter. While winter losses remain somewhat high, the number of those losses attributed to CCD has dropped from roughly 60 percent of total hives lost in 2008 to 31.1 percent in 2013; in initial reports for 2014-2015 losses, CCD is not even mentioned.

Walker, A.N, P. Bush, J. Puritz, T. Wilson, E.S. Chang, T. Miller, K. Holloway, and M.N. Horst. 2005. Bioaccumulation and metabolic effects of the endocrine disruptor methoprene in the lobster, *Homarus americanus. Integr. Comp. Biol.* 45:118-126.

> Methoprene has toxic effects on larval and adult crustaceans. Subsequently, the seasonal lobster catches from the WLIS have decreased dramatically. The lethality of the pesticides to lobsters had been unknown. We studied the effects of methoprene while other investigators studied effects of the other pesticides. Effects on larvae, adults or both, could have contributed to this decline. We found that low levels of methoprene had adverse effects on lobster larvae. It was toxic to stage II larvae at 1 ppb. Stage IV larvae were more resistant, but did exhibit

significant increases in molt frequency beginning at exposures of 5 ppb. Juvenile lobsters exhibited variations in tissue susceptibility to methoprene: hepatopancreas appeared to be the most vulnerable, reflected by environmental concentrations of methoprene inhibiting almost all protein synthesis in this orga suggesting that methoprene affects the normal pathway of lobster cuticle synthesis and the quality of the post-molt shell. Although it is likely that a combination of factors led to the reduced lobster population in WLIS, methoprene may have contributed both by direct toxic effects and by disrupting homeostatic events under endocrine control.

Williams. B. et al., eds. 1994. Assessing Pesticide Impacts on Birds. Final Report of the Avian Effects Dialogue Group, 1988-1993. RESOLVE, Center for Environmental Dispute Resolution. Williams, B. et al., Editors.

> This is the final report of the Avian Effects Dialogue Group's five year meetings to evaluate and rank the potential for laboratory tests to project likely effects of pesticides in actual field applications. The panels included government, industry, university and private scientists who brought real life experience and information to the discussions. The resulting information helped to direct and revisit many of the testing protocols used in the USEPA pesticide registration process. The results indicate that few laboratory tests actually predict possible field effects without large uncertainty. The USEPA uses many of the recommendations to review and design new, more appropriate test guidelines.

Williams T., J. Valle, and E. Vinuela. 2003. Is the naturally derived insecticide Spinosad® compatible with insect natural enemies? *Biocontrol Science and Technology* 13:459–475.

> Reports the relative efficacy and nontarget toxicity of spinosad and reports that "spinosad is highly active against Lepidoptera but is reported to be practically nontoxic to insect natural enemies" .In their studies, very large direct doses of spinosad in laboratory setting were toxic to nontarget insect predators, while low doses did not exhibit the same level of toxicity to non-targets and was relatively safe against the bulk of the insect predators.

World Health Organization. 2015a. Carcinogenicity of tetrachlorvinphos, parathion, malathion, diazinon, and glyphosate. *The Lancet* May;16:490-91.

> Very conservative report of the UN IARC, and using the precautionary principle it reported that glyphosate, and some of the other pesticides reviewed are "possibly carcinogenic.

World Health Organization. 2015b.Evaluation of five organophosphate insecticides and herbicides. Includes rebuttal discussions. *IARC Monographs* 112.

> Actual WHO report provided by the JMPR panel for toxicology. Includes an explanation of their role and mission of the panel membership of the JMPR of the World Health Organization in the United Nations. This panel provides a very conservative report of the UN IARC, and using the precautionary principle it reported that glyphosate, and some of the other pesticides reviewed are "possibly carcinogenic."

World Health Organization (WHO). 2015c. Joint FAO/WHO Meeting on Pesticide Residues (JMPR). Available online at http://www.who.int/foodsafety/areas_work/chemical-risks/jmpr/en/ [accessed October 1, 2015].

> Explanation and panel membership of the JMPR of the World Health Organization in the United Nations. This panel provides a very conservative report of the UN IARC, and using the precautionary principle it reported that glyphosate, and some of the other pesticides reviewed are "possibly carcinogenic.

