Statement of Best Management Practices For Santa Cruz County Mosquito and Vector Control

Santa Cruz County Mosquito Abatement / Vector Control CSA53

FOR WATER QUALITY ORDER NO **2011-0002-DWQ** STATEWIDE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) PERMIT FOR RESIDUAL PESTICIDE DISCHARGES TO WATERS OF THE UNITED STATES FROM VECTOR CONTROL APPLICATIONS
GENERAL PERMIT NO. **CAG 990004**

BACKGROUND

The above named district is seeking coverage under the Permit as a "public entity" that applies aquatic pesticides for vector control in waters of the United States. The Santa Cruz County Mosquito and Vector Control (MVC) is a County Service Area operating as a division of the County Agricultural Commissioner. MVC was established in 1993 by Board resolution through CA Government Code (25210) in response to many years of public demand for relief from pestiferous mosquitoes. The MVC's underlying health and safety statutory mandates and requirements are outlined within the California Health and Safety Code (Division 3, Sections 2000 *et seq.*).

The program's primary function is vector surveillance and control following Integrated Pest Management practices incorporating public education, biological control, source reduction and least toxic pesticides that have minimal impact on people, wildlife, and the environment. The program and CEQA Technical Review can be found at the MVC website http://www.agdept.com/mvc.html .

The mosquito larvicides used are applied to water bodies with the purpose and intent of killing mosquito larvae. Extensive research has indicated that little or no lasting environmental impacts are imparted. Currently used EPA and DPR registered aquatic pesticides (*Bacillus thuringiensis israelensis*, *B. sphaericus*, methoprene and surface films) degrade rapidly in the environment, thus the areal extent and duration of residues may be considered negligible. When integrated with other strategies including vegetation management, surface acting agents, and predatory mosquitofish, following the label of these aquatic pesticides constitute safe and effective best management practices (BMP).

This document presents the BMPs of the MVC as a requisite to the NPDES Aquatic Pesticides Permit. Currently established MVC practices are sustainable, prioritizing environmental safety, using least-toxic alternatives and proven IPM systems developed following guidelines developed by the University of California and California Department of Public Health. Aquatic pesticides are applied at low rates leaving the physical parameters of the environment (i.e., temperature, salinity, turbidity and pH) essentially unchanged.

Statement of Best Management Practices

The MVC was formed pursuant to Government Code (25210.80) in 1993 by local citizens and governments to reduce the nuisance of biting mosquitoes and the associated risks of vector-borne disease to residents of the County. This includes vector-borne diseases such as West Nile virus and malaria.

A diverse group of agencies regulate and oversee MVC's pesticide use. Vector control districts are indirectly regulated by the Department of Pesticide Regulation (DPR). Supervisors and applicators are licensed through the California Department of Public Health (CDPH). Pesticide use by vector control agencies is reported to the County Agricultural Commission (CAC) in accordance with a 1995 Memorandum of Understanding among DPR, CDPH, and the CACs for the Protection of Human Health from the Adverse Effects of Pesticides and with cooperative agreements entered into between CDPH and vector control agencies, pursuant to Health and Safety Code section 116180.

The MVC has implemented Best Management Practices (BMP) based on the philosophy of integrated pest management (IPM). The basic components of the program are:

(1) surveillance of pest populations,
(2) determination of treatment thresholds,
(3) selection from a variety of control options including physical, cultural, biological and chemical techniques
(4) training and certification of applicators
(5) public education

1. MOSQUITO SURVEILLANCE

Surveillance of pest populations is essential for assessing the necessity, location, timing and choice of appropriate control measures. It reduces the aerial extent and duration of pesticide use, by restricting treatments to areas where mosquito populations exceed established thresholds.

The 19 mosquito species known in the County differ in their biology, nuisance and disease potential and susceptibility to larvicides. Field data such as; species, density, and stages present are used to select an appropriate control strategy from integrated pest management alternatives.

A. Larval Mosquito Surveillance

Surveillance for immature mosquitoes is conducted by MVC staff assigned to zones within the district. These technicians maintain a list of known sites of mosquito development and visit them on a regular basis. When a site is surveyed, water is sampled with a 12 oz dipper to check for the presence of mosquitoes. Samples are examined in the field or laboratory to determine the abundance, species, and life-stage of mosquitoes present. This information is compared to historical records and used as a basis for treatment decisions.

