ATTACHMENT G – NOTICE OF INTENT

WATER QUALITY ORDER NO. 2011-XXXX-DWQ
GENERAL PERMIT NO. CAG XXXXXX

STATEWIDE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT FOR BIOLOGICAL AND RESIDUAL PESTICIDE DISCHARGES TO WATERS OF THE UNITED STATES FROM VECTOR CONTROL APPLICATIONS

I. NOTICE OF INTENT STATUS (see Instructions)

Mark only one item ☒ A. New Applicator ☐ B. Change of Information: WDID# _____

☐ C. Change of ownership or responsibility: WDID# _____

II. DISCHARGER INFORMATION

A. Name Sacramento – Yolo Mosquito & Vector Control District			
B. Mailing Address 8631 Bond Rd			
C. City Elk Grove	D. County Sacramento	E. State CA	F. Zip Code 95624
G. Contact Person David Brown	H. Email address dabrown@fightthebite.net	I. Title Manager	J. Phone (916) 405-2059

III. BILLING ADDRESS (Enter Information *only* if different from Section II above)

A. Name			
B. Mailing Address			
C. City	D. County	E. State	F. Zip Code
G. Email address	H. Title	I. Phone	

IV. RECEIVING WATER INFORMATION

A. ~~Pesticide residues~~Biological and residual pesticides discharge to (check all that apply):

1. Canals, ditches, or other constructed conveyance facilities owned and controlled by Discharger.
   ☐ Name of the conveyance system: _____

2. Canals, ditches, or other constructed conveyance facilities owned and controlled by an entity other than the Discharger.
   ☒ Owner's name: See Attachment A
   Name of the conveyance system: Applications may be made to some of the water conveyances shown on map.

3. Directly to river, lake, creek, stream, bay, ocean, etc.
   ☒ Name of water body: See Attachment A Applications may be made to some of the water bodies shown on map.

   * A map showing the affected areas for items 1 to 3 above may be included.

B. Regional Water Quality Control Board(s) where application areas are located (REGION 1, 2, 3, 4, 5, 6, 7, 8, or 9): Region 5
(List all regions where pesticide application is proposed.)

A map showing the locations of A1-A3 in each Regional Water Board shall be included.

V. PESTICIDE APPLICATION INFORMATION

A. Target Organisms: X Vector Larvae X Adult Vector

B. Pesticides Used: List ~~Name~~name, ~~and a~~Active ingredients and, if known, degradation by-products

See Attachment B

C. Period of Application: Start Date JAN 1 End Date Dec 31

D. Types of Adjuvants Added by the Discharger:

VI. PESTICIDES APPLICATION PLAN

A. Has a Pesticides Application Plan been prepared?*
   ☒ Yes ☐ No

   If not, when will it be prepared? _____

* A copy of the PAP shall be included with the NOI.

B. Is the applicator familiar with its contents?
   ☒ Yes ☐ No

VII. NOTIFICATION

Have potentially affected governmental agencies been notified?

☒ Yes ☐ No

* If yes, a copy of the notifications shall be attached to the NOI.

VIII. FEE

Have you included payment of the filing fee (for first-time enrollees only) with this submittal?

☒ Yes ☐ NO ☐ NA

IX. CERTIFICATION

"I certify under penalty of law that this document and all attachments were prepared under my direction and supervision in accordance with a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment. Additionally, I certify that the provisions of the General Permit, including developing and implementing a monitoring program, will be complied with."

A. Printed Name: DAVID BROWN

B. Signature: David Brown **Date:** March 2 2011

C. Title: Manager

TENTATIVE ORDER

X. FOR STATE WATER BOARD USE ONLY

WDID:	**Date NOI Received:**	**Date NOI Processed:**
Case Handler's Initial:	**Fee Amount Received:** $	**Check #:**

Sacramento-Yolo Mosquito & Vector Control District (District) PAP:

1. **Description of all target areas, if different from the water body of the target area, in to which larvicides and adulticides are being planned to be applied or may be applied to control vectors. The description shall include adjacent areas, if different from the water body of the target areas::**

   Please see Agency Boundary Map

2. **Discussion of the factors influencing the decision to select pesticide applications for vector control:**

   Please see Sacramento-Yolo MVCD's Mosquito and Mosquito-Borne Disease Management Plan; Appendix I,II

3. **Pesticide products or types expected to be used and if known, their degradation by-products, the method in which they are applied, and if applicable, the adjuvants and surfactants used:**

   Please see Attachments E and F within NPDES Permit for Biological and Residual Pesticide Discharges to Waters of the U.S. From Vector Control Applications.
   Products will be applied by truck, backpack, hand can and airplane.

4. **Description of all the application areas and the target areas in the system that are being planned to be applied or may be applied. Provide a map showing these areas.**

   Any site that holds water for more than 96 hours (4 days) can produce mosquitoes. Source reduction is the District's preferred solution, and whenever possible the District works with property owners to effect long-term solutions to reduce or eliminate the need for continued applications as described in the District's Mosquito Reduction Best Management Practices Document. The typical sources treated by this District include: permanent/semi-permanent/seasonal wetlands, rice fields, irrigated crops and associated water conveyance systems, storm drains river seepage and creeks within aerial ULV spray blocks.
   Please see Agency Boundary Map

5. **Other control methods used (alternatives) and their limitations:**

   With any mosquito or other vector source, the District's first goal is to look for ways to eliminate the source, or, if that is not possible, for ways to reduce the vector potential. The most commonly used methods and their limitations are

included in the District's Mosquito Reduction Best Management Practices Document. District distributes Gambusia affinis to rice fields, wetlands, irrigation drains and neglected swimming pools on a yearly basis. The District's Ecological Management Department identifies mosquito breeding sites throughout the District and works with property owners and land managers to incorporate District BMPs to reduce or eliminate mosquito breeding habitat.

6. **How much product is needed and how this amount was determined:**

Material	*Pounds*	*Gallons*
Methoprene 20%		21.44
Methoprene 5%		26.00
Poly-w-hydroxy (agnique) Liquid		45.95
Poly-w-hydroxy (agnique) Granule	2770.57	
Methoprene Briquets 30 day	110.45	
Methoprene Pellets	10699.94	
Methoprene Granule 7-day	2115.00	
Methoprene Briquets 120 day	3922.77	
Methoprene Granule 21 day	22604.53	
10% Sumethrin		1135.24
Bti Granule	345003.68	
5% Pyrethrin		110.58
6% Pyrethrin		879.22
Petroleum Distillate		247.49
Spinosad 30 day Pellet	1379.21	
Spinosad Briquet	1839.48	
4.75% Deltamethrin		2.60
Naled		118.10
Bti Liquid		2473.52
Bti WDG	370.89	
Bs Granule	3119.84	
Bs WDG	9.50	
Bti/Bs Granule	16631.09	

The above totals represent all pesticide applications within the District boundaries for 2010. Determining application totals for sources designated as, Waters of the US, is difficult due to yearly variability. Actual applications made to Waters of the US will likely be less then described above.

7. **Representative monitoring locations* and the justification for selecting these locations:**

Please see the MVCAC NPDES Coalition Monitoring Plan

8. **Evaluation of available BMPs to determine if there are feasible alternatives to the selected pesticide application project that could reduce potential water quality impacts:**

Please see District's Mosquito Reduction Best Management Practices Document. In addition, the District's Ecological Management Department reviews post BMP implementation source pesticide application data to determine efficacy and compliance of BMP treatment.

9. **Description of the BMPs to be implemented:**

a. measures to prevent pesticide spill

District staff monitors application equipment on a daily basis to ensure it remains in proper working order. Spill mitigation devices are placed in all spray vehicles and pesticide storage areas to respond to spills. Employees are trained on spill prevention and response annually.

b. measures to ensure that only a minimum and consistent amount is used

Spray equipment is calibrated each year and is a part of the MOU with CDPH.

c. a plan to educate Coalition's or Discharger's staff and pesticide applicator on any potential adverse effects to waters if the U.S. from the pesticide application.

Applicators are required to complete pesticide training yearly.

d. descriptions of specific BMPs for each spray mode, e.g. aerial spray, truck spray, hand spray, etc.

District will calibrate truck and hand larviciding equipment each year to meet application specifications. Supervisors review spray records daily to ensure appropriate amounts of material are being used. ULV equipment is calibrated for output and droplet size to meet label requirements. Aerial larviciding equipment is calibrated by the Contractor. Aerial adulticide equipment is calibrated regularly and droplet size will be monitored by the District to ensure droplets meet label requirements. Airplanes used in urban ULV applications and the primary airplane used for rural ULV spraying is equipped with advanced guidance and drift management equipment to ensure the best available technology is being used to place product in the intended spray area. If a secondary airplane is used in rural ULV applications it will be equipped with an advanced guidance system.

f. descriptions of specific BMPs for each type of environmental setting (agriculture, urban, and wetlands).

