Mosquito and Mosquito-Borne Disease Management Plan

SACRAMENTO-YOLO
MOSQUITO
& VECTOR
CONTROL
DISTRICT

Amended by the Board of Trustees of the Sacramento-Yolo Mosquito and Vector Control District

March 2005

Table of Contents

by
Kenneth W. Boyce, Program Development Manager

In collaboration with
Sacramento/Yolo Mosquito and Vector Control District Staff

Sacramento/Yolo Mosquito and Vector Control District
8631 Bond Road
Elk Grove, California 95624
1997
Revised 2003 and 2005

Preface

The purpose of the **Mosquito and Mosquito-Borne Disease Management Plan** is to provide *guidelines* to Sacramento and Yolo Mosquito and Vector Control District staff and information to stakeholders regarding the various responses made to prevent and control mosquito-borne diseases and disease outbreaks in Sacramento and Yolo Counties. This document integrates Management*, Administrative staff, Public Information, Laboratory and Control Operations responses together to interrupt mosquito-borne disease transmission. These responses have been organized for the species of mosquitoes in the District that are known to transmit malaria parasites and mosquito-borne arboviruses that cause illness in humans (i.e. encephalitis), domestic animals, and wildlife.

Critical to the success of these responses is the effective cooperation and communication among collaborative agencies in the effort to prevent or stop the spread of mosquito-borne disease. Included in this response as an addendum is the "California Mosquito-Borne Virus Surveillance and Response Plan" prepared jointly by the California Department of Health Services, Mosquito and Vector Control Association of California and the University of California.

This document approved by the Sacramento/Yolo Mosquito and Vector Control District Board of Trustees delineates this agency's fundamental mosquito and mosquito-borne disease outbreak management policies and procedures. Public health protection, Integrated Pest Management (IPM), application of professional judgment, stakeholder partnerships, and continuous improvement are this document's *guiding principles*.

Public Health Protection

The District's primary mission is to *protect public health* by managing immature and adult mosquitoes so that they *do not* present a significant risk to District residents. Protection of domestic and captive animals is a secondary goal.

Integrated Pest Management

The District will apply IPM principles in its mosquito management program. These principles will serve as the foundation for management strategy development and assessment. Ongoing mosquito population and mosquito-borne pathogen monitoring in addition to specific action thresholds generate the criteria that implement mosquito management measures. The District believes that a benefit of a rigorous IPM program will lead, in the long term, to greater reliance and success of non-pesticide control measures and the avoidance of unnecessary pesticide applications.

Application of Professional Judgment

The District applies professional judgment when necessary. Although it represents our best efforts, using available information to delineate District response for reasonably foreseeable situations, it is recognized that management of mosquito populations and mosquito-borne diseases is complex and far from completely understood. In addition, site specific and incident specific conditions are highly variable and unpredictable. Therefore, District management and staff are allowed and expected to *exercise professional judgment in implementation of these policies and procedures*. Deviation from this policy is therefore allowable where deemed necessary by District management or authorized staff, based on available information, to meet the District primary goal of protecting the public from mosquito-borne diseases.

Stakeholder Partnerships

The District will actively seek partnerships with other stakeholders. The District identifies Federal Government, State of California, the County, incorporated city and local government officials, agricultural producers, environmental groups, community leaders, and citizens within the District jurisdiction as stakeholders. By providing accurate and useful information, the District will seek to engage and empower these stakeholders to participate in the management of mosquitoes and mosquito-borne pathogens.

Continuous Improvement

The District regularly seeks the latest and most reliable mosquito monitoring and management techniques. Staff will be encouraged to investigate innovative methods to improve mosquito and mosquito-borne disease management plans and incorporate them as necessary. This document will be reviewed annually by the District Board of Trustees.

*Defined as Manager and Assistant manager or a designee

Level 1- Standard Mosquito Control Activities

Standard mosquito control activities will follow Integrated Pest Management principles and will generally consist of the components listed below: This level is equivalent to the "California Mosquito-Borne Virus Surveillance and Response Plan" Level 1-Normal Season.

- Routine public education and awareness through the distribution of media releases, attendance at public events, classroom presentations, and other similar outreach mechanisms.
- Routine mosquito, mosquito–borne disease, and public health pesticide efficacy surveillance activities
    a. American Light Traps
    b. Mosquito magnet traps
    c. Gravid traps
    d. Encephalitis Virus Surveillance
    e. Monitoring Sentinel Chickens
    f. Monitoring public health pesticide efficacy
- Routine immature mosquito management *1 (see appendix I: Integrated Vector Management (IVM) of immature mosquito guidelines)
    a. Evaluate site for immature mosquito threshold densities.
    b. Evaluate environmental and regulatory conditions and requirements
    c. If possible, conduct drainage or modification of site
    d. If appropriate, introduce biological control measures
    e. If appropriate, apply appropriate public health pesticide
- Routine Adult Mosquito Management measures *2 (see appendix II: Integrated Vector Management of adult mosquito guidelines)
    a. Adult management is initiated when threshold criteria in the IVM of adult mosquito application guidelines are met or exceeded.
    b. Wide spread adult control measures conducted by ground and air applications in non-urban areas that exceed adult mosquito threshold levels
    c. Control in urban areas will be on an as needed basis predicated by direct request from a homeowner.