B. Adult Mosquito Surveillance

Although control of larval mosquitoes is preferred, it is not possible to identify all larval sources. Therefore, adult mosquito surveillance is needed to pinpoint problem areas and locate previously unrecognized or new sites of larval development. Adult mosquitoes are sampled using standardized trapping techniques (i.e., New Jersey light traps, carbon dioxide-baited traps and oviposition traps).

Mosquitoes collected by these techniques are counted and identified to species. The spatial and seasonal abundance of adult mosquitoes is monitored on a regular basis and compared to historical data.

C. Service Requests

Information on adult mosquito abundance from traps is augmented by tracking mosquito complaints from residents. Analysis of service requests allows district staff to gauge the success of control efforts and locate undetected sources of mosquito development. The MVC conducts public outreach programs and encourage local residents to contact us to request services. When such requests are received, technicians visit the area, interview residents and search for sources that may have been missed. Residents are asked to provide a sample of the insect causing the problem. Identification of these samples provides information on the species present and can be helpful in locating the source of the complaint.

2. PRE-TREATMENT DECISION-MAKING

A. Thresholds

Treatment thresholds are established for mosquito developmental sites where potential disease vector and/or nuisance risks are evident. Therefore, only those sources that represent imminent threats to public health or quality of life are treated with larvicides (see attached Threshold explanation). Treatment thresholds are based on the following criteria:

- Mosquito species present
- Mosquito stage of development
- Nuisance or disease potential
- Biting complaints
- Mosquito abundance
- Flight range
- Proximity to populated areas or human activity
- Size of source
- Presence/absence of natural enemies or predators
- Presence of sensitive/endangered species

B. Selection of Control Strategy

Dip-sampled larvae are counted and averaged for areas of a breeding site, also trapping results are evaluated. When thresholds are exceeded an appropriate control strategy is implemented. Control strategies are selected to minimize potential environmental impacts while maximizing efficacy (see attached Larval Treatment Criteria and Control Selection Criteria). The method of control is based on the threshold criteria but also:

- Habitat type
- Water conditions and quality
- Weather conditions
- Cost
- Site accessibility
- Size and number of developmental sites

3. CONTROL STRATEGIES

A. Source Reduction and Physical Control

Source reduction includes elements such as, physical control, habitat manipulation and water management, and forms a component of the MVC's IPM program. The goal of physical control is to eliminate or reduce mosquito production at a particular site through alteration of habitat, where appropriate. Physical control is usually the most effective mosquito control technique because it provides a long-term solution by reducing or eliminating mosquito developmental sites and ultimately reduces the need for chemical applications.

Physical control programs conducted by MVC may be categorized into three areas: "maintenance", "new construction", and "cultural practices" such as vegetation management and water management. Maintenance activities are conducted within managed tidal and non-tidal marshes, seasonal wetlands, and flood control channels and in some creeks adjacent to wetlands. The following activities are classified as maintenance:

* Removal of sediments from existing water circulation ditches
* Repair of existing water control structures
* Removal of debris, weeds and emergent vegetation in natural channels
* Clearance of brush for access to wetland areas
* Filling of existing, non-functional water circulation ditches to achieve required water circulation dynamics and restore ditched wetlands.

The preceding activities are included within the permits obtained from the U.S. Army Corps of Engineers (USACE) and Central Coast Regional Water Quality Control Board (CCRWQCB) and coordinated by the CDPH. Additional agencies involved may include the Coastal Conservancy, US Fish and Wildlife Service and the California Department of Fish and Game. Obtaining permits is increasingly laborious, detailed and difficult, requiring administrative resources sometimes beyond our capability, and frustrated by the difficulty of predicting the maintenance project sites necessary to complete the documents. When combined with the cost and logistics of obtaining labor, equipment and biological oversight for performing source reduction, we often find that responsive solutions such as larviciding as necessary to be the more efficacious and expedient solution.