Please see District's Mosquito Reduction Management Practices Document

10. Identification of the problem.

The District's BMPs are described in Districts Mosquito Reduction Best Management Practices Document and the District's Mosquito and Mosquito-Borne Disease Management Plan.; Appendix I,II

a. If applicable, establish densities for larval and adult vector populations to serve as action threshold(s) for implementing pest management strategies

Please see Sacramento-Yolo MVCD's Mosquito and Mosquito-Borne Disease Management Plan; Appendix I,II

b. Identify target vector species to develop species-specific pest management strategies based on developmental and behavioral considerations for each species

Please see Sacramento-Yolo MVCD's Mosquito and Mosquito-Borne Disease Management Plan; Appendix I,II

c. Identify known breeding areas for source reduction, larval control program, and habitat management: and

Any site that holds water for more than 96 hours (4 days) can produce mosquitoes. Source reduction is the District's preferred solution, and whenever possible the District works with property owners to implement long-term solutions to reduce or eliminate the need for continued applications as described in the District's Mosquito Reduction Best Management Practices Document.

d. Analyze existing surveillance data to identify new or unidentified sources of vector problems as well as areas that have recurring vector problems.

This information is located in the Sacramento-Yolo MVCD's Mosquito and Mosquito-Borne Disease Management Plan; Appendix I,II. The District utilizes 178 mosquito surveillance traps on a weekly basis to obtain appropriate mosquito abundance and disease activity data to guide control decisions.

11. Examination of Pesticide Use Alternatives

a. **Evaluating management and treatment options that may impact water quality, non-target organisms, vector resistance, feasibility, and cost effectiveness, such as:**
   - **No action**
   - **Source prevention**
   - **Mechanical or physical source reduction methods**
   - **Cultural methods**
   - **Biological control agents**
   - **Pesticides**

   If there are no alternatives to pesticides, dischargers shall use the least amount of pesticide necessary to effectively control the target pest.

   Applying pesticides only when vectors are present at a level that will constitute a nuisance

   This is described in the District's existing integrated vector management (IVM) program, as well as the practices described in our Mosquito and Mosquito-Borne Disease Management Plan and Mosquito Reduction Best Management Practices Document. In addition, the District may utilize legal abatement authority to mitigate mosquito production.

12. **Correct Use of Pesticides**
    Coalition's or Discharger's use of pesticides must ensure that all reasonable precautions are taken to minimize the impacts caused by pesticide applications. Reasonable precautions include using the proper spraying techniques and equipment, taking account of weather conditions and the need to protect the environment.

    This is an existing practice of the District, and is required to comply with the Department of Pesticide Regulation's (DPR) requirements and the terms of our California Department of Public Health (CDPH) Cooperative Agreement. All pesticide applicators receive annual safety and spill training in addition to their regular continuing education.

13. **Website for Public Notice**

    www.fightthebite.net

E. Pesticide Application Log

The Discharger shall maintain a log for each pesticide application. The application log shall contain, at a minimum, the following information, when practical, for larvicide or adulticide applications:

The Discharger shall maintain a log for each pesticide application. The application log shall contain, at a minimum, the following information, when practical, for larvicide or adulticide applications:

1. **Date of application;**
2. **Location of the application and target areas (e.g., address, crossroads, or map coordinates);**
3. **Name of applicator;**
4. **The names of the water bodies treated if known/ named(i.e., canal, creek, lake, etc.);**
5. **Application details, such as when the application started and stopped, pesticide application rate and concentration, water flow rate of the target area, surface water area, volume of water treated, pesticide(s) and adjuvants used by the Discharger, and volume or mass of each component discharged;**

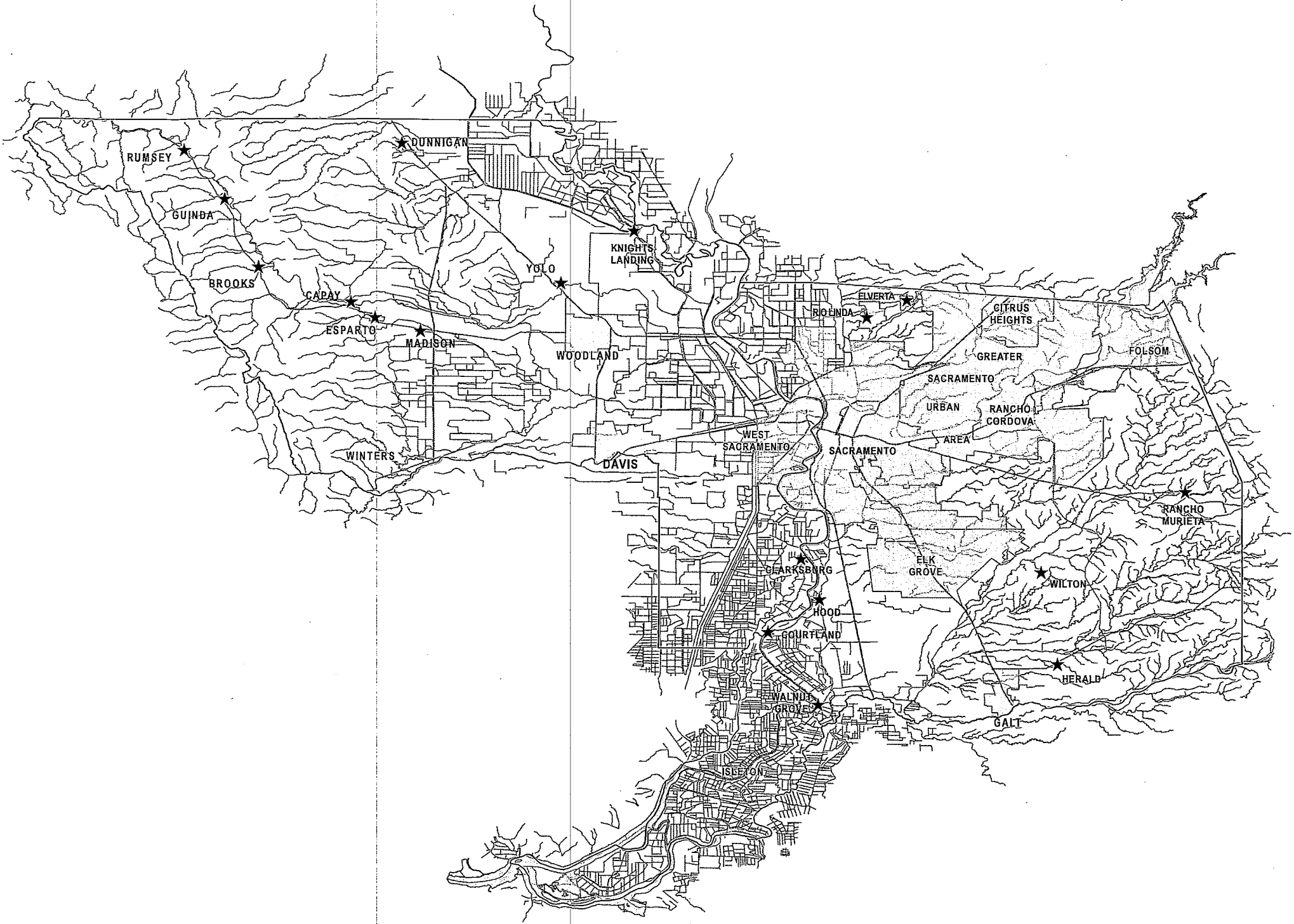
This is an existing practice of the District as required to comply with DPR regulations and our CDPH Cooperative Agreement requirements.
District utilizes hand held and laptop data collection devices to input necessary and practical application permit data into our database.