Wu, X., D.H. Bennett, B. Ritz, J. Frost, D. Cassady, K. Lee, and I. Hertz-Picciotto. 2011. Residential insecticide use in Northern California homes with young children. *Journal of Exposure Science and Environmental Epidemiology* 21: 427-436.

> Residential insecticide usage and actual application details were collected in a population-based sample of 477 households residing within 22 counties in northern California with at least one child of age ≤ 5 years between January 2006 and August 2008. Altogether, 80% of the households applied some type of insecticide in the previous year, with half of this population using two or more application methods. Of the households using insecticides, half reported applying insecticides relatively infrequently (<4 times per year), whereas 11-13% reported high frequency of use (>24 times per year). Application frequency was temperature dependent, with significantly more applications during the warmer months from May through October. Spot treatments appeared to be the most prevalent application pattern for sprays. For one out of three of the indoor applications, children played in the treated rooms on the day of the application, and for 40% of the outdoor applications, pets played in the treated area on the day of the application. These authors report that describing the intensity of insecticide use and accompanying behaviors in families with young children may inform future insecticide exposure modeling efforts, and ultimately, risk assessments

Zhang, X. Hu, J.Luo, Z. Wu, L. Wang, B. Li, Y. Wang, and G. Sun. 2015. Degradation dynamics of glyphosate in different types of citrus orchard soils in China. *Molecules* 20: 1161-1175.

> In this study, the degradation dynamics of glyphosate in different types of citrus orchard soils in China were evaluated under field conditions. Glyphosate soluble powder and aqueous solution were applied at 3000 and 5040 g active ingredient/hm2, respectively, in citrus orchard soils, and periodically drawn soil samples were analyzed by high performance liquid chromatography. The results showed that the amount of glyphosate and its degradation product aminomethylphosphonic acid (AMPA) in soils was reduced with the increase of time after application of glyphosate formulations. Indeed, the amount of glyphosate in red soil from Hunan and Zhejiang Province, and clay soil from Guangxi Province varied from 0.13 to 0.91 µg/g at 42 days after application of aqueous solution. The amount of glyphosate in medium loam from Zhejiang and Guangdong Province, and brown loam from Guizhou Province varied from less than 0.10 to 0.14 µg/g, Overall, these findings demonstrated that the degradation dynamics of glyphosate aqueous solution and soluble powder as well as AMPA depend on the physicochemical properties of the applied soils, in particular soil pH, which should be considered in the application of glyphosate herbicide.

Zoecon Corporation. 1974. Technical bulletin on Altosid. Toxicological properties.

> Technical bulletin describing the physiochemical characteristics of Altosid (methoprene) with information on applications restrictions, and target species. This bulletin was updated at least once by USEPA in 2001.

Bill A. Williams PhD

Current Position

Senior Consultant & Risk Assessor

Discipline Area

> Ecological & Human Health Risk Assessments
> Natural Resource Damage Assessments
> Environmental Site Assessments
> Probabilistic Risk Assessments
> Toxicology
> Biomarker Research
> Mitigation Strategies

Years' Experience

47 Years

Joined Cardno

2009

Education

> National Academy of Sciences Post-Doctoral 1968-1970
> PhD, Physiology & Biophysics, University of Illinois, Urbana, 1968
> MS, Physiology & Biophysics, University of Illinois, Urbana, 1965
> BA, Physiology & Biophysics, University of California, Berkeley, 1963

Affiliations

Summary of Experience

Dr. Williams has more than 40 years of experience and expertise in environmental risk assessment and toxicology including CERCLA, NRDA, NEPA, and CEQA projects ranging from upland to sediment to freshwater/marine projects. Dr. Williams has been a member of numerous international, National Academy, and federal committees and workshops to define risk assessment guidelines, test procedures, field study approaches, and avian and mammalian test protocols, and provide other technical assistance utilized by USEPA regulators. He helped develop USEPA's Framework for Ecological Risk Assessment and USEPA's risk assessment of 2,3,7,8 TCDD. He was a charter member of the Avian Dialogue Group, convened by the Conservation Foundation (RESOLVE) to bring industry, academia, and government regulators together to resolve conflicts between the groups. Dr. Williams has led and supported dozens of successful projects that were acceptable to the Washington Department of Ecology, Oregon Department of Environmental Quality, Oregon Department of Fish and Wildlife, US Environmental Protection Agency, Region X, and numerous other USEPA regions nationwide.
Dr. Williams has served on several Oregon DEQ advisory science committees and workshops. He has been a member of several national and regional EPA Science Advisory Panels, including the SAP panels on endocrine disruptors, uncertainty in risk assessments, and the panel on use of laboratory data in estimates of risk to wildlife.