For wetland restoration, excavation of new ditches or construction of new water control structures, the MVC would consult with the County or Cities' Public Works departments to initiate new or remedial physical control projects. In most cases, MVC tries to work with landowners to manage their lands in a manner that does not promote mosquito development. MVC staff review proposals for wetlands construction to assess their impact on mosquito production. MVC then submits recommendations on hydrological design and maintenance that will reduce the production of mosquitoes and other vectors. This proactive approach involves a collaborative effort between landowners and MVC. Implementation of these standards may include cultural practices such as water management and aquatic vegetation control.

B. Biological control

Biological control agents of mosquito larvae include predatory fish, predatory aquatic invertebrates and mosquito pathogens. Of these, only mosquitofish are available in sufficient quantity for practical use in mosquito control programs. Natural predators may sometimes be present in numbers sufficient to reduce larval mosquito populations. The MVC’s goal is to preserve and encourage species diversity while selectively reducing mosquitoes. Biological control is sometimes used in conjunction with selective bacterial or chemical insecticides.

1. Mosquitofish (*Gambusia affinis*)

The mosquitofish, *Gambusia affinis*, is a natural predator of mosquito larvae used throughout the world as a biological control agent for mosquitoes. Although not native to California, mosquitofish are now ubiquitous throughout most of the State's waterways and tributaries, where they have become an established part of aquatic food chains. In most natural pond locations in this area they pre-date the establishment of the MVC. They can be stocked in discrete mosquito larval sources by trained district technicians where appropriate, such as in backyard ornamental ponds and other artificial containers where there is not in-flow or out-flow to natural systems or ESA-listed species.

Advantages: The use of mosquitofish as a component of an IPM program may be environmentally and economically preferable to habitat modification or the exclusive use of pesticides, particularly in altered or artificial aquatic habitats. Mosquitofish are self-propagating, have a high reproductive potential and thrive in shallow, vegetated waters preferred by many mosquito species. They prefer to feed at the surface where mosquito larvae concentrate. These fish can be readily mass-reared for stocking or collected seasonally from sources with established, healthy populations for redistribution.

Barriers to Use: Water quality conditions, including temperature, dissolved oxygen, pH and pollutants may reduce or prevent survival and/or reproduction of mosquitofish in certain habitats. Mosquitofish may be preyed upon by other predators. They are opportunistic feeders and may prefer alternative prey when available. Introduction of mosquitofish may modify food chains in small contained pools and have potential impacts on endemic fish and shrimp in such situations. Wildlife agencies suspect mosquitofish may impact survival of amphibian larvae through predation or transmission of disease. Recent research has shown no significant impact on survival of the threatened California red-legged frog (Lawler et al. 1998), but mosquitofish have been shown to negatively impact the survival of the California tiger salamander (Leyse and Lawler 2000).

Impact on water quality: As used, mosquitofish populations are unlikely to impact water quality.

Solutions to Barriers: Strict stocking guidelines adopted by MVC restrict the use of mosquitofish to discrete habitats such as artificial containers, ornamental ponds, abandoned swimming pools, cattle troughs, stock ponds, etc., where water quality is suitable for survival and sensitive or endangered aquatic organisms are not present. Fish are treated for disease or parasites and are generally stocked at population densities lower than those required for effective mosquito control and allowed to reproduce naturally commensurate with the availability of mosquito larvae and other prey. MVC guidelines restrict capture from or stocking in habitats when ESA-listed amphibians, fish or other sensitive species/life stages or diseases may be present.

2. Natural predators: aquatic invertebrates

Many aquatic invertebrates, including diving beetles, dragonfly and damselfly naiads, backswimmers, water bugs and hydra are natural predators of mosquito larvae.

Advantages: In situations where natural predators are sufficiently abundant, additional mosquito control measures including application of pesticides may be deemed unnecessary.

Barriers to Use: Predatory aquatic invertebrates are frequently not sufficiently abundant to achieve effective larval control, particularly in disturbed habitats. Most are generalist feeders and may prefer alternative prey over mosquito larvae if available and more accessible. Seasonal abundance and developmental rates often lag behind mosquito populations. Introduction or augmentation of natural predators has been suggested as a means of biological control, however there are currently no commercial sources since suitable mass-rearing techniques are not available.