References:

Mosquito and Mosquito-Borne Disease Management Plan. 2005. Sacramento-Yolo Mosquito and Vector Control District. Download from http://www.fightthebite.net/mosquito-management-plan/

Mosquito Reduction Best Management Practices. Available from Sacramento-Yolo Mosquito & Vector Control District, by download from http://www.fightthebite.net/download/ecomanagement/SYMVCD_BMP_Manual.pdf or calling 800-429-1022

MVCAC NPDES Coalition Monitoring Plan. [In development at the time of this draft]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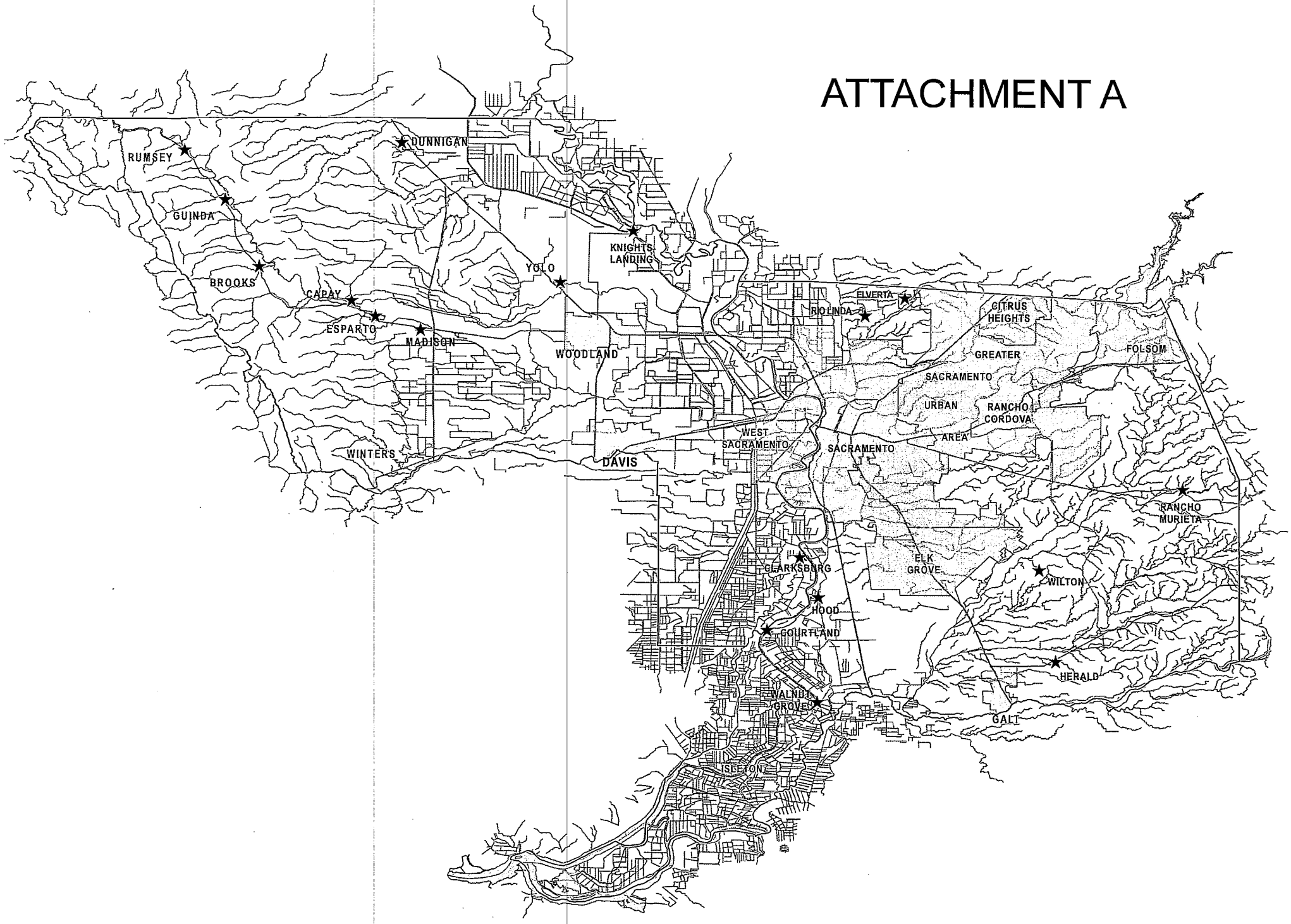
CAPAY
ESPARTO
MADISON
WOODLAND
WINTERS
DAVIS
WEST SACRAMENTO
SACRAMENTO
ELVERTA
ROSEVILLE
CITRUS HEIGHTS
GREATER SACRAMENTO URBAN AREA
RANCHO CORDOVA
FOLSOM
RANCHO MURIETA
CLARKSBURG
ELK GROVE
WILTON
HOOD
COURTLAND
HERALD
WALNUT GROVE
GALT
ISLETON

ATTACHMENT A



Attachment B
Sacramento-Yolo MVCD NOI
V. Pesticide Application Information
B. List of Larvicides that may be used under NPDES Permit. Products found in Attachment F of Permit

Name	Active Ingredient
Aquabac xt	Bacillus thuringienses var. israelensis
Vectobac 12AS	Bacillus thuringienses var. israelensis
Vectobac G	Bacillus thuringienses var. israelensis
Vectobac WDG	Bacillus thuringienses var. israelensis
Aquabac 200 g	Bacillus thuringienses var. israelensis
Vectobac Technical Powder	Bacillus thuringienses var. israelensis
Teknar HP-D	Bacillus thuringienses var. israelensis
Vectolex CG	Bacillus sphaericus
Vectolex WSP	Bacillus sphaericus
Spheratax SPH (50G)WSP	Bacillus sphaericus
Spheratax SPH (50G)	Bacillus sphaericus
Vectomax G	Bacillus thuringienses var. israelensis, Bacillus sphaericus
Vectomax CG	Bacillus thuringienses var. israelensis, Bacillus sphaericus
Vectomax WSP	Bacillus thuringienses var. israelensis, Bacillus sphaericus
FourStar Briquets	Bacillus thuringienses var. israelensis, Bacillus sphaericus
FourStar SBG	Bacillus thuringienses var. israelensis, Bacillus sphaericus
Altosid XR Briquets	S-methoprene
Altosid Pellets / Altosid WSP	S-methoprene
Altosid ALL	S-methoprene
Altosid ALL Concentrate	S-methoprene
Altosid XR-G	S-methoprene
Altosid SBG	S-methoprene
Mosquito Larvicide GB-1111	Petroleum Oil
BVA 2 Mosquito Larvicide Oil	Mineral Oil
BVA Spray 13	Refined Petroleum Distillate
Agnique MMF	Poly (oxy-1,2-ethanediyl), α-(C_{16-20} branched and linear alkyl)-ω-hydroxy
Agnique MMF G	Poly (oxy-1,2-ethanediyl), α-(C_{16-20} branched and linear alkyl)-ω-hydroxy
Abate 2-BG	Temephos
5% Skeeter Abate	Temephos
Natular 2EC	Spinosad
Natular G	Spinosad
Natular XRG	Spinosad
Natular XRT	Spinosad

Adulticides

Pyrocide Mosquito Adulticiding Con	Pyrethrins / Piperonyl butoxide, technical
Evergreen Crop Protection EC 60-6	Pyrethrins / Piperonyl butoxide, technical
Pyrenone Crop Spray	Pyrethrins / Piperonyl butoxide, technical
Prentox Pyronyl Crop Spray	Pyrethrins / Piperonyl butoxide, technical
Pyrocide Mosquito Adulticiding Con	Pyrethrins / Piperonyl butoxide, technical
Aquahalt	Pyrethrins / Piperonyl butoxide, technical
Pyrocide Mosquito Adulticide 7453	Pyrethrins / Piperonyl butoxide, technical
Pyrenone 25-5 Public Health Insecti	Pyrethrins / Piperonyl butoxide, technical
Prentox Pyronyl Oil Concentrate #52	Pyrethrins / Piperonyl butoxide, technical
Prentox Pyronyl Oil Concentrate	Pyrethrins / Piperonyl butoxide, technical

Permanone 31-66	Permethrin / Piperonyl butoxide, technical
Kontrol 30-30 Concentrate	Permethrin / Piperonyl butoxide, technical
Aqualuer 20-20	Permethrin / Piperonyl butoxide, technical
Aqua-Reslin	Permethrin / Piperonyl butoxide, technical
Aqua-Kontrol Concentrate	Permethrin / Piperonyl butoxide, technical
Kontrol 4-4	Permethrin / Piperonyl butoxide, technical
Biomist 4+12	Permethrin / Piperonyl butoxide, technical
Permanone RTU 4%	Permethrin / Piperonyl butoxide, technical
Prentox Perm-X UL 4-4	Permethrin / Piperonyl butoxide, technical
Allpro Evoluer 4-4	Permethrin / Piperonyl butoxide, technical
Biomist 4+4	Permethrin / Piperonyl butoxide, technical
Kontrol 2-2	Permethrin / Piperonyl butoxide, technical
Scourge 18%+54% MF Formula II	Resmethrin / Piperonyl butoxide, technical
Scourge 4% + 12% MF Formula II	Resmethrin / Piperonyl butoxide, technical
Anvil 10+10	Sumithrin / Piperonyl butoxide, technical
AquaANVIL	Sumithrin / Piperonyl butoxide, technical
Duet Dual-Action	Prallethrin/Sumithrin / Piperonyl butoxide, technical
Anvil 2+2	Sumithrin / Piperonyl butoxide, technical
Zenivex E20	Etofenprox
Trumpet EC	Naled
Fyfanon	Malathion