Significant Projects

Expert Witness-Senior Consultant- Ecological Risk Estimates and Development of Integrated Pest Management Guidance for Pesticides for Mid-Peninsula Open Space District, Los Altos, California.

Dr. Williams provided strategic and scientific support in the development of an Integrated Pest Management (IPM) system for use by the Mid-Peninsula Open Space District. The IPM is tailored to the vectors of concern, the pesticides and herbicides used by the District, and potential risk to the non-target aquatic and terrestrial species. Pesticides incorporated into the IPM were based on evaluations of the use of more than 20 herbicides (with emphasis on use of glyphosate in regional wildland areas for control of over 60 invasive plant species), dozens of insecticides, structural and nuisance agricultural and urban pests, and selected regional wildlife pests. The IPM developed for the District included control of ants, cockroaches, wasps and flies, ticks, and mosquitoes. The IPM plan included recommendations for establishing and conducting pest identification, conducting damage assessments, establishing tolerance levels and several tiers of proposed vector control that addressed top to bottom elements of implementation strategies. The IPM delivered to the District included more than 120 pages of evaluations and recommendations, including extensive quantitative Ecological and Human Health Risk assessments. Dr. Williams prepared and supported draft and final documents and graphics for use in public meetings relating to the results of the studies.

Expert Witness-Senior Consultant- Ecological Risk Estimates and Development of Herbicide Risks to Non-target vegetation and Wildlife in California Wildfire Areas for the California Department of Forestry & Fire Protection (CAL FIRE).

Dr. Williams provided scientific reviews and risk assessments addressing the potential adverse effects of CAL FIRE herbicide use to reduce the potential for and mitigation of wildfires in California. The Vegetation Treatment Program (VTP) project included evaluation of potential adverse impacts of herbicides used in forestry and rangeland to control brush

- Society of Environmental Toxicology & Chemistry
- Pacific Northwest Society of Environmental Toxicology & Chemistry

and grasses and for maintenance of areas that have been previously cleared of heavy vegetative fuels. The primary herbicides of concern in the evaluation were the numerous products containing glyphosate as the active ingredient. Glyphosate was one of the most effective herbicides for control of the vegetation that provides potential fuel for wildfires. Control of this vegetation is the target of the CAL FIRE VTP management process statewide. Because vegetation control treatments are not appropriate in all locations and can cause environmental impacts, the recommendations were designed for site specific conditions in the wide range of wildfire environments in the State. In response to the need for their VTP, comprehensive guidelines were developed for the practical management and operation of the VTP including prioritization, selection, assessment, and mitigation of appropriate vegetation treatments. The reviews and documents provided to CAL FIRE for its Vegetation Treatment Program provides the framework that is being used for the implementation of appropriate fuels treatments across non-federal lands in California.

Senior Consultant- Ecological Risk Estimates of Pesticides for Nine Mosquito/Vector Control Districts, Northern California

Dr. Williams is providing strategic and scientific support in the development of the ecological and human health assessments of commercial pesticide product applications (46 active ingredients and adjuvants) for the control of mosquitoes and other vectors of human diseases and discomfort in nine counties of California. Providing impact analyses for both chemical and nonchemical treatment methods of control in Programmatic Environmental Impact Reports (under CEQA) for the nine districts/agencies in the San Francisco Bay Area and Monterey County. . The impact analyses considered the toxicity and fate and transport of the active ingredients based on a literature review including ultra-low volume (ULV) spray applications. Also included were herbicides for the control of mosquito-breeding habitat.