Solutions to Barriers: The presence and abundance of natural predators is noted and taken into account during the larval surveillance process. Conservation of natural predators, whenever possible, is achieved through judicious use of highly target-specific pesticides including bacterial insecticides, with minimal impacts on non-target taxa.

Impact on water quality: As predatory invertebrates represent a natural part of aquatic ecosystems, they are unlikely to impact water quality. There are no established standards, tolerance, or EPA approved tests for aquatic invertebrate populations.

3. Insectivorous bats and birds

Bat dietary studies have shown that insectivorous bats are opportunistic feeders and that mosquitoes make up a very small percentage of their natural diet. Bats' behavior when locked in a room with nothing to feed upon but mosquitoes (and interpolated to estimate several thousand per hour) has no bearing on their behavior in the wild.

In order for a generalist insect predator to be an effective control, mosquito density must be high enough for random foraging to result in a drop of the mosquito population, and the height of activity for the predator and mosquitoes must coincide. In most locations, given a choice between chasing down a random mosquito or a fat moth or beetle, these insectivores will instinctively make the energy expenditure / protein gain decision favoring the large prey. It is far easier for bats to hunt around a streetlight. Bats and swallows are otherwise intrinsically important in natural ecosystems and helpful pest predators in gardens and agriculture.

It is sometimes asked why mosquito control districts do not use bat or swallow houses to supplement their other integrated mosquito management methods. Most bat house designs do not have the insulating values necessary to encourage bats to over-winter. Bats and swallows may abscond to highway overpasses and roof eaves and attics. In the latter their fecal deposits and mites may be a nuisance. Public agencies cannot accept the liability of encouraging a low benefit activity that could result in home damage, pest control expenditures or in the worst case scenario, rabies transmission from bats.

C. Bacterial Insecticides

Bacterial insecticides contain naturally produced bacterial proteins that are toxic to mosquito larvae when ingested in sufficient quantity. Although they are biological agents, such products are labeled and registered by the Environmental Protection Agency as pesticides and are considered by some to be a form of Chemical Control. Depending on the formulation, the method of application varies from hand spreading or graduated spray bottles for small breeding sources to backpack sprayers or blowers for medium-sized areas, and targeted boat applications and contracted helicopter (bucket granule spreader) for large areas. All mechanical methods employ graduated measurement devices and annually calibrated application equipment.

1. Bacillus thuringiensis var. *israelensis* (BTI)

Product names: Acrobe, Bactimos pellets, Teknar HP-D, Vectobac 12AS, Vectobac G.

Advantages: BTI is highly target-specific and has been found to have significant effects only on mosquito larvae, and closely related insects (eg., blackflies and some midges). It is available in a variety of liquid, granular and pelleted formulations which provide some flexibility in application methods and equipment. BTI has no measurable toxicity to vertebrates and is classified by EPA as "Practically Non-Toxic" (Caution). BTI formulations contain a combination of five different proteins within a larger crystal. These proteins have varying modes of action and synergistically act to reduce the likelihood of resistance developing in larval mosquito populations.

Barriers to Use: Bacterial insecticides must be fed upon by larvae in sufficient quantity to be effective. Therefore applications must be carefully timed to coincide with periods in the life cycle when larvae are actively feeding. Pupae and late 4th stage larvae do not feed and therefore will not be controlled by BTI. Low water temperature inhibits larval feeding behavior, reducing the effectiveness of BTI during the cooler months. Highly organic conditions also reduce the effectiveness of BTI. Cost per acre treated is generally higher than surfactants or organophosphate insecticides.

Solutions to Barriers: An increased frequency of surveillance of larvae ensures that bacterial insecticides can be applied during the appropriate stages of larval development to prevent adult mosquito emergence. Treated sites are re-checked to determine efficacy and assure selectivity.

Impact on water quality: BTI contains naturally produced bacterial proteins generally regarded as environmentally safe. It leaves no residues and is quickly biodegraded. At the application rates used in mosquito control programs, BTI is unlikely to have any measurable effect on water quality. There are no established standards, tolerances or EPA approved tests. Other naturally occurring strains of this bacterium are commonly found in aquatic habitats.