Level 2- Response to Malaria Activity (Imported Malaria Case)

The following responses are initiated when County Public Health officials notify the District of an imported malaria case(s) within the District boundaries. District response to a reported case is determined by the vector activity period, difference between the date of diagnosis and the current date, mosquito population, and the date of the reported case. After responding to the initial report, unless surveillance indicates an additional infestation, the District will return to Level 1 control operations.

Administrative Staff Responsibility	**Laboratory Responsibility**
Complete the Mosquito-borne Disease Report Maintain malaria database	Determine scope of activity Identify adult mosquitoes collected Submit *Anopheles species* to the Microbiologist Determine if *Anopheles species* are infected with malaria parasites
Control Operations in Urban and Suburban Areas Responsibility Inspect and treat mosquito development sites Assess adult mosquito population Control adult mosquitoes	**Control Operations in Rural Areas Responsibility** Inspect and treat mosquito development sites Assess adult mosquito population Design ground based ULV routes Consider controlling adult mosquitoes

Level 3- Response to Malaria Activity (Locally Acquired Malaria Case)

The following responses are initiated when County Public Health officials notify the District of a locally acquired malaria case(s) within the District boundaries. District response to a reported case is determined by the vector activity period, difference between the date of diagnosis and the current date, mosquito population, and the date of the reported case. After responding to the initial report, unless surveillance indicates an additional infestation the District will return to Level 1 control operations.

Administrative Staff Responsibility Complete the Mosquito-borne Disease Report, Form MDR Maintain Malaria database	**Management Responsibility** Notify District Board President Contact County Agricultural Commissioner in County where case occurred If aircraft spraying is necessary, contact and coordinate with other agencies
Public Information Responsibility Distribute a News Release If aircraft spraying is necessary, include additional information in News Release Explore use of interpreters	**Laboratory Responsibility** Determine scope of activity Identify adult mosquitoes collected Submit *Anopheles species* to the Microbiologist Determine if *Anopheles species* are infected with malaria parasites
Control Operations in Urban and Suburban Areas Responsibility Inspect and treat mosquito development sites Assess adult mosquito population Control adult mosquitoes Develop aircraft application strategy Distribute education information	**Control Operations in Rural Areas Responsibility** Inspect and treat mosquito development sites Assess adult mosquito population Design ground based ULV routes Control adult mosquitoes Develop aircraft application strategy Distribute education information

Level 4- Response to Malaria Activity (Infected Mosquitoes)

The following responses are initiated when *Anopheles freeborni* or *An. punctipennis* are found infected with malaria parasites within the District boundaries. District response to a reported case is determined by the vector activity period and mosquito population. After responding to an initial report, standard adult mosquito control threshold levels are *permanently reduced* until control activities are terminated for the season (see appendix II: Integrated Vector Management of adult mosquito application guidelines).

Administration Responsibility Consider holding special Board of Trustee meeting Notify County Public Health Officials Contact County Agricultural Commissioners If aircraft spraying is necessary, contact and coordinate with other agencies Assess staffing requirements	**Public Information Responsibility** Distribute a News Release If aircraft spraying is necessary, include additional information in News Release Explore use of interpreters
Laboratory Responsibility Determine scope of activity Identify adult mosquitoes collected Submit *Anopheles species* to the Microbiologist Determine if *Anopheles species* are infected with malaria parasites	**Control Operations in Urban and Suburban Areas Responsibility** Inspect and treat mosquito development sites Assess adult mosquito population Control adult mosquitoes Develop aircraft application strategy Distribute education information
Control Operations in Rural Areas Responsibility Inspect and treat mosquito development sites Assess adult mosquito population Design ground based ULV routes Control adult mosquitoes Develop aircraft application strategy Distribute education information	

Level 2-Response to Mosquito-borne Virus Activity (Dead bird/Mosquito Pool)

The following responses are initiated when the District Microbiology Laboratory detects a mosquito borne virus (i.e., WNV, WEE, SLE) or DHS notifies the District of a mosquito borne virus from a dead bird(s) or mosquito pool(s) within the District boundaries. After responding to the initial report, standard adult mosquito control threshold levels are *permanently reduced* until control activities are terminated for the season (see appendix II: Integrated Vector Management of adult mosquito application guidelines). This level is equivalent to the "California Mosquito-Borne Virus Surveillance and Response Plan" Level 2-Epidemic Conditions.