Senior Consultant/Technical Advisor/Ecological Risk – Passaic River Project, Newark, New Jersey, Passaic Coordinating Partners Group (CPG)

Providing strategic and conceptual support to a member of the CPG for their Passaic River facility. Developing strategy and proactive approaches to CERCLA and NRDA mitigation and restoration options. Working with CPG member to define their potential risk, and strategy for acceptable allocation within the Consortium of PRPs on the Passaic River. Providing comprehensive evaluation of Ecological and Human Health risks. Providing on-going technical review of all on-going work, including existing work plans, schedules, and work elements to develop new plans and approach to streamline the schedule and to reduce costs.

Senior Consultant- NRDA-Gulf of Mexico

Dr. Williams is on the Cardno NRDA team responding to the Deepwater Horizon accident and oil spill in the Gulf of Mexico on behalf of BP Exploration & Production Inc. (BP). Bill has provided support to the Terrestrial Mammal and Bird Technical Working Groups (TWG) and participated in the design or implementation of the cooperative NRDA studies included in those TWGs.

Senior Consultant- Ecological Risk Estimates of Contamination at a Golf Course in Southern California

Dr. Williams provided strategic and scientific support in the development of the risk estimates of commercial use and application of herbicides for the control of unwanted vegetation of California. Prepared documents and graphics for use in discussions and public meetings relating the results of the studies. Confidential Client.

Senior Scientist – Evaluation of Mercury and Other Contaminants in Outfall Plumes, Port Gamble, Washington and Mare Island Site, City of Vallejo

Evaluated and critiqued contaminants detected in facility outflow, and estimate risk to aquatic and terrestrial resident and endangered species. Prepared presentation approaches and materials for discussions with U.S. Environmental Protection Agency (EPA) Region 10.

Senior Project Manager – Ecological Risk Assessment, Whitefish River, Montana, Burlington Northern Santa Fe

Developed an ecological risk assessment for a river adjacent to a railroad fueling facility. Reviewed results of initial sampling of sediment in the river to identify preliminary chemicals of potential ecological concern, and then prepared a sampling and analysis plan for additional studies needed to conduct the risk assessment, including co-located sediment and benthic samples. Compared the results of the benthic community analysis with chemical data for co-located sediment samples to evaluate whether chemicals in sediment were resulting in toxicity to the benthos or whether physical conditions were responsible for changes in the benthic communities. The risk assessment estimated potential risks to resident and endangered ecological receptors, and identified protective sediment concentrations of PAHs and PCBs for the most sensitive ecological receptors.

Senior Project Manager – Probabilistic Risk Assessments, Southeastern U.S.; FMC Corp. and American Cyanamid, Princeton, New Jersey; and Novartis, Inc. and Rhone Poulenc, Durham, North Carolina

While employed by Kennedy Jenks, conducted probabilistic risk assessments to assess potential risks from application of pesticide to agricultural crops in southeastern United States. This risk assessment was conducted to evaluate numerous application and exposure scenarios that might result in risk to aquatic and terrestrial resident, endangered, and other non-target wildlife. Results from these studies are being used to evaluate the potential use of probabilistic risk assessment to evaluate the appropriateness of EPA restrictions on the labeling of the pesticide.

Senior Risk Assessor – Human Health and Ecological Risk Assessments, Spokane, WA, Teck Cominco America

Provided strategic support and risk assessments for a potential Superfund listing for Lake Roosevelt, Washington Presented approaches to EPA Region 10 for the development of the characterization, RI/FS, and potential NRDA for Lake Roosevelt. As Senior NRDA advisor and risk assessor, provided strategic support and risk assessments in support of a potential Superfund listing for Lake Roosevelt. Aquatic, sediment, and upland sources in the lake were being characterized for the potential cleanup of metals and other contaminants.

Expert Witness – Ecological Risk Assessment, Columbia River Basin, Bellevue, Washington, Northwest Pulp and Paper Association,

Provided expert evaluation and testimony concerning the impact of pulp and paper effluents, including dioxin and other organochlorines, on populations of Bald Eagles in the Columbia River Basin. The focus of the project was to determine the extent of potential exposure and possible effects of pulp mill operations on the Bald Eagle population in the Columbia River Basin. An ecological risk assessment was conducted that focused on the reproductive success and population dynamics of resident and endangered species, especially the Bald Eagles in the region. As a result of the assessment, it was concluded that the number of nesting pairs of Bald Eagles in the region had far surpassed the U.S. Fish and Wildlife Service Recovery goals, and that the population of eagles in the region was actually vigorous and strong. The results of the study were presented at open congressional hearings and to the Department of Interior. Shortly thereafter, DOI changed the listing from Endangered to Threatened with caveats for several regions.