2. Bacillus sphaericus (BS)

Product names: Vectolex CG, Vectolex WDG

Advantages: BS is another bacterial pesticide with attributes similar to those of BTI. The efficacy of this bacterium is not affected by the degree of organic pollution in larval development sites and it may actually cycle in habitats containing high densities of mosquitoes, reducing the need for repeated applications.

Barriers to Use: Like BTI, BS must be consumed by mosquito larvae and is not is therefore not effective against nonfeeding stages such as late 4th instar larvae or pupae. BS is also ineffective against certain mosquito species such as those developing in saltmarshes, seasonal forest pools or treeholes. Toxicity of BS to mosquitoes is due to a single toxin rather than a complex of several molecules as is the case with BTI. Development of resistance has been reported in Brazil. Thailand and France in sites where BS was the sole material applied to control mosquitoes for extended periods of time.

Solutions to Barriers: Information obtained from larval surveillance on the stage and species of mosquitoes present can increase the effectiveness of this material, restricting it use to sources containing susceptible mosquitoes. Development of resistance can be delayed by rotating BS with other mosquitocidal agents and re-checking treated sites to determine efficacy.

Impact on water quality: BS is a naturally occurring bacterium and is environmentally safe. It leaves no residues and is quickly biodegraded. At the application rates used in mosquito control programs, BS is unlikely to have any measurable effect on water quality. There are no established standards, tolerances or EPA approved tests. Other naturally occurring strains of this bacterium are commonly found in aquatic habitats.

D. Methoprene

Product Names: Altosid briquets, Altosid liquid larvicide, Altosid pellets, Altosid SBG, Altosid XR briquets, Altosid XRG. See Section C above for application methods.

Advantages:

Methoprene is a larvicide that mimics the natural growth regulator used by insects. Methoprene can be applied as liquid or solid formulation or combined with BTI or BS to form a "duplex" application. Methoprene is a desirable IPM control strategy since affected larvae remain available as prey items for predators and the rest of the food chain. This material breaks down quickly in sunlight and when applied as a liquid formulation it is effective for only 3 to 5 days. Methoprene has been impregnated into charcoal-based carriers such as pellets and briquettes for longer residual activity ranging up to 150 days. The availability of different formulations provides options for treatment under a wide range of environmental conditions. Studies on nontarget organisms have found methoprene to be nontoxic to vertebrates and most invertebrates when exposed at concentrations used for mosquito control.

Barriers to Use: Methoprene products must be applied to larval stage mosquitoes since it is not effective against the other life stages. Monitoring for effectiveness is difficult since mortality is delayed. Methoprene is more expensive than most other mosquitocidal agents. Methoprene use is avoided in vernal pools. There may be toxicity to certain nontarget crustacean and insect species.

Solutions to Barriers: Surveillance and monitoring can provide information on mosquito larval stage present, timing for applications and efficacy and selectivity of the treatments.

Impact on Water Quality: Methoprene does not have a significant impact on water quality. It is rapidly degraded in the environment and is not known to have persistent or toxic breakdown products. It is applied and has been shown to be effective against mosquitoes at levels far below those that can be detected by any currently available test. Methoprene has been approved by the World Health Organization for use in drinking water containers.

E. Surfactants

Product Names: Golden Bear 1111, BVA, Agnique MMF

Surfactants are "surface-acting agents" that are either petroleum or isostearyl alcohol-based materials that form a thin layer on the water surface. These materials typically kill surface-breathing insects by mechanically blocking the respiratory mechanism. They are typically used as pupacides or larvicides in polluted sites where mosquitoes are the dominant organism.

Advantages: These materials are the only materials efficacious for reducing mosquito pupae since other larviciding strategies (i.e., methoprene, BTI and BS) are ineffective to that life stage. Agnique forms an invisible monomolecular film that is visually undetectable. Treatments are simplified due to the spreading action of the surfactant across the water surface and into inaccessible areas. These surfactants are considered "practically nontoxic" by the EPA. Agnique is labeled "safe for use" in drinking water.

Barriers to Using: The drawback of using oils in habitats where natural enemies are established is that surface-breathing insects, particularly mosquito predators, are similarly affected. GB1111 forms a visible film on the water surface.