NPDES Government Contact List Attachment C

City of Davis, City Manager	Paul Navazio	pnavazio@cityofdavis.org
City of Woodland, City Manager	Mark Deven	cm1@cityofwoodland.org
City of Sacramento, City Manager	Gus Vina	gvina@cityofsacramento.org
City of Winters, City Manager	John Donlevy, Jr.	john.donlevy@cityofwinters.org
City of Folsom, City Manager	Kerry Miller	kmiller@folsom.ca.us
City of Galt	Jason Behrmann	jbehrmann@ci.galt.ca.us
City of Citrus Heights	Henry Tingle	citymanager@citrusheights.net
City of Rancho Cordova	Ted Gaebler	tgaebler@cityofranchocordova.org
Isleton	Bruce Pope	po box 716 Isleton, CA 95641-0716
west sacramento	Toby Ross	1110 W. Capitol Ave. 3rd floor, West Sacramento, CA 95691
Elk grove	Laura Gill	8401 Laguna Palms Way, Elk Grove, CA 95758
California Dept of Water Resources Division of Land and ROW	Juan Mercado	jmercado@water.ca.gov
Cosumnes River Preserve (CRP)	Harry McQuillen	harry_mcQuillen@ca.blm.gov
California Dept. of Fish and Game Yolo Bypass Wildlife Area	Dave Feliz	dfeliz@dfg.ca.gov
DFG, Lands Program	Heidi West	HWEST@dfg.ca.gov
USFWS, Stone Lakes National Wildlife Refuge	Bart McDermott	bart_mcdermott@fws.gov
Yolo County Flood Control and Water Conservation District	Tim O'Halloran	tohalloran@ycfcwcd.org
Cal Trans District 3		
Yolo County Resource Conservation District		
United States Bureau of Reclamation	Kathy Schroeder	kschroeder@usbr.gov
United States Bureau of Reclamation	Ned Gruenhagen	ngruenhagen@usbr.gov
State of California Dept. of Parks and Recreation Gold Fields District	Jim Michaels	jmiche@parks.ca.gov
Cosumnes Community Services District	Jeff Ramos	jefframos@yourcsd.com
United States Fish and Wildlife (USFWS)	Kathy Brown	kbrown@usfws.gov
United States Department of Agriculture Natural Resources Conservation Service (NRCS)	Dean Kwasny	dean.kwasny@ca.usda.gov

Yolo County Board of Supervisors	Mike McGowan	mike.mcgowan@yolocounty.org

Yolo County Board of Supervisors	Helen MacLeod Thomson	helen.thomson@yolocounty.org
Yolo County Board of Supervisors	Matt Rexroad	matt@rexroad.com
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Sacramento County Board of Supervisors	Jimmie R. Yee	jyee@saccounty.net
Sacramento County Board of Supervisors	Susan Peters	susanpeters@saccounty.net
Sacramento County Board of Supervisors	Roberta MacGlashan	macglashanr@saccounty.net
Sacramento County Board of Supervisors	Don Nottoli	nottolid@saccounty.net
Sacramento Co. Agriculture Dept.	Frank Carl	agcomm@saccounty.net
Yolo Co. Agriculture Dept	John Young	john.young@yolocounty.org

Reclamation District 3 P.O. Box 1011, Walnut Grove, CA 95690 (916) 776-1945
Reclamation District 317 P.O. Box 338, Walnut Grove, CA 95690 (916) 776-2544
Reclamation District 341 18419 State Highway 160, Rio Vista, CA 94571 (916) 777-4244
Reclamation District 349 District Office P.O. Box 368, Courtland, CA 95615 (916) 775-1516
Reclamation District 369 13952 Main Street, Locke, CA 95690 (916) 776-1684
Reclamation District 407 P.O. Box 338, Walnut Grove, CA 95690 (916) 776-2544
Reclamation District 551 1515 13th Ave., Sacramento, CA 95818 (916) 775-1337
Reclamation District 554 P.O. Box 248, Walnut Grove, CA 95690
Reclamation District 556 P.O. Box 1046, Walnut Grove, CA 95690 (916) 776-2092
Reclamation District 563 P.O. Box 470, Walnut Grove, CA 95690-0470 (916) 776-2544
Reclamation District 765 8780 Auburn-Folsom Rd, Granite Bay, CA 95746 (916) 782-1177
Reclamation District 755 11275 State Highway 160, Courtland, CA 95615 (916) 775-1379
Reclamation District 785 429 First Street, Woodland, CA 95695 (530) 662-2859
Reclamation District 787 41758 County Rd, #112, Knights Landing, CA 95645 (530) 735-6274
Reclamation District 800 P.O. Box 115, Elk Grove, CA 95759 (916) 685-9461
Reclamation District 813 P.O. Box 557, Courtland, CA 95615 (916) 871-4060
Reclamation District 827 429 First Street, Woodland, CA 95695 (530) 662-2859
Reclamation District 900 P.O. Box 673, West Sacramento, CA 95691 (916) 371-1483
Reclamation District 999 38563 Netherlands Rd, Clarksburg, CA 95612-5003 (916) 775-2144
Reclamation District 1000 1633 Garden Highway, Sacramento, CA 95833 (916) 922-1449
Reclamation District 1002 962 Lambert Road, Courtland, CA 95615 (916) 775-1674
Reclamation District 1600 429 First Street, Woodland, CA 95695 (530) 662-2859
Reclamation District 1601 2360 West Twitchell Island Rd, Rio Vista, CA 94571 (916) 257-4241
Reclamation District 2035 45332 County Road 25, Woodland, CA 95776 (530) 662-9080
Reclamation District 2067 P.O. Box 338, Walnut Grove, CA 95690 (916) 776-2544

Reclamation District 2093 116 New Montgomery St, San Francisco, CA 94105 (415) 495-5660
Reclamation District 2110 P.O. Box 1151, Walnut Grove, CA 95690 (916) 683-1767
Reclamation District 2111 P.O. Box 248, Walnut Grove, CA 95690 (916) 776-1701
Reclamation District 2120 1325 J Street, Sacramento, CA 95814 (916) 557-7708
Brannan-Andrus LM Dist P.O. Box 338, Walnut Grove, CA

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	**Control Operations in Rural Areas Responsibility**
Inspect and treat mosquito development sites Assess adult mosquito population Control adult mosquitoes	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 → **Delineate treatment area**
25 or more **female** mosquitoes →

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.
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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
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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

SACRAMENTO-YOLO
MOSQUITO
& VECTOR
CONTROL
DISTRICT

MAILING ADDRESS
SACRAMENTO COUNTY
8631 BOND ROAD
ELK GROVE, CA 95624

YOLO COUNTY
1234 FORTNA AVENUE
WOODLAND, CA 95695

1.800.429.1022
FIGHTtheBITE.net

March 1, 2011

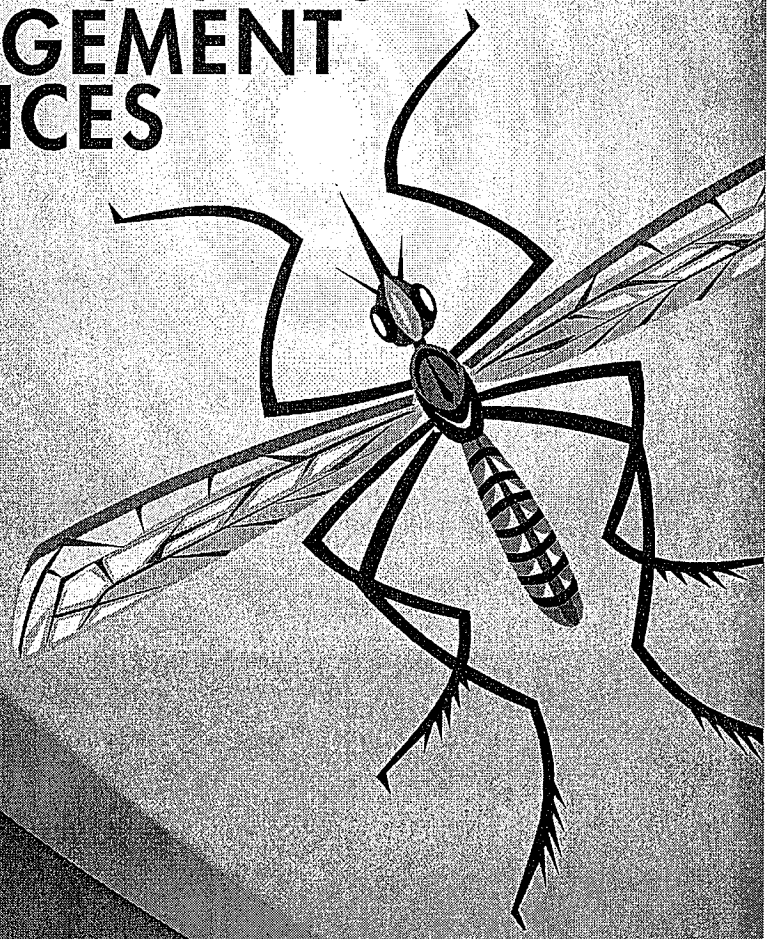
Dear Agency,

The Sacramento-Yolo Mosquito and Vector Control District (District) may be making larvicide and or adulticide applications to waters of the US under your jurisdiction for mosquito reduction purposes. Applications will be posted and can be viewed on our website at www.fightthebite.net. The District is required to notify all Government Agencies that may be affected by these applications under the requirements of the General NPDES Permit for Biological and Residual Pesticide Discharges from Vector Control Applications. Please contact Gary Goodman at 800-429-1022 if you have additional questions.