Consultant – Human Health Risk Assessments, Klamath Falls, Oregon

Provided strategic support and risk assessments for a site contaminated with asbestos and heavy metals. Developed sampling and analysis protocols, data objectives, and soil risk triggers for adults, children, and pets. Provided several risk scenarios for exposure to both the buried and surface asbestos, including evaluation of ACM and inert moieties. Provided expert testimony and presentations for the plaintiffs.

Senior Risk Assessor – Ecological Risk Assessment, Eugene, OR, L.D. McFarland, Colorado

Provided an ecological risk assessment of pentachlorophenol and copper on freshwater fish and other aquatic species. Provided study plan, sampling plan, and fish residue testing oversight. Provided complete review of aquatic residue data, including hazard and exposure data for use in the preliminary ecological risk assessment. The focus was the impact of a spill of lumber treatment products on fish and benthic invertebrates in two small sport-fishing ponds. The spill included products containing creosote and substantial amounts of PCPs. Although there was substantial mortality of some fishes, it was determined that the impact would be short-lived, and that the ponds could be used for sport fishing after a period of a few months without additional mitigation. The results and recommendations of the project were accepted by the Oregon Department of Fish and Wildlife.

Senior Risk Assessor – Environmental Risk Assessment, Refinery Terminal Site, Willamette River, Portland, Oregon, Texaco/Equilon

Conducted human health and ecological risk assessments focusing on the potential risk of upland operations and river sediments at a refinery terminal site on the Willamette River. Constituents of concern included benzene, toluene, ethylbenzene, and xylene (BTEX); metals; and PAHs. The project was conducted according to the Oregon Department of Environmental Quality Risk Assessment guidelines.

Senior Risk Assessor – Environmental Risk Assessment, Nine Navy Bases in the San Francisco Bay Area, San Bruno, California, U.S. Navy

Conducted human health and ecological risk assessments for nine Navy bases in the San Francisco Bay area. Developed and instituted guidance for Feasibility Study Design, and provided mitigation strategies based on protective concentrations of contaminants acceptable to the Regional Boards, the U.S. Navy, and other regulators. Project involved use of innovative approaches to refining ecological estimates of exposure to higher trophic level receptors. Approach included site-specific and realistic estimates of doses to receptors using probabilistic techniques, and resulted in the innovative approach to development of "protective chemical levels" (PCLs) still in use by regulators and other environmental assessors.

Senior Risk Assessor – Environmental Sampling and Risk Assessment, Walnut Creek, California, Carollo Engineers

Provided project and sampling plan oversight and scientific support to a risk-based analysis of the contribution of publicly owned treatment works (POTW) effluent to waterways, including risk to aquatic organisms and birds at sites in northern California. Risk assessment has focused on effluents and contamination according to the National Toxics Rule, the California Toxics Rule, and EPA Ambient Water Quality Criteria guidelines. Constituents evaluated included organics, metals, and PAHs.

Senior Risk Assessor – Ecological Risk Assessment, Washington, DC, U.S. Environmental Protection Agency (EPA)

Produced a series of wildlife toxicity profiles for PCBs for use by EPA as guidelines for acceptable exposure levels of PCBs to birds and mammals. In addition to acute toxicity profiles, the report also presented thresholds and acceptable exposure levels for reproduction, growth, and immunological endpoints. The report was used as a preliminary guideline, and was incorporated into EPA wildlife exposure handbooks

Senior Risk Assessor – Ecological Risk Assessment, Washington, DC, EPA

Developed position documents for the EPA Office of Toxic Substances for the risk of dioxin to terrestrial wildlife methods to provide predictive impacts on birds and mammals. In addition to acute toxicity profiles, the report also presented thresholds and acceptable exposure levels for reproduction, growth, and immunological endpoints. The report was used as a preliminary guideline, and was incorporated into EPA wildlife exposure handbooks for dioxin.