Solutions to Barriers: As a general rule, surfactant use is considered after alternate control strategies have been ruled out or in habitats that are not supporting a rich macro-invertebrate community (i.e., manmade sites).

F. Cultural Practices and Public Education

Wetland design criteria were developed and endorsed by CDPH and described in their booklet “Best Management Practices for Mosquito Control on California State Properties”. Guidelines for the following source types are included in the above publication and may be considered cultural control techniques:

* Drainageway construction and maintenance practices
* Dredge material disposal sites
* Irrigated pastures
* Permanent ponds used as waterfowl habitat
* Permanent Water impoundments
* Salt marsh restoration of exterior levee lands
* Sedimentation ponds and retention basins
* Tidal marshes
* Utility construction practices

An integral part of the MVC BMP is to provide information to the public to assist them in resolving their pest problems. Staff at the MVC provides public outreach in the form of presentations to schools, utility districts, homeowner associations, county fairs, home and garden shows, as well as through the media such as newspaper, television, and radio. Information is provided on biological, physical and cultural control methods (i.e., BMPs) that property owner and managers can use to preclude or reduce mosquitoes and other disease and nuisance pests within their jurisdictions.

MVC provides literature and education programs for property owners on water management and elimination of mosquito developmental sites from residential property. These sources include rain gutters, artificial containers, ornamental ponds, abandoned swimming pools, tree holes, septic tanks, and other impounded waters. On public lands, governmental agencies are contacted for consultation prior to mosquito management intervention. Local development plans that contain stormwater BMP designs or wetland creation, restoration or impacts are reviewed for vector breeding potential and consulted upon.

G. Vegetation Management

Vegetation Management consists of the removal of vegetation within mosquito developmental sites to promote water circulation and species diversity, increase access of natural predators such as fish or provide MVCD staff access for surveillance and treatment operations. Vegetation management is achieved either through recommendations to the landowner or by the use of hand tools and the application of selective herbicides when appropriate.

Vegetation management, one aspect of physical mosquito control, is an effective long-term control strategy that is occasionally employed by MVC. This methodology utilizes water management, burning, physical removal, and chemical means to manage vegetation within mosquito developmental sites. The presence of vegetation provides harborage for immature and adult mosquitoes by protecting them from potential predators as well as the effects of wind and wave action, which readily cause mortality. Vegetation reduction not only enhances water quality, circulation and the effects of predators and abiotic factors, but also reduces the need for chemical control. Several factors can limit the utilization of vegetation management. These include: sensitivity of the habitat, presence of special status species, size of the site, density and type of vegetation, species of mosquito and weather.

Vegetation management often requires permitting, and the cost in resources is a limiting factor to the MVC. Wetland vegetation that was historically managed because it was exotic or invasive, provided mosquito harborage or impeded surveillance and control will now seldom be managed because the required NPDES Weed Control permit has discharge monitoring and testing requirements that are beyond the resources of MVC and most vector control agencies.

1. Burning and livestock grazing

Although not practiced by MVC to date, these techniques are used to achieve effective mosquito control where the density of unwanted vegetation precludes the use of other methodologies. Burning requires a permit, and coordination with local fire agencies and the Air Pollution Control District or Air Quality Management District. Factors limiting the use of this technique include weather, the limited number of approved burn days, and proximity of human habitation. As a general rule, burning is a last resort and not a primary method. These strategies are normally limited to manmade impoundments and fallow farmlands.

2. Physical Removal/Mowing/Trimming

Physical removal of vegetation is used to clear obstructed channels and ditches to promote water circulation, effectiveness of predators and improve access for mosquito control personnel to enter mosquito developmental sites. Ditches and channels can be cleared with a variety of tools ranging from shovels and small pruners to weed whackers and large mechanized equipment. Most removal activities performed by MVC utilizes small hand tools. This is the most frequently employed management technique once regulators and property owners have been consulted and all necessary permits have been obtained and it is performed in all types of habitats. Unfortunately, its effectiveness is temporary and labor intensive, and therefore requires routine maintenance on an annual or at most biennial basis. Other limiting factors include permitting costs and the limited time period that MVC is allowed to perform the activity for many types of mosquito developmental sites.