Sincerely,

Gary Goodman
Assistant Manager
Sacramento-Yolo MVCD

MOSQUITO REDUCTION BEST MANAGEMENT PRACTICES



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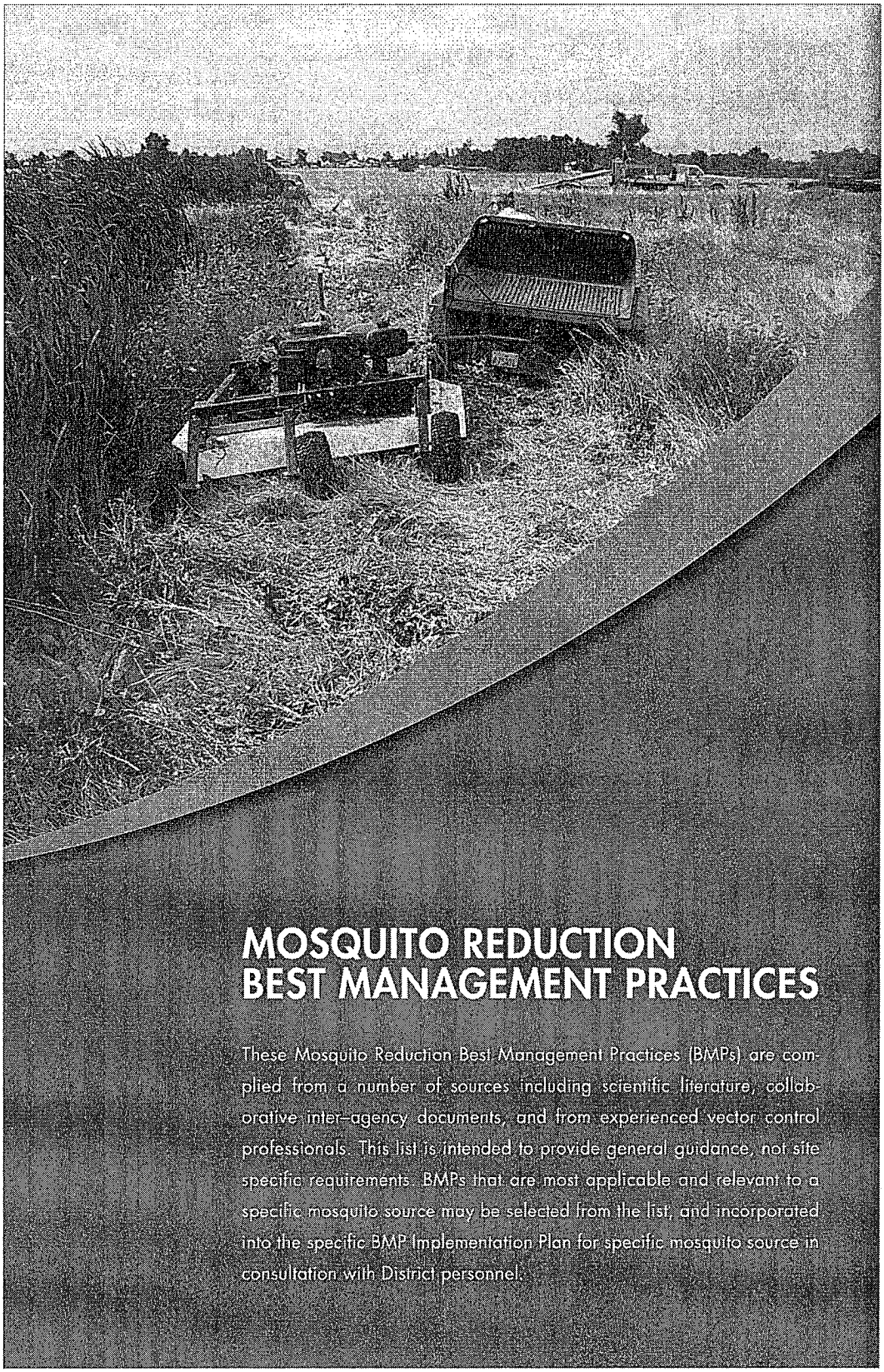

MOSQUITO REDUCTION BEST MANAGEMENT PRACTICES

These Mosquito Reduction Best Management Practices (BMPs) are compiled from a number of sources including scientific literature, collaborative inter-agency documents, and from experienced vector control professionals. This list is intended to provide general guidance, not site specific requirements. BMPs that are most applicable and relevant to a specific mosquito source may be selected from the list, and incorporated into the specific BMP Implementation Plan for specific mosquito source in consultation with District personnel.

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MOSQUITO REDUCTION BEST MANAGEMENT PRACTICES IMPLEMENTATION POLICIES

The Sacramento–Yolo Mosquito and Vector Control District (District) recognizes that certain land management practices can reduce mosquito populations thereby reducing long–term mosquito treatment costs, reducing the amount of pesticides used in mosquito control operations, helping to protect public health, and contributing to the District's integrated pest management (IPM) approach to mosquito and vector control.

Integrated Pest Management is an approach that focuses on site–specific, scientifically sound decisions to manage pest populations by matching a wide variety of techniques with the conditions found on site. These techniques are commonly grouped into four categories:

1. Source reduction or physical control—environmental manipulation that results in a reduction of mosquito development sites
2. Biological Control—use of biological agents to limit larval mosquito populations
3. Chemical Control—larvicides (materials that kill immature larval mosquitoes) and adulticides (materials that kill adult mosquitoes)
4. Cultural Control—change the behavior of people so that their actions prevent the development of mosquitoes or the transmission of vector–borne disease.

Through the adoption of these policies and procedures, the District would like to enhance the clarity of its efforts to effectively control mosquitoes by physical, cultural, and biological means. To this end, this document includes District guidelines for land–management practices that provide landowners and land managers an opportunity to address any land–based mosquito problems as may be identified by the District.

The Mosquito Reduction Best Management Practices (BMPs) referred to in this document are the recommended land management practices that can provide a reduction in mosquito populations by various means including: reducing or eliminating breeding

areas, increasing the efficacy of biological controls, increasing the efficacy of chemical controls, and improving access for control operations. These BMPs have been circulated among representatives of stakeholder groups including landowners, land managers, regulatory agencies, and other interest groups. As a result of the comments and suggestions received from this process, the District has a good understanding of practical and appropriate BMPs for a variety of land uses that exist in Sacramento and Yolo counties. Not all BMPs included in this document will apply equally to all mosquito sources; however the BMPs listed serve as a starting point in the cooperative development of site–specific BMP Implementation Plans that will address particular mosquito sources.

The District intends to encourage those responsible for significant mosquito sources on their property to develop and implement a cooperative Mosquito Reduction BMP plan with the District to avoid the need for formal enforcement actions authorized under the California Health and Safety Code (HSC)[1]. While in some situations, the District must employ the California Health and Safety Code in order to ensure safe conditions and to carry out its public responsibilities, it has been the District's experience that a cooperative approach provides more effective and long–lasting mosquito management.

The Mosquito Reduction BMP Implementation Policies are designed to address mosquito breeding sources including, but not limited to: managed wetlands, duck clubs, rice fields, agricultural ditches, stormwater structures, wastewater facilities, residential properties, and cemeteries. Many of these sources produce significant mosquitoes due to management practices that promote favorable habitat for mosquitoes.

While it is generally accepted that mosquito production from all sources may be reduced through the widespread implementation of Mosquito Reduction BMPs, these policies specifically target the most severe mosquito problems with the greatest likelihood of responding through the use of BMPs. These sources are defined as Significant Mosquito Sources, and will be addressed according to the following policies and procedures. For those properties with mosquito sources that do not fit the definition of Significant Mos-

[1]Under the California Health and Safety Code, mosquito and vector control districts may legally abate a public nuisance defined as "Any water that is a breeding place for vectors" and "Any activity that supports the development, attraction, or harborage of vectors, or that facilitates the introduction or spread of vectors." (HSC §2002(j)). Abatement can result in civil penalties of up to $1000.00 per day (HSC §2085(a), §2061).

quito Source, the BMPs offer an opportunity to proactively address mosquito problems to avoid development into a significant mosquito source.