Management Responsibility Notify District Board President Notify County Public Health Officials Contact County Agricultural Commissioners Evaluate District staffing and program needs	**Public Information Responsibility** Distribute a News Release Explore use of interpreters
Laboratory Responsibility Determine scope of virus activity Continue to collect mosquito pools for isolation of virus *as scheduled* Continue to bleed sentinel chickens a*s scheduled*	
Control Operations in Urban and Suburban Areas Responsibility Inspect and treat mosquito development sites Assess adult mosquito population Consider Controlling adult mosquitoes	**Control Operations in Rural Areas Responsibility** Inspect and treat mosquito development sites Assess adult mosquito population Consider controlling adult mosquitoes Develop truck mounted ULV application strategy

Level 3-Response to Mosquito-borne Virus Activity (Sentinel Chicken/Animal)

The following responses are initiated when the District Microbiology Laboratory detects seroconversion to a mosquito borne virus (i.e., WNV, WEE, SLE) in a sentinel chicken(s) or DHS notifies the District of a mosquito-borne virus infected horse or other animal within the District boundaries. After responding to the initial report, standard adult mosquito control threshold levels are *permanently reduced* until control activities are terminated for the season (see appendix II: Integrated Vector Management of adult mosquito application guidelines). This level is equivalent to the "California Mosquito-Borne Virus Surveillance and Response Plan" Level 2-Epidemic Conditions.

Management Responsibility Notify District Board President Notify County Public Health Officials Contact County Agricultural Commissioners	**Public Information Responsibility** Distribute a News Release Explore use of interpreters
Laboratory Responsibility Determine scope of virus activity Collect mosquito pools in areas of concern Sample sentinel chicken flocks as scheduled	**Control Operations in Urban and Suburban Areas Responsibility** Inspect and treat mosquito development sites Assess adult mosquito population Consider controlling adult mosquitoes Develop truck mounted ULV application strategy
Control Operations in Rural Areas Responsibility Inspect and treat mosquito development sites Assess adult mosquito population Consider Controlling adult mosquitoes Develop truck mounted ULV application strategy	

Level 4-Response to Mosquito-borne Virus Activity (Locally Acquired Case)

The following responses are initiated when County Public Health Laboratory or DHS officials notify the District that a ***human*** has locally acquired a mosquito-borne virus (i.e., WNV, WEE, or SLE) disease within the District boundaries. After responding to an initial report, standard adult mosquito control threshold levels are ***permanently reduced*** until control activities are terminated for the season (see appendix II: Integrated Vector Management of adult mosquito application guidelines). This level is equivalent to the "California Mosquito-Borne Virus Surveillance and Response Plan" Level 3-Epidemic Conditions.

Administrative Staff Responsibility Complete the Mosquito-borne Disease Report, Form MDR	**Management Responsibility** Notify District Board President Notify County Public Health Officials Contact County Agricultural Commissioners If truck mount ULV or aircraft spraying is necessary, contact and coordinate with other agencies Assess staffing requirements
Public Information Responsibility Distribute a News Release Explore use of interpreters If truck mounted ULV or aircraft spraying is necessary, include additional information in News Release	**Laboratory Responsibility** Determine scope of virus activity Collect mosquito pools in areas of concern Sample sentinel chicken flock(s) Evaluate sampling livestock in the area
Control Operations in Urban and Suburban Areas Responsibility Inspect and treat mosquito development sites Assess adult mosquito population Control adult mosquitoes Distribute information Develop truck mounted ULV application strategy	**Control Operations in Rural Areas Responsibility** Inspect and treat mosquito development sites Assess adult mosquito population Develop truck mounted ULV application strategy Control adult mosquitoes Distribute education information Develop aerial application strategy

Level 5-Response to Mosquito-borne Virus Activity (Epidemic Conditions)

The following responses are initiated when County Public Health Laboratory or DHS officials notify the District that ***multiple*** mosquito-borne virus (i.e., WNV, WEE, or SLE) infections have occurred in ***humans*** within a specific area or there is evidence that the epidemic conditions exist. The epidemic area is defined as the geographic region in which human cases are clustered (incorporated City, community, neighborhood, or Zip Code). After the initial response, standard adult mosquito control threshold levels are ***permanently reduced*** until control activities are terminated for the season (see appendix II: Integrated Vector Management of adult mosquito application guidelines). This level is equivalent to the "California Mosquito-Borne Virus Surveillance and Response Plan" Level 3-Epidemic Conditions.