Access trails to breeding sources are cleared seasonally using hand tools such as shovels, pruners, weed whackers, hedge trimmers and chainsaws. This technique is very labor intensive does not produce long-lasting results. Access pathways created in this manner require annual maintenance. Factors limiting the use of this technique include presence of sensitive species or habitats, difficulty in obtaining permits and availability of sufficient staff to perform the work.

3. Chemical

MVC has conducted chemical control of vegetation in man-made habitats such as impoundments, channels and ditches. Both pre- and post-emergent herbicides have been used, with strict attention given to label requirements, weather conditions, potential for runoff and drift, and proximity of sensitive receptors such as special-status species, sensitive habitats, livestock, crops, and people. Routine intensive surveys are conducted to address many of these factors. The MVC uses very little herbicide. The herbicides currently in use are glyphosate based (Roundup and Rodeo). The MVC will now restrict this useful practice to sites that are not waters of the U.S., as the current necessity of obtaining an NPDES permit with associated monitoring and water quality testing requirements would be burdensome and expensive for all areas.

Chemical name: Glyphosate

Product names: Roundup, Rodeo, Gallup, Landmaster, Pondmaster, Ranger, Touchdown, Aquamaster

Advantages: Glyphosate based herbicides are not applied directly to water, but along the levee tops and margins of wastewater ponds, channels, ditches and access roads as post-emergence herbicides. These are non-selective, low-residual herbicides used to control weeds and low-growing brush. These materials come in a variety of formulations, allowing for flexibility of use and application. MVC in recent years has only used the Roundup, Rodeo and Aquamaster formulations (Aquamaster being the registered replacement for Rodeo). Glyphosate acts in plants by inhibiting amino acid synthesis. Roundup (41% of the isopropylamine salt of glyphosate with surfactants) and Aquamaster (53% of the isopropylamine salt of glyphosate without surfactants) are applied from March through October for spot control of weed growth. Both of these materials have also occasionally been used to control growth of poison oak, blackberry vines and non-native aquatic weeds such as water hyacinth or parrotfeather that would prevent access, impede water flows or out-compete native vegetation in sensitive habitats.

Barriers to using: Landowners and regulators are notified before glyphosate is applied to any site and applications are timed with their operations. Furthermore, to prevent large, tall stands of dead vegetative material, applications must be timed so that weed growth is minimal. Weather conditions, specifically wind and rainfall, also affect timing and application of glyphosate based products. The proximity of food crops, groundwater protection zones and sensitive habitats must also be considered. Current NPDES permitting requirements for aquatic weed control require monitoring and testing requirements that create impediments and inefficiencies to MVC in the use of herbicides for small spot treatments, such as those used to keep trails to riparian sites from being overgrown by poison oak, as even peripheral dry sites may be construed as being waters of the United States.

Solutions to barriers: Intensive surveillance in and around target sites ensures that nontargets are not affected. Coordination with landowners and appropriate regulatory authorities and strictly conforming to label directions ensures that reasonable and ecologically acceptable applications occur. For large treatments, such as those used for invasive aquatic weed control, MVC could work in collaboration with landowners, with NPDES aquatic herbicide permits obtained by them.

Impact on water quality: In water, glyphosate is strongly adsorbed to suspended organic and mineral matter and is broken down primarily by microorganisms. Its half life in pond water ranges from 12 days to 10 weeks (Extoxnet). A 2004 report by the San Francisco Estuary Institute, contracted by the State Water Board to conduct the aquatic pesticide monitoring program reported: No toxicity was found to be associated with the glyphosate applications used in several locations with a nonylphenolethoxylate surfactant.

H. Organophosphates (OP)

MVC has never used OP's for mosquito control. Mosquito and vector control agencies that operate under the California Health and Safety Codes may utilize those materials registered as mosquitocides under the Federal Fungicide, Insecticide, and Rodenticide Act. Such materials used in accordance with label instructions are allowed by law. However, as a result of heightened concern over environmental impacts and worker health and safety, most of the districts have voluntarily eliminated their use. Organophosphate use, such as applications of temephos, will probably be reserved for emergency use against disease outbreaks and epidemics or when there is resistance to least-toxic materials.