Senior Risk Assessor and Expert Witness – Ecological Risk Assessments, Various Locations, Multiple Clients

While at EP&T, developed a series of comprehensive ecological risk assessments for new agricultural chemicals proposed for registration and chemicals due for re-registration according to the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). Risk assessments included predictive risk to non-target aquatic and terrestrial wildlife. The results of the studies were prepared in formats acceptable to the state and EPA regulators. Clients included American Cyanamid, Princeton, NJ; Rhone-Poulenc, Durham, NC; Ciba Geigy Company; and Dow Chemical.

Workshops and Invited Panel Member

- Invited Speaker, “Implementing Probabilistic Ecological Assessments: A Consultation”. National Academy of Sciences Advisory Panel to USEPA, Washington, DC. 5-7 April 2001
- Invited Instructor. “Ecotoxicology for Hazard Communication”. Society of Chemical Hazard Communication Annual Meeting. Washington, DC. 3 October 1999
- Invited Panel Member, “Review of Probabilistic Risk Assessment for Chlorfenpyr”. National Academy of Sciences Advisory Panel to USEPA, Washington, DC. 23-24 September 1999
- Invited Panel Member, “Uncertainty Analysis in Ecological Risk Assessments” SETAC Workshop, Pellston, MI. August, 1995
- Invited Panel Member, Session Chair, SETAC/OECD Joint Workshop on Avian Toxicity Laboratory Testing. Pensacola, FL. 4-7 December 1994
- Program Chair. Ecotoxicological Principles for Avian Field Studies. SETAC Pellston Workshop on Radiotelemetry for Avian Field Studies. Asilomar, CA. January 1993
- Invited Panel Member, “Wildlife Criteria External Advisory Panel”. Washington State Department of Ecology, Olympia, WA. 1994-1998
- Invited Panel Member, “Environmental Effects Assessment Workshop”, USEPA, Office of Hazardous Waste, Seattle, Washington. 24-28 July 1988
- Invited Charter Member, “Avian Field Testing Dialogue Group”, The Conservation Foundation, Wash., DC. 1988-1992
- Invited Panel Member, “Risk Assessments for Land Application of Pulp and Paper Mill Sludge”, USEPA Workshop on Dioxin, Baltimore, MD. September 1991

> Invited Panel Member, Session Chair, SETAC Pellston Workshop on the Population Ecology and Wildlife Toxicology of Agricultural Pesticide Use: A Modeling Initiative for Avian Species. Kiawah Island, S. Carolina. July 1990
> Panel Panel Member, "Standing Committee on Ecotoxicology of the Risk Assessment Council, USEPA, Washington, DC. 1987-1988
> Invited Panel Member, "Terrestrial Environmental Risk Assessments" in the Organization of European Council of Development" Conference, Wash, DC. 13-17 June 1988
> Chair and Panel Member "Critical Ecosystems of Concern," Oregon State University. September 1987
> Invited Panel Member, SETAC Conference, "Research Priorities in Ecological Risk Assessment," Breckenridge, Colorado. August 1987

Chair/Session Organizer Technical Meetings

> Session Chair: Emerging Pollutants. Society of Environmental Toxicology and Chemistry. November 14-18, 2004, Portland, Oregon
> Organizational/Program. Pacific Northwest Society Environmental Toxicology and Chemistry. April, 2004. Port Townsend, WA.
> Session Chair: Applications of Ecotoxicology to Real World Problems. Society Environmental Toxicology and Chemistry. November 7-12, 2003, Austin Texas
> Session Chair. Exposure and Effects Endpoints. Society Environmental Toxicology and Chemistry. November 7-12, 2003, Austin Texas
> Organizational/Program Co-Chair. Pacific Northwest Society Environmental Toxicology and Chemistry. May, 2002, Portland, Oregon
> National Academy of Sciences Risk Assessment Task Force (1988-1990)
> Wildlife Toxicology Special Session on Acetylcholinesterase Assays in the Field. 10th Society Environmental Toxicology and Chemistry. Toronto, Canada. 29 October – 3 November 1989
> ASTM Committee on Field Protocols for Wildlife Population Studies (1987-1990)
> ASTM Committee on Acetylcholinesterase Determination in Field Studies (1988)
> Wildlife Toxicology Session Chair, 8th Society Environmental Toxicology and Chemistry, Pensacola, Florida. 9-12 November 1987
> Wildlife Toxicology Session Chair, 7th Society Environmental Toxicology and Chemistry, Washington, DC. 3-6 November 1986
> Acetylcholinesterase Assay Symposium Chairman, VII Society Environmental Toxicology and Chemistry, Washington, DC. 3-6 November 1986
> Wildlife Toxicology Session, 6th Society Environmental Toxicology and Chemistry, St. Louis, MO. 8-22 November 1985
> General Conference Chairman, Wildlife Toxicology Symposium, Portland, OR. January 1984