Administrative Staff Responsibility Complete the Mosquito-borne Disease Report, Form MDR	**Management Responsibility** Consider holding a special Board of Trustee meeting Notify County Public Health Officials Contact County Agricultural Commissioners Contact Department of Health Services Vector-borne Disease Section If truck mounted ULV or aircraft spraying is necessary, contact and coordinate with other agencies Assess staffing requirements
Public Information Responsibility Distribute a News Release Explore use of interpreters If truck mounted ULV or aircraft spraying is necessary, include additional information in News Release Consider purchasing TV and radio time for PSAs	**Laboratory Responsibility** Determine scope of virus activity Collect mosquito pools in areas of concern Sample and test sentinel chicken flock(s) Evaluate sampling livestock in the area If truck mounted ULV or aircraft spraying is necessary, evaluate the control program
Control Operations in Urban and Suburban Areas Responsibility Inspect and treat mosquito development sites Assess adult mosquito population Control adult mosquitoes Distribute education information Develop aerial application strategy	**Control Operations in Rural Areas Responsibility** Inspect and treat mosquito development sites Assess adult mosquito population Control adult mosquitoes Distribute education information Develop aerial application strategy

Appendix I

Integrated Vector Management

Immature Mosquito Guidelines

Site Assessment

Criteria	***Evaluation***	*Decision*
Is development site a vernal pool?	**Yes →**	Do not walk into vernal pond. **Sample** development site (return water to pond) Then consider **ecological criteria** (do not introduce biologicals into the vernal pond)
No ↓		
Fairy shrimp present?	**Yes →**	**Sample** development site (return water to pond) Then consider **ecological criteria** (do not introduce biologicals into site)
No ↓		
Are endangered species present?	**Yes →**	Has supervisor been consulted about habitat? **Avoid taking *[1]endangered species.** If collected, return endangered species to habitat**.** **Sample** development site. Then consider **preventive physical measures**
No ↓		
Environmentally sensitive habitat?	**Yes →**	Consult supervisor about habitat. Avoid damage to sensitive areas**.** **Sample** development site. Then consider **preventive physical measures**
No ↓		
Will mosquitoes develop it the habitat?	**No →**	Consult supervisor about habitat. Consider reducing site surveillance. **Sample** development site. Then consider **preventive physical measures**
Yes ↓		
Sample development site Then consider **preventive physical measures**		

Preventive Physical Measures

Criteria	***Evaluation***	*Decision*
Can I **eliminate** the mosquito development site? Can I **remove the water**? Can I **drain** the mosquito development site?	**Yes →**	Institute necessary preventive **physical measures**
No ↓		
Can habitat be modified to reduce mosquito development?	**Yes →**	Consult with **Water Management Department** Institute necessary preventive **physical measures**
No ↓		
consider **preventive biological measures**		

Integrated Vector Management

Immature Mosquito Guidelines

Preventive Biological Measures

Criteria	***Evaluation***	*Decision*
Will habitat support immature mosquitoes?	No →	Do not apply biologicals. Set a **return inspection date**
Yes ↓		
Time water will remains in MDS?	Intermittent→	**Consider ecological criteria**
Semi-permanent or permanent ↓		
Environmentally sensitive habitat?	Yes →	Consult with supervisor before release. Can stock if available**:** **backswimmers, flatworms, *R. culicivorax,* or *L. giganteum***
No ↓		
Water Quality?	Highly organic →	Stock with **guppies or consider ecological criteria** Set a **return inspection date** and **record data**
Fresh ↓		
Swimming pool or backyard pond?	Yes →	Can stock **threespine stickleback, guppy, or mosquitofish** Set a **return inspection date** and **record data**
No ↓		
Can apply if available**: mosquitofish, guppies, backswimmers, flatworms, *R. culicivorax*, or *L. giganteum*** Set a **return inspection date** and **record data** Or consider **ecological criteria**		

Ecological Criteria

Criteria	***Evaluation***	*Decision*
Mosquito stages present?	eggs →	Do not treat. Set a **return inspection date**
1st to pupa ↓		
Number of immature mosquitoes?	*Anopheles sp.* or *Coquillettidia sp.* **0** immature/40 dips or **less than 0.025** immatures/dip → *Culex sp*. **0** immatures/20 dips or **less than 0.05** immatures/dip → *Aedes sp., Culiseta sp., Ochlerotatus sp., or Orthopodomyia sp*. **0** immatures/10 dips or **less than 0.10** immatures/dip →	Do not treat. Set a **return inspection date**
Anopheles sp. or *Coquillettidia sp.* **1** immature/40 dips or **≥ 0.025** immatures/dip → *Culex sp*. **1** immature/20 dips or **≥0.05** immatures/dip → *Aedes sp., Culiseta sp., Ochlerotatus sp., or Orthopodomyia sp*. **1** immature/10 dips or **≥0.10** immatures/dip → ↓		
Beneficials present with immature mosquitoes?	*Anopheles sp.* or *Coquillettidia sp.* **1** immature/40 dips or **less than 0.05** immatures/dip → *Culex sp*. **1** immatures/20 dips or **less than 0.1** immatures/dip → *Aedes sp., Culiseta sp., Ochlerotatus sp., or Orthopodomyia sp*. **1** immatures/10 dips or **less than 0.2** immatures/dip →	Do not treat. Set a **return inspection date**
Anopheles sp. or *Coquillettidia sp.* **2** immature/40 dips or **≥ 0.05** immatures/dip → *Culex sp*. **2** immatures/20 dips or **≥ 0.10** immatures/dip → *Aedes sp., Culiseta sp., Ochlerotatus sp., or Orthopodomyia sp*. **2** immatures/10 dips or **≥ 0.20** immatures/dip → ↓		
Consider **target population modification**		