In cases where the implementation of Mosquito Reduction BMPs would cause economic hardship or cause technical difficulties, the District may choose to offer assistance in the form of equipment, labor, technical advice, or other resources. The level of assistance offered will be determined on a case by case basis.

SIGNIFICANT MOSQUITO SOURCES

Significant Mosquito Sources will be identified based on the following criteria:

- Mosquito production from the source is more than similar land uses, and exceeds treatment thresholds;
- Treatment costs incurred by the District are increased due to problems caused by management practices;
- The source is in close proximity to areas of significant population density; and/or
- BMPs exist to address the land management practices and can be reasonably utilized to reduce mosquito production.

If left untreated, a Significant Mosquito Source would be considered a public nuisance as defined in the California Health and Safety Code (HSC) §2002(j).

A combination of larval dip data and adult mosquito surveillance data will be used determine the pre and post BMP implementation mosquito abundance for a particular property or mosquito source. In cases where existing data or current sampling methods are not sufficient to detect the efficacy of a particular BMP, a specific monitoring plan will be established to meet the needs of the particular property or mosquito source.

Management practices that would contribute to increased mosquito production include but are not limited to: poor water management, lack of emergent vegetation control, lack of effective refugia to maintain biological control populations (e.g. borrow pits), poor condition of water conveyance or drainage structures, practices that impede access to the source, and lack of notification of practices that would effect mosquito control operations.

Other factors such as treatment costs, proximity to population centers, vector–borne disease status, mosquito species produced, and the efficacy of available treatment options will be considered when evaluating a Significant Mosquito Source as defined above. Those sources that are determined to have the highest potential for mosquito reduction from the implementation of BMPs and are adjacent to population centers of reasonably high density will be selected for inclusion into the BMP compliance program.

BMP IMPLEMENTATION PLAN

Once the District has identified a Significant Mosquito source, it will present a draft BMP Implementation Plan to the responsible party, in consultation with state and federal biologists if appropriate, proposing a course of action based on one or more BMPs that, if implemented, can reduce or eliminate the mosquito breeding sources.

The draft BMP Implementation Plan will contain at least the following:

- Justification for requested actions.
- Description of the proposed BMPs including specific guidance regarding method and timing of implementation.
- District resources available to assist with BMP Implementation.
- Assessment method.

The responsible party will have the opportunity to review and comment on the draft plan. Reasonable adjustments may be negotiated between the responsible party and the District to achieve a mutually agreeable plan. A reasonable time limit will be set at the beginning of the negotiation phase at which time the District will finalize any unresolved issues at its discretion. This time limit may be extended if all parties agree that there is reasonable cause to do so.

If the responsible party is unwilling to accept the terms of this cooperative process, the District may be forced to pursue an enforcement process including abatement.

CHARGES FOR TREATMENT COSTS

The District is authorized by the Health and Safety Code to recover treatment costs for mosquito control operations. Since most treated properties in the District pay for a base level of mosquito control through the payment of property taxes, the District would consider charging for treatment cost that are above and beyond the normal level of treatment required by a similar mosquito source with similar land use. Since one of the primary goals of the BMP Policies is to reduce pesticide use in Sacramento and Yolo counties, the District would only consider accepting charges for additional treatment in lieu of BMPs on a case–by–case basis for a limited period of time. As new BMPs are developed and efficacy of existing BMPs is reserched further, the expectation would be that the charge for treatment portions of the BMP Implementation Plans would be replaced by non–pesticide based long–term mosquito management plans.

APPEAL PROCESS

The responsible party may submit comments in writing to the District Board of Trustees of the District before the implementation deadline indicated on the Draft BMP Implementation Plan presented to the responsible party in Step #2 on Figure 1. After review, the Board will issue a determination which may include no change in the content of the Draft BMP Implementation Plan, an extension of the implementation deadline, a waiver of fees, or other appropriate action.

If the responsible party is a state agency, appeals may be made to the State Department of Health Services pursuant to the California Health and Safety Code.

BMP IMPLEMENTATION PROCESS FOR SIGNIFICANT MOSQUITO SOURCES

The following items are a generally chronological progression of the Mosquito Reduction BMP Compliance Program actions after a Significant Mosquito Source is identified.

NOTE: *The numbered items correspond to the numbers on Figure 1.*

1. **IDENTIFY A SIGNIFICANT MOSQUITO SOURCE**—The District will identify Significant Mosquito Sources based on the previously defined criteria.

2. **CONTACT RESPONSIBLE PARTY**—The District will contact the responsible party (as defined in HSC §2060) of properties in Sacramento or Yolo county that have been identified as significant mosquito sources, that if untreated, would become a public nuisance (under HSC §2060). The Department will also contact state and federal agencies that have an underlying interest in the property, including a conservation easement, habitat management plan, or other habitat maintenance agreement. A draft BMP Implementation Plan will be provided to the responsible parties. This plan will include an explanation of why the site was determined to be a significant mosquito source, including mosquito surveillance data if requested

3. **NEGOTIATE BMP IMPLEMENTATION PLAN**—The District's Ecological Management Department will work with the responsible party to achieve a mutually agreeable course of action to address the mosquito source including specific BMPs, implementation timeline, maintenance requirements, and monitoring plan. A defined negotiation period will be designated at the start of the negotiations.

4. **ADDITIONAL RESOURCES**—At the discretion of the District, resources may be made available to assist in complying with the BMP requirements. In cases where District resources are used, specific maintenance requirements will be specified in the cooperative agreement, and will be signed by the responsible party and the District. This Agreement will contain the name of the responsible party, location of the property, description of the work to be done, the cost of the work, if

any, to be paid by the responsible party, and requirements for maintenance to be performed by the responsible party. In some cases, such as maintaining access to dairy sumps by regular mowing, the District will use a Vegetation Control Agreement to establish a long–term contract with each dairy operator. This agreement shall be subject to the same requirements as any other agreement covered by these policies.

5. **COORDINATE WITH OTHER REGULATORY AGENCIES**—Other local, state, federal, and conservation agencies will be brought into the negotiation process to avoid or address any potential regulatory conflicts with the draft BMP Implementation Plan.

6. **COOPERATIVE AGREEMENT**—The cooperative agreement will formalize the relationship between the District and the responsible party holding both to the terms agreed upon in the BMP Implementation Plan. This document will also outline the consequences of non–compliance with the BMP Implementation Plan under the California Health and Safety Code.

7. **IMPLEMENTATION AND MONITORING**—After successful implementation of the requirements, regular inspections of the property will be conducted to assess the responsible party's continued maintenance and compliance with the BMPs. The District reserves the right to re–negotiate the BMP Implementation Plan if it is discovered that adequate mosquito control is not being achieved. In this case, the process would return to Step 2. As long as the responsible party is in compliance with the terms of the cooperative agreement, no additional charges or penalties will be assessed by the District.

8. **EVALUATION OF BMP EFFICACY**—An effective mosquito management plan requires regular assessment and adaptive management to address changing conditions or unforeseen effects. The District will evaluate each BMP Implementation Plan to determine if the BMPs are meeting the needs of both the responsible party and the District. Based on this evaluation, either party may initiate a review of the BMP Implementation Plan pursuant to the terms of the cooperative agreement.