I. Adulticiding

MVC has only conducted a ULV application of pyrethrin fog on one date in 1995, and does not expect to require adulticiding. This is due to success at breaking the mosquito breeding cycle by other IPM means, combined with low threat levels of mosquito-borne viruses, resulting in no reported human or equine cases locally despite the presence of West Nile Virus in local wild bird populations. Our disease response is outlined in the Santa Cruz County Arbovirus Surveillance and Response Plan (2006) prepared at County Board of Supervisor request by the West Nile Virus Technical Advisory Committee. As adulticiding is a last-resort element of this Plan, MVC is joining the MVCAC NPDES Coalition for the purpose of representative aquatic monitoring.

4. TRAINING AND CERTIFICATION

All MVC applicators must be certified to apply public health pesticides. The CDPH Vector-Borne Disease Section administers certification training and testing. All mosquito control personnel applying pesticides or overseeing the application of pesticides must obtain a Vector Control Technician certificate number. The Mosquito and Vector Control Association of California (MVCAC) provides training materials and exams are conducted by the CDPH. All certificate holders must maintain continuing education credit in at least two and as many as four subcategories. Category A (Laws and Regulations) and category B (Mosquito Biology) is mandatory for all certificate holders and requires 12 and 8 continuing education units (CEU) respectively, in a two year period. Category C (Terrestrial Invertebrate Control) and Category D (Vertebrate Control) are optional both with 8 hours of CEU per two-year cycle.

The MVCAC and MVC conduct educational and safety programs to increase the expertise of operational staff. Ultimate decisions regarding the need for and application of pesticides rest on the professional judgment of trained field staff based on information acquired from surveillance data and scrutiny of the pesticide label. Decisions to apply a particular product are made in accordance to California Environmental Quality Act (CEQA) documentation including threshold levels and other information regarding habitat type, distance from populated areas, and water quality data. In

2005 MVC prepared CEQA environmental review documents (negative declaration) and these documents are available on our web site http://www.agdept.com/mvc.html

Training opportunities to accumulate CEU credits are made available by the MVCAC regional committees that develop training programs fine-tuned to the local ecology and unique problems of the region. Training programs are submitted to the MVCAC state training coordinator for approval and then to the CDPH for final approval. Thirty-six hours of CEU credits are offered each two-year cycle.

5. OVERSIGHT

MVC, as a member of the MVCAC operates under the California Health and Safety Code and the California Government Code (reference Division 1, Administration of Public Health, Chapter 2, Powers and Duties; also Part 2, Local Administration, Chapter 8, State Aid for Local Health Administration; Division 3, Mosquito Abatement and Vector Control District Law, Sections 2000 *et seq.*). In addition, members of the MVCAC that are signatories to the California Department of Public Health Cooperative Agreement (Pursuant to Section 116180, Health and Safety Code) are required to comply with the following:

1. Calibrate all application equipment using acceptable techniques before using; maintain calibration records for review by the County Agricultural Commissioner (CAC).

2. Maintain for at least two years, pesticide use data for review by the CAC including a record of each pesticide application showing the target vector, the specific location treated, the size of the source, the formulations and amount of pesticides used, the method and equipment used, the type of habitat treated, the date of the application, and the name of the applicator.

3. Submit to the CAC each month a Pesticide Use Report on Department of Pesticide Regulation form PR-ENF-060. The report shall include the manufacturer and product name, the EPA registration number from the label, the amount of pesticide used, the number of applications of each pesticide, and the total number of applications, per county, per month.

4. Report to the CAC and the CDPH, in a manner specified any conspicuous or suspected adverse effects upon humans, domestic animals and other non-target organisms, or property from pesticide applications.

5. Require appropriate certification of its employees by CDPH in order to verify their competence in using pesticides to control pest and vector organisms, and to maintain continuing education unit information for those employees participating in continuing education.

6. Be inspected by the CAC on a regular basis to ensure that local activities are in compliance with state laws and regulations relating to pesticide use.

Other agencies such as local fire departments, the California Department of Fish and Game, U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, and other County departments such as Environmental Health (pesticide storage permit), and others have jurisdiction and oversight over some of our activities. We work closely with these agencies to comply with their requirements.