Integrated Vector Management
Immature Mosquito Guidelines

Target Population Modification

Criteria	***Evaluation***	*Decision*
Mosquito development site size?	more than 5 acres →	Consult with supervisor before treatment
less than 5 acres ↓		
Water quality?	moderate to highly organic *Culex sp*. sources →	Apply appropriate **public health pesticide** and consider **treatment methods**
Fresh ↓		
Majority of immature stages present?	late 4th to pupae →	Apply appropriate **public health pesticide** and consider **treatment methods**
1st to early 4th ↓		
Vernal pool?	**Yes →**	Apply only *Bti* and consider **treatment methods**
No ↓		
Fairy shrimp present?	Yes →	Apply only *Bti* and consider **treatment methods**
No ↓		
Apply appropriate **public health pesticide** and consider **treatment methods**		

Treatment Method

Criteria	***Evaluation***	*Decision*
Distribution of immature?	Isolated locations →	Treat **selectively**
Throughout source ↓		
Treat **entire** mosquito development site		

Abbreviations and Definitions:

1. **MDS** = mosquito development site
2. **The Endangered Species Act -** defines take to mean "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct"
3. **Environmental sensitive habitats -** wetlands, riparian areas, organic farms, State, Federal, local wildlife areas or other areas posted as such.

Public health pesticide (PHP) use and resistance management (applications can be over more than one year)

1. Consult PHP's label before treatment
2. Apply PHP's within the same class or mode of activity on a rotational basis by the following guidelines unless no other alternatives are available:
   a. Slow release PHP formulations- rotate to a new class **after three consecutive applications** to the same site.
   b. Short-lived PHP's formulations- rotate to a new class **after ten consecutive applications** to the same site.

Factors or conditions that may modify immature mosquito management guidelines

1. Sentinel chicken seroconversion
2. Human malaria or encephalitis occurrence
3. Unforeseen biological or environmental conditions
4. Legal or political legislation
5. Availability of District funding, resources or equipment
6. Availability of suitable larvicides
7. Susceptibility of immature mosquito populations to larvicides
8. Environmental conditions not listed in the program
9. Continued occurrence of immatures in a development site
10. Encephalitis or malaria mosquito pool isolation
11. Natural disasters

Appendix II

Integrated Vector Management

Adult Mosquito Guidelines

Initiation Criteria

#1- **Human illness** caused by a mosquito-borne pathogen within the District boundaries?	yes ➔	**Determine level of mosquito activity**
no ⬇		
#2- **Mosquito-borne pathogen** detected in a dead or live bird or another animal within the District boundaries?	yes ➔	**Determine level of mosquito activity**
no ⬇		
#3- Evidence of a recent **serological conversion** to a mosquito–borne pathogen in a **sentinel chicken** or other animal within the District boundaries?	yes ➔	**Determine level of mosquito activity**
no ⬇		
#4- Mosquito–borne pathogen isolated from a **mosquito** within the District boundaries?	yes ➔	**Delineate treatment area**
no ⬇		
#5- Mosquito Magnet or EVS Trap collection within the District boundaries of	**100** or more **female** *Culex tarsalis* or *Cx. pipiens* a collection for **three consecutive days** and/or ➔ **150** or more **female** of any *Aedes, Anopheles, Coquillettidia, Culex, Culiseta, Ochlerotatus, or Orthopodomyia* species a collection for **three consecutive days** and/or ➔ **200** or more total **female** mosquitoes a collection for **three consecutive days** ➔	**Delineate treatment area**
less than **100 female** *Culex tarsalis* or *Cx. pipiens* a collection for **three consecutive days** and/or less than **150 female** of any *Aedes, Anopheles, Coquillettidia, Culex, Culiseta, Ochlerotatus, or Orthopodomyia* species a collection for **three consecutive days** and/or less than **200** total **female** mosquitoes a collection for **three consecutive days** ⬇		
#6- American Light or Gravid Trap collection within the District boundaries of	**10** or more **female** *Culex tarsalis* or *Cx. pipiens* a collection for **three consecutive days** and/or ➔ **25** or more **female** of any *Aedes, Anopheles, Coquillettidia, Culex, Culiseta, Ochlerotatus, or Orthopodomyia* species a collection for **three consecutive days** and/or ➔ **50** or more total **female** mosquitoes a collection for **three consecutive days** ➔	**Delineate treatment area**
less than **10 female** *Culex tarsalis* or *Cx. pipiens* a collection for **three consecutive days** and/or less than **25 female** of any *Aedes, Anopheles, Coquillettidia, Culex, Culiseta, Ochlerotatus, or Orthopodomyia* species a collection for **three consecutive days** and/or less than **50** total **female** mosquitoes a night for **three consecutive days** ⬇		
#7- One-minute sweep net or landing count collection within the District boundaries	**10** or more **female** *Aedes or Ochlerotatus* species and/or ➔ **25** or more **female** mosquitoes ➔	**Delineate treatment area**
less than **10 female** *Aedes or Ochlerotatus* species and/or less than **25 female** mosquitoes ⬇		
#8- Mosquitoes creating a public health nuisance at a residence	**1** or more **female mosquito(s)** collected by homeowner ➔	**Delineate treatment area**