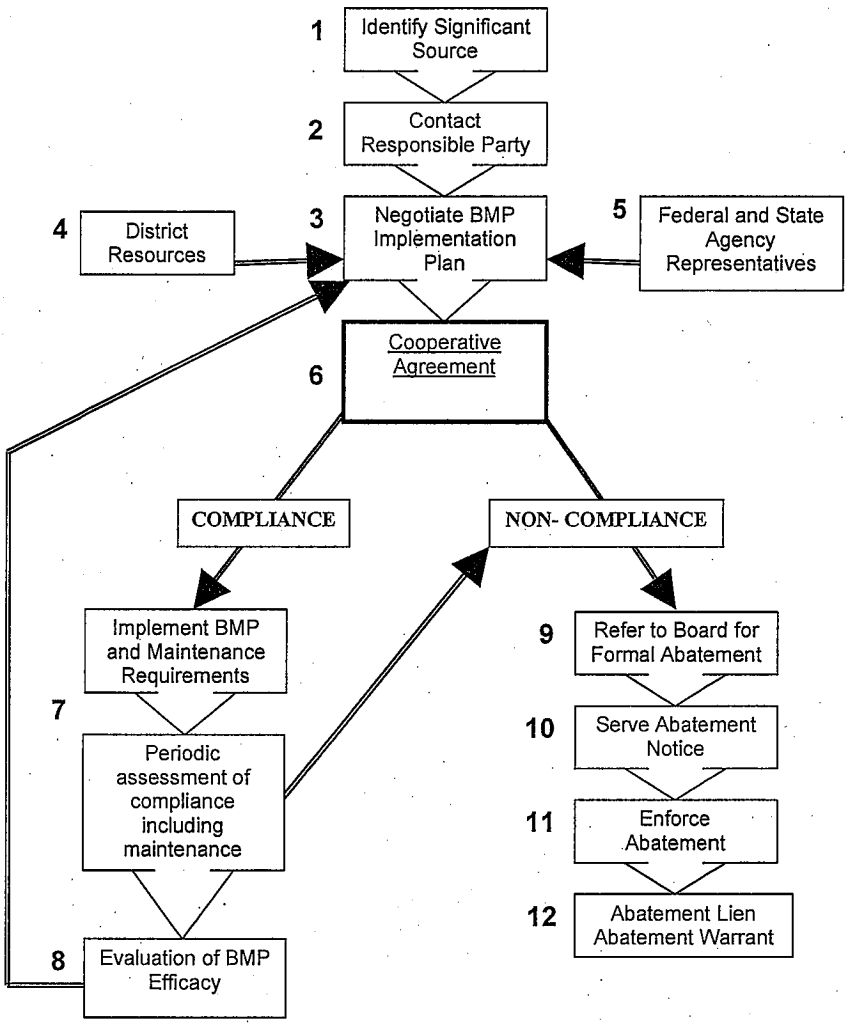
9. **ABATEMENT PROCESS**—If the responsible party does not take corrective action or does not provide a reasonable explanation for the continued lack of compliance with the cooperative agreement, the case may be brought to the District Board of Trustees to begin the Formal Abatement process as defined in HSC §2061.

10. **SERVE ABATEMENT NOTICE**—Under guidance from of the District Board of Trustees, the responsible party will be served an abatement notice directing them to comply with the cooperative agreement within the specified timeframe. Civil penalties of up to $1000 per day will be imposed for non-compliance pursuant to §2061 and §2063 of the California Health and Safety Code

11. **ENFORCE ABATEMENT**—Under the direction of the District Board of Trustees, civil penalties and treatment costs not paid within 60 days will be collected "at the same time and in the same manner as ordinary county taxes....and shall be subject to the same procedure and sale in case of delinquency as are provided for ordinary county taxes." HSC §2065(b).

12. **ADDITIONAL ABATEMENT ACTIONS**—Under the direction of the District Board of Trustees, and/or manager, other measures such as an abatement warrant or abatement lien may be imposed pursuant to the California Health and Safety Code.

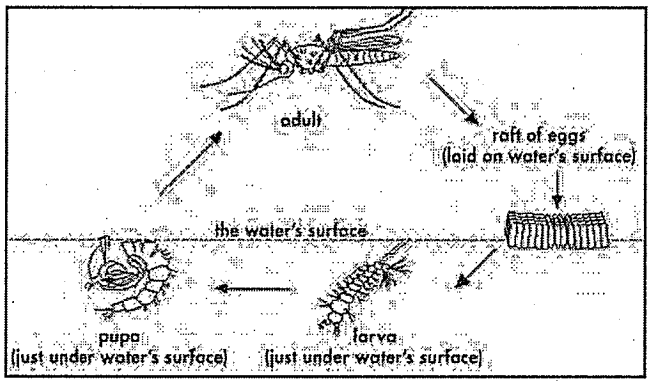
FIGURE 1: **BMP PROGRAM FLOWCHART**



BASIC MOSQUITO BIOLOGY

There are over 50 different species of mosquito in California. Fortunately, only a handful are of significant concern in our area. It is important to realize that each species of mosquito has different habitat requirements and behaviors that affect its ability to transmit disease, bite humans, and be controlled by a specific BMP.

BASIC MOSQUITO LIFE CYCLE



All mosquitoes share a similar life cycle with an aquatic stage (larvae) and an aerial stage (adult). Nearly all mosquito reduction best management practices (BMPs) focus on managing the aquatic stage of the mosquito by creating the conditions less favorable for mosquito development. This usually involves manipulating the amount or timing of standing water, decreasing the amount of vegetation in and around the standing water, and creating a situation where natural or introduced predators can consume the mosquito larvae. Since each species of mosquito has slightly different habitat requirements, it is important to understand which mosquitoes favor which habitats to realize how a particular BMP is designed to work.

To understand BMPs it is useful to think of mosquitoes as belonging to one of the following three categories. Examples of common species within each category follow.

1. **STANDING–WATER MOSQUITOES** prefer still water commonly found in ponds, un–maintained swimming pools, rice fields, puddles, etc.

   Common Mosquito Reduction BMPs:

   a. Drain standing water.
   b. Reduce or eliminate emergent vegetation in and along the edges of the water.
   c. Hold water level constant to encourage natural predators or biological control agents (e.g. mosquitofish).
   d. Contact the District to coordinate mosquito prevention with other mosquito control operations such as chemical and biological control.

2. **FLOODWATER MOSQUITOES** commonly lay their eggs in moist soil. When they become submerged as in a seasonal wetland or irrigated pasture, the eggs hatch.

   Common Mosquito Reduction BMPs:

   a. Flood when air temperatures do not encourage rapid mosquito development (e.g. late fall rather than summer).
   b. Reduce or eliminate emergent vegetation by disking or mowing.
   c. Flood quickly to encourage all eggs to hatch at once and minimize the need for multiple larvicide applications.
   d. Contact the District to coordinate mosquito prevention with other mosquito control operations such as chemical and biological control.

3. **CONTAINER MOSQUITOES** prefer contained areas of water such as tree holes, buckets, tires, etc. Some standing water mosquitoes will also develop in containers such as the House Mosquito (*Culex pipiens*).

   Common Mosquito Reduction BMPs:

   a. Drain containers of standing water.
   b. Cover, overturn, or create drainage holes that prevent standing water in the container.
   c. Identify and prevent sprinklers or other water from refilling containers.
   d. Contact the District to coordinate mosquito prevention with other mosquito control operations such as chemical and biological control.

STANDING–WATER MOSQUITOES

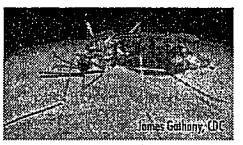
ENCEPHALITIS MOSQUITO (*Culex tarsalis*)

The Encephalitis Mosquito can transmit encephalitis viruses to humans. It has been known to transmit West Nile virus, Western Equine Encephalomyelitis virus and St. Louis encephalitis virus. The Encephalitis Mosquito can be found throughout Sacramento and Yolo counties. Immature mosquitoes develop in wetlands, duck clubs, rice fields and irrigated crops. The adult mosquito prefers to feed on birds and mammals. It is most active during summer and fall.

NORTHERN HOUSE MOSQUITO (*Culex pipiens*)

The Northern House Mosquito has been known to transmit West Nile virus and St. Louis encephalitis virus. It is common throughout Sacramento and Yolo counties. Immature mosquitoes often develop in foul water sources such as dairy lagoons, storm drains, un–maintained swimming pools, cemetery vases and other containers. It prefers to feed on birds but will readily feed on humans. This mosquito is most active during the summer and fall.

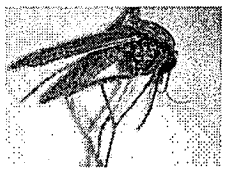
WESTERN MALARIA MOSQUITO (*Anopheles freeborni*)



Anopheles freeborni can transmit the malaria parasite to humans. It is common in rice growing regions of California. Immature stages develop in rice fields, wetlands, duck clubs and rain pools. While malaria does not normally occur in California anymore, this mosquito allows the potential for local outbreaks of malaria if a person gets infected elsewhere, and then is bitten by a local *Anopheles* mosquito.

FLOODWATER MOSQUITOES

WETLANDS MOSQUITO (*Aedes melanimon*)



Aedes melanimon is involved in the encephalitis transmission cycle and is a severe outdoor pest. It is common in Sacramento and Yolo counties. This mosquito develops in wetlands, duck clubs and irrigated pastures. It prefers to feed on mammals. It is most active during the fall and spring.

INLAND FLOODWATER MOSQUITO (*Aedes vexans*)

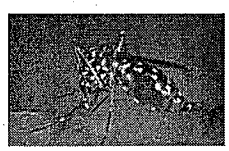
This mosquito is a secondary vector for dog heartworm and is a severe outdoor pest. It is common in irrigated pastures and in woodland water course pools. They feed primarily on mammals. This mosquito is most active in early spring through late fall. They typically blood feed at dawn and dusk, but may also be active during the day.

CONTAINER MOSQUITOES

WESTERN TREEHOLE MOSQUITO (*Aedes sierrensis*)

This mosquito can transmit the dog heartworm parasite (*Dirofilaria immitis*), and is a severe outdoor pest. The western treehole mosquito is common in oak woodlands. Immature stages develop in tree rot holes. Female adults feed primarily on mammals, and are most active during late winter through early spring.