Publications

Selected Book Chapters

> Kapustka, L.A., B.A. Williams, A. Fairbrother, J. Glicken, and R. Bennett. 1996. "Environmental Risk Assessment for Sustainable Cities -- A Position Paper." United Nations Environmental Programme-International Environmental Technology Centre Special Publication # 3. Osaka, Japan.

> Williams, B.A. and J.M. Emlen. 1994. "Population Models as a Research Tool: An Empirical Perspective." In: Wildlife Toxicology and Population Modeling: Integrated Studies of Agroecosystems, pp. 501-508. Kendall, R.J and T.E. Lacher, eds. Lewis Publishers.

> Williams, B.A. 1993. "Biomarkers in Avian Field Studies: Environmental Toxicology and Risk Assessment." In: ASTM Volume 2 STP 1216, Gorsuch, J.W., F.J. Dwyer, C.G. Ingersoll, and T.W. La Point, eds. American Society for Testing and Materials, Philadelphia.

Selected Journal Publications (Of 55)

> Fairbrother, A., L.A. Kapustka, B.A. Williams, and R.S. Bennett. 1997. "Effects - Initiated Assessments Are Not Risk Assessments." Human and Ecological Risk Assessment: (3), No. 2, pp. 119-124.

> Fairbrother, A., L.A. Kapustka, B.A. Williams, and J. Glicken. 1996. Ecological Risk Assessment Benefits Environmental Management. Sandia Report SAND94 3062 UC - 630. Sandia National Laboratories, Albuquerque, NM.

> Kapustka, L.A., B.A. Williams, and A. Fairbrother. 1996. "Evaluating Risk Predictions at Population and Community Levels in Pesticide Registration - Hypotheses To Be Tested." Environ. Toxicol. & Chem. 15(4), 427-431.

> Williams, B.A., et al. 1994. "Assessing Pesticide Impact in Birds. Final Report of the Avian Effects Dialogue Group (1988-1993)." Resolve, 156 pp., Washington, DC.

> Williams, B.A. and J.M. Emlen. 1994. "Population Models as a Research Tool: An Empirical Perspective." In: Wildlife Toxicology and Population Modeling: Integrated Studies of Agroecosystems, pp. 501-508. Kendall, R.J. and T.E. Lacher, eds. Lewis Publishers.

> Williams, B.A. 1993. "Biomarkers in Avian Field Studies: Environmental Toxicology and Risk Assessment." In: ASTM Volume 2 STP 1216, Gorsuch, J.W., F.J. Dwyer, C.G. Ingersoll, and T.W. La Point, Eds. American Society for Testing and Materials, Philadelphia, PA.

> Williams, B.A., et al. 1991. "Assessing Pesticide Impact in Birds. Discussions of the Avian Effects Dialogue Group (1989-1991)." Resolve, Washington, DC.

> Kilbride, K.M., J.A. Crawford, K.L., Blakely, and B.A. Williams. 1992. "Habitat Use by Breeding Female California Quail in Western Oregon." J. Wildl. Manage, 56(1):85-90.

> Bennett, R.S., B.A. Williams, D.W., Schmedding, and J.K. Bennett. 1991. "Effects of Dietary Exposure to Methyl Parathion on Egg Laying and Incubation in Mallards." Environmental Toxicology and Chemistry, 10(4): 501-507.

> Buerger, T.T., R.J. Kendall, B.S. Mueller, T. DeVos, and B.A. Williams. 1991. "Effects of Methyl Parathion on Northern Bobwhite Survivability." Environmental Toxicology & Chemist, 10(4) 527-532.

Selected Recent Abstracts (Of 105)

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