Adult mosquito sample not submitted to District

⬇

Do Not Institute Adult Mosquito Management Measures

Integrated Vector Management

Adult Mosquito Guidelines

Determine Level of Mosquito Activity

Malaria case?	*Anopheles freeborni* or *An. punctipennis* present in a trap within a ¼ mile radius of human case ➔	Delineate Treatment Area

Mosquito Not Present

↓

Do Not Institute Adult Mosquito Management Measures

WNV, WEE, SLE, or other mosquito-borne virus case?	***Culex tarsalis***, ***Cx. pipiens*** or another mosquito species that can vector a virus pathogen within a one mile radius of human case ➔	Delineate Treatment Area

Mosquitoes Not Present

↓

Do Not Institute Adult Mosquito Management Measures

Integrated Vector Management

Adult Mosquito Guidelines

Delineate Treatment Area

Is the initiation or continuance criterion **within defined *Culex tarsalis* treatment area**?

yes ➔ Consider Agricultural and Land Use Practices

no ⬇

Is the initiation or continuance criterion in **previous undefined treatment area**?

yes ➔ Define the Boundaries of the Treatment Area and Consider Agricultural and Land Use Practices

Agricultural and Land Use Practices

Are endangered or threatened species present?

yes ➔ Consider the presence of Endangered or Threatened Species then Consider Meteorological Conditions within the Delineated Treatment Area

no ⬇

Environmentally sensitive habitat?

yes ➔ Consider Treatments Compatible with a Sensitive Habitat then Consider Meteorological Conditions within the Delineated Treatment Area

no ⬇

Organically grown crops?

yes ➔ Consider Treatments That Meet Organic Standards then Consider Meteorological Conditions within the Delineated Treatment Area

no ⬇

Consider Meteorological Conditions within the Delineated Treatment Area

Meteorological Conditions for Ground Applications

Temperature inversion?

Absent ➔ **Delay Instituting Adult Mosquito Management Measures**

Present ⬇

Wind speed?

exceeds Public Health Pesticide label recommendations ➔ **Delay Instituting Adult Mosquito Management Measures**

less than Public Health Pesticide label recommendations ⬇

Institute Adult Mosquito Management Measures with Appropriate Public Health Pesticide

Meteorological Conditions for Aerial Applications

Wind speed?

exceeds Public Health Pesticide label recommendations ➔ **Delay Instituting Adult Mosquito Management Measures**

less than maximum Public Health Pesticide label recommendations ⬇

Institute Adult Mosquito Management Measures with Appropriate Public Health Pesticide

Integrated Vector Management

Adult Mosquito Guidelines

Continuance Criteria

Level 1- Standard Mosquito Control Activities
(Level 2, 3, 4 or 5-Response to Mosquito-borne Virus Activity)

24 hour EVS trap or Mosquito Magnet Trap collection with	**100** (***25***) or more **female** *Culex tarsalis* or *Cx. pipiens* and/or ➔ **150** (***50***) or more of any **female** *Aedes, Anopheles, Coquillettidia, Culex, Culiseta, Ochlerotatus, or Orthopodomyia* species and/or ➔ **200** (***75***) or more total **female** mosquitoes ➔	**Consider Meteorological Conditions in the treatment area**
less than **100** (***25***) **female** *Culex tarsalis* or *Cx. pipiens* and/or less than **150** (***50***) **female** of any *Aedes, Anopheles, Coquillettidia, Culex, Culiseta, Ochlerotatus, or Orthopodomyia* species and/or less than **200** (***75***) total **female** mosquitoes ⬇		
24 hour American Light or Gravid Trap collection with	**25** (***10***) or more **female** *Culex tarsalis* or *Cx. pipiens* and/or ➔ **50** (***25***) or more **female** of any *Aedes, Anopheles, Coquillettidia, Culex, Culiseta, Ochlerotatus, or Orthopodomyia* species and/or ➔ **75** (***50***) or more total **female** mosquitoes ➔	**Consider Meteorological Conditions in the treatment area**
less than **25** (***10***) **female** *Culex tarsalis* or *Cx. pipiens* and/or less than **50** (***25***) **female** of any *Aedes, Anopheles, Coquillettidia, Culex, Culiseta, Ochlerotatus, or Orthopodomyia,* species and/or less than 75 (***50***) total **female** mosquitoes ⬇		
One-Minute Sweep Net or Landing Count collection with	**10** or more **female** *Aedes or Ochlerotatus* species and/or ➔ **25** or more **female** mosquitoes ➔	**Consider Meteorological Conditions in the treatment area**
less than **10 female** *Aedes or Ochlerotatus* species and/or less than **25 female** mosquitoes ⬇		
Do Not Institute Adult Mosquito Management Measures		

Integrated Vector Management

Adult Mosquito Guidelines

Termination Criteria

Level 1- Standard Mosquito Control Activities
(Level 2, 3, 4 or 5-Response to Mosquito-borne Virus Activity)

Date? ↓	after December 1st ➔	**Terminate Adult Mosquito Applications within the delineated treatment area**
before December 1st ↓		
Mosquito Magnet or EVS Trap collection with	less than **100** (***25***) **female** *Culex tarsalis* or *Cx. pipiens* a collection for **five consecutive days** and/or ➔ less than **150** (***50***) of any **female** *Aedes, Anopheles, Coquillettidia, Culex, Culiseta, Ochlerotatus, or Orthopodomyia* species a collection for **five consecutive days** and/or ➔ less than **200** (***75***) total **female** mosquitoes a collection for **five consecutive days**➔	**Terminate Adult Mosquito Applications within the delineated treatment area**
100 (***25***) or more **female** *Culex tarsalis* or *Cx. pipiens* a collection for **five consecutive days** and/or **150** (***50***) or more of any **female** *Aedes, Anopheles, Coquillettidia, Culex, Culiseta, Ochlerotatus, or Orthopodomyia* species a collection for **five consecutive days** and/or **200** (***75***) or more total **female** mosquitoes a collection for **five consecutive days** ↓		
American Light or Gravid Trap collection with	less than **25** (***10***) **female** *Culex tarsalis* or *Cx. pipiens* a collection for **five consecutive days** and/or ➔ less than **50** (***25***) of any **female** *Aedes, Anopheles, Coquillettidia, Culex, Culiseta, Ochlerotatus, or Orthopodomyia* species a collection for **five consecutive days** and/or ➔ less than **50** (***25***) total **female** mosquitoes a collection for **five consecutive days** ➔	**Terminate Adult Mosquito Applications within the delineated treatment area**
25 (***10***) or more **female** *Culex tarsalis* or *Cx. pipiens* a collection for **five consecutive days** and/or **50** (***25***) or more of any **female** *Aedes, Anopheles, Coquillettidia, Culex, Culiseta, Ochlerotatus, or Orthopodomyia* species a collection for **five consecutive days** and/or **50** (***25***) or more total **female** mosquitoes a collection for **five consecutive days** ↓		
One-minute Sweep Net or Landing Count collection with	less than **10 female** *Aedes or Ochlerotatus* during the **next sampling period** and/or ➔ less than **25 female** mosquitoes a night for **next sampling period** ➔	**Terminate Adult Mosquito Applications within the delineated treatment area**
10 or more **female** *Aedes or Ochlerotatus* species for the **next sampling period** and/or **25** or more **female** mosquitoes a night **next sampling period** ↓		
Environmental conditions?	**10 consecutive nights** unfavorable for ULV treatments➔	**Terminate Adult Mosquito Applications within the delineated treatment area**
favorable for adult mosquito management measures ↓		
Continue to Consider Continuance Criteria		

Integrated Vector Management

Adult Mosquito Guidelines

Definitions

A. Initiation Criteria

These are criteria that when achieved trigger the initial adult mosquito application measures. At present, the District recognizes seven separate conditions to be adult mosquito application triggers.

B. Continuance Criteria

When achieved these are criteria that trigger additional applications in an area that has previously attained an initiation criterion. These criteria are considered until a termination criterion is achieved for a treatment area. In ***Cx. tarsalis* treatment areas** subsequent applications are triggered only if *Cx. tarsalis* counts exceed continuance criteria (**100** (***25***) or more **female** *Culex tarsalis*).

C. Termination Criteria

These are criteria that when achieved conclude adult mosquito application measures in a treatment area until initiation criteria are again achieved.

D. **Adult Mosquito Management Measures**

These management measures may consist of application of public health pesticides by ultra low volume (ULV) application equipment or direct application (barrier treatments) to residences, outbuildings, other structures and mosquito resting sites.

Additional Technical Information

1. **Adult Mosquito Surveillance Devices**

Each year, a surveillance device or method may be selected as a measure of adult mosquito population in defined treatment area(s). However, during the mosquito season other devices or methods may be utilized to measure the adult mosquito population within a defined treatment area.

2. **Delineation of the *Culex tarsalis* Treatment Area**

In the Sacramento/Yolo Mosquito and Vector Control District the primary goal of the adult mosquito management program is to maintain the Encephalitis Mosquito (*Cx. tarsalis*) population below disease transmission levels. This species is the primary target because it is considered to be the principal vector of mosquito-borne arboviruses like Western Equine Encephalitis (WEE), Saint Louis Encephalitis (SLE) or California Encephalitis (CE) in the western United States and California (Reeves 1990). In addition, laboratory experiments have determined that this species is a very competent vector of West Nile virus (WNV) (Goddard et al. 2002).

Each year, the Adulticide Airplane Coordinator, or designee determined by the Manager establish the boundaries of *Cx. tarsalis* treatment areas. Area boundaries can be established by any or all of the following parameters: (1) the location of known *Cx. tarsalis* immature development sites, (2) historic adult *Cx. tarsalis* surveillance data, (3) disease surveillance data and (4) proximity of adult Cx. tarsalis to cities, towns and communities. Treatment boundaries may be adjusted during the season to address changes in *Cx. tarsalis* development sites, the adult *Cx. tarsalis* population, application methods or types of adulticide(s) utilized (Reeves et al. 1983). Defining a boundary does not imply that all or part of that area can be or will be treated if the treatment criterion is achieved (Center for Disease Control 2003).

3. **Delineation of previously undefined Treatment Areas**

Other adult mosquito species within *Cx. tarsalis* treatment area(s) and other regions of the District periodically achieved treatment criterion (Meyer and Durso 1999). This species are targeted for management because many are vectors of arboviruses (WEE, SLE, CE, WNV) or play a role in transmission of these diseases to bird reservoirs (Reeves 1990; Goddard et al. 2002). The *Anopheles* species are targeted for management because some species are important malaria vectors (Coatney et al. 1971). Additionally, many of these mosquito species are targeted for management because their biting habitats create a public health nuisance.

The Adulticide Airplane Coordinator, or designee determined by the Manager define the boundaries of the treatment area. The boundaries of the area treatment are determined by the mosquito species that achieved the criterion, the species biology, its flight range, and the area determined to be infested. Defining a boundary does not imply that all or part of that area can or will be treated if the treatment criterion is achieved (Center for Disease Control 2003).

4. **Aerial Applications**

Aerial applications can be by fixed-wing or rotary aircraft. Outside contractors insure that the aircraft is calibrated for the area atmospheric conditions and that the application is uniform. Aerial applications of public health pesticides are an essential tool in managing adult mosquito populations in both small and large geographic areas (Center for Disease Control 2003; Reeves et al. 1983).

Public Health Pesticide Use and Resistance Management

1. Consult Public Health Pesticide (PHP) label before treatment
2. Apply PHP's within the same class or mode of activity on a rotational basis by the following guidelines unless no other alternatives are available:
   a. Rotate to a new class **after five consecutive applications** to the same site.
      Note: applications can be over more than one year

Factors That May Influence the Implementation or Modify the Program

1. Availability of a suitable adulticiding material
2. Susceptibility of mosquito populations to adulticiding materials
3. Environmental conditions not listed in the program
4. Availability of District funding or resources
5. Legal or political legislation
6. Unforeseen biological conditions
7. Presence or absence of mosquito-borne disease

References Cited

1. Reeves W.C. 1990. Epidemiology and Control of Mosquito-Borne Arboviruses in California, 1943-1987. Calif. Mosq. Vector Contr. Assoc.
2. Goddard LB, Roth AE, Reisen WK, Scott TW. 2002. Vector competence of California mosquitoes for *West Nile Virus*. Emerging Infectious Diseases. Center for Disease Control. Dec; 8.
3. Meyer R.P. and S.L. Durso. 1999. Identification of the Mosquitoes of California. California Mosquito and Vector Control Association, Inc. 80 pp.
4. Coatney, G.R., W. E. Collins, M. Warren and P. G. Contacos. 1971. The primate malarias. Supt. Docs. U.S. Govt. Print Office. Washington. 366 pp.
5. Epizootic West Nile Virus in the United States: Revised Guidelines for Surveillance, Prevention, and Control. 2003. Centers for Disease Control and Prevention. pp. 80.
6. Reeves, W. C., W. K. Reisen, M. M. Milby, G. Yoshimura, and R. P. Meyer. 1983b. Studies toward the management of arboviral epidemics. II. Dynamics and age structure of the target population. Proc. Calif. Mosq. Vector Contr. Assoc. 51:4-6.

Distribution List

The following agencies have received copies of this document and will be integral to the success of these responses.

Department of Health Services Vector-borne Disease Section
Sacramento County Agricultural Commissioner
Yolo County Agricultural Commissioner
Yolo County Office of Emergency Services
Sacramento County Office of Emergency Services
Sacramento County Health Officer
Yolo County Health Officer
County of Sacramento
City of Citrus Heights
City of Elk Grove
City of Folsom
City of Galt
City of Isleton
City of Rancho Cordova
City of Sacramento
County of Yolo
City of Davis
City of West Sacramento
City of Winters
City of Woodland