ASIAN TIGER MOSQUITO (*Aedes albopictus*)



This species of mosquito has not established in California yet, but is an aggressive exotic species that has invaded the eastern and southern US. Over the past 10 years there have been several cases where this mosquito was found in cargo containers in port areas in Los Angeles and San Francisco. This container breeding species is a potential vector for various vector–borne diseases such as Rift Valley Fever, Chikungunya Virus, Dengue Fever, and Yellow Fever. Should *Aedes albopictus* become established in California, the need for effective mosquito control practices will be even more important to protect public health.

AGRICULTURAL IRRIGATION AND DRAINAGE

These Mosquito Reduction Best Management Practices (BMPs) are compiled from a number of sources including scientific literature, collaborative inter–agency documents, and from experienced vector control professionals. This list is intended to provide general guidance, not site specific requirements. BMPs that are most applicable and relevant to a specific mosquito source may be selected from the list, and incorporated into the specific BMP Implementation Plan for a specific mosquito source in consultation with District personnel.

COMMON MOSQUITO DEVELOPMENT SITES

- Vegetated ditches
- Seepage or flooding of fallow fields
- Irrigation tail water return sumps
- Blocked ditches or culverts
- Leaky water control structures
- Irrigated pastures
- Low areas caused by improper grading
- Broken or leaky irrigation pipes or valves

COMMON MOSQUITO SPECIES

- Clean standing water sources: *Culex tarsalis*
- Nutrient rich water sources: *Culex pipiens*
- Seasonally flooded areas: *Aedes* species *(Ae. melanimon)*

SPECIAL CONCERNS

Agricultural practices vary among growers, locations, and conventional or organic production methods. Pesticide regulations can affect the ability to use chemical control The Mosquito Reduction Best Management Practices below are offered as tools to balance the economic and agronomic requirements of the growers and land owners with the need for effective mosquito control. The District is committed to working with growers to implement mosquito control practices that coincide with agricultural practices and minimize the impact on the economics or yields of the crop.

General Mosquito Reduction Principles

1. Prevent or eliminate unnecessary standing water that stands for more than 72 –96 hours during mosquito season which can start as early as March and extend through October depending on weather.
2. Maintain access for District staff to monitor and treat mosquito breeding sources.
3. Minimize emergent vegetation and surface debris on the water.
4. Contact the District for technical guidance or assistance in implementing mosquito reduction BMPs.

MOSQUITO REDUCTION BMPS FOR AGRICULTURAL SETTINGS

DITCHES AND DRAINS

DD-1. Construct or improve ditches with at least 2:1 slopes and a minimum 4 foot bottom. Consider a 3:1 slope or greater to discourage burrowing animal damage, potential seepage problems, and prevent unwanted vegetation growth. Other designs may be approved by the MVCD based on special circumstances.

DD-2. Keep ditches clean and well–maintained. Periodically remove accumulated sediment and vegetation. Maintain ditch grade to prevent areas of standing water.

DD-3. Design irrigation systems to use water efficiently and drain completely to avoid standing water.

IRRIGATED PASTURES

IP-1. Grade field to achieve efficient use of irrigation water. Use NRCS guidelines for irrigated pastures. Initial laser leveling and periodic maintenance to repair damaged areas are needed to maintain efficient water flow (Lawler and Lanzaro, 2005).

IP-2. Irrigate only as frequently as is needed to maintain proper soil moisture. Check soil moisture regularly until you know how your pasture behaves (Lawler and Lanzaro, 2005).

IP-3. Do not over fertilize. Excess fertilizers can leach into irrigation tail water, making mosquito production more likely in ditches or further downstream (Lawler and Lanzaro, 2005).

IP-4. Apply only enough water to wet the soil to the depth of rooting (Lawler and Lanzaro, 2005).

IP-5. Drain excess water from the pasture within 24 hours following each irrigation. This prevents scalding and reduces the number of weeds in the pasture. Good check slopes are needed to achieve drainage. A drainage ditch may be used to remove water from the lower end of the field (Lawler and Lanzaro, 2005).

IP-6. Inspect fields for drainage and broken checks to see whether re–leveling or reconstruction of levees is needed. Small low areas that hold water can be filled and replanted by hand. Broken checks create cross–leakage that provide habitat for mosquitoes (Lawler and Lanzaro, 2005).

IP-7. Keep animals off the pasture while the soil is soft. An ideal mosquito habitat is created in irrigated pastures when water collects in hoof prints of livestock that were run on wet fields or left in the field during irrigation. Keeping animals off wet fields until soils stiffen also protects the roots of the forage crop and prevents soil compaction that interferes with plant growth (Lawler and Lanzaro, 2005).

IP-8. Break up pastures into a number of smaller fields so that the animals can be rotated from one field to another. This allows fields to dry between irrigations and provides a sufficient growth period between grazings. It also prevents hoof damage (pugging), increases production from irrigated pastures, and helps improve water penetration into the soil by promoting a better root system (Lawler and Lanzaro, 2005).

DAIRIES

COMMON MOSQUITO DEVELOPMENT SITES

- Wastewater lagoons
- Animal washing areas
- Drain ditches
- Sumps/ponds
- Watering troughs
- Irrigated pastures
- Irrigated crops

COMMON MOSQUITO SPECIES

- Clean standing water sources: *Culex tarsalis*
- Nutrient rich water sources: *Culex pipiens*

SPECIAL CONCERNS

Dairy and associated agricultural practices vary; however, these practices need to take into account mosquito and vector control issues. The Best Management Practices for Mosquito Reduction below offer options to balance the requirements of the dairy operators with the need for effective mosquito control. The District is committed to working with dairy operators to implement mosquito control practices that are effective and have the least possible impact on the economics and operation of the dairy.

GENERAL MOSQUITO REDUCTION PRINCIPLES

1. Prevent or eliminate unnecessary standing water that remains for more than 72 –96 hours during mosquito season which can start as early as March and extend through October depending on weather.
2. Maintain access for District staff to monitor and treat mosquito breeding sources.
3. Minimize emergent vegetation and surface debris on the water.
4. Contact the District for technical guidance or assistance in implementing mosquito reduction BMPs.

SPECIFIC MOSQUITO REDUCTION BMPS

DA-1. Wastewater holding ponds should not exceed 150' in width.

DA-2. All holding ponds should be surrounded by lanes of adequate width to allow safe passage of vector control equipment. This includes keeping the lanes clear of any materials or equipment (e.g. trees, calf pens, hay stacks, silage, tires, equipment, etc.).

DA-3. If fencing is used around the holding ponds, it should be placed on the outside of the lanes with gates provided for vehicle access.

DA-4. All interior banks of the holding ponds should have a grade of at least 2:1.

DA-5. An effective solids separation system should be utilized such as a mechanical separator or two or more solids separator ponds. If ponds are used, they should not exceed sixty feet in surface width.

DA-6. Drainage lines should never by–pass the separator ponds, except those that provide for normal corral run–off and do not contain solids. All drain inlets must be sufficiently graded to prevent solids accumulation.

DA-7. Floating debris should be eliminated on all ponds; mechanical agitators may be used to break up crusts.

DA-8. Vegetation should be controlled regularly to prevent emergent vegetation and barriers to access. This includes access lanes, interior pond embankments and any weed growth that might become established within the pond surface. An approved vegetation management plan should be on file with the District.

DA-9. Dairy wastewater discharged for irrigation purposes should be managed so that it does not stand for more than three days.

DA-10. All structures and water management practices should meet current California Regional Water Quality Control Board requirements (Creedon, 2006).

DA-11. Tire sidewalls or other objects that will not hold water should be used to hold down tarps (e.g. on silage piles). Whole tires or other water–holding objects should be replaced.

RICE FIELDS

COMMON MOSQUITO DEVELOPMENT SITES

- Flooded rice fields can always support the development of mosquitoes. As the rice stand develops and grows denser, the production of mosquitoes tends to increase while the ability for chemical control agents to penetrate the canopy decreases.
- Organic rice production limits the available chemical control materials available, so additional attention to BMPs is critical.
- Leaky levees
- Weedy borrow pits and field borders
- Irrigation and drain ditches

COMMON MOSQUITO SPECIES

- *Culex tarsalis*
- *Anopheles* species

SPECIAL CONCERNS

Agricultural practices vary among growers, locations, and conventional or organic production methods. Also local differences in environmental conditions may affect mosquito production from field to field. The BMPs below try to balance the economic and agronomic requirements of the growers and land owners with the need for effective mosquito control. The District is committed to continue working with growers, the California Rice Commission and other stakeholders to develop and implement mosquito control practices that coordinate with standard rice production practices, and minimize the impact on the economics or yields of the crop.

The need for close cooperation is important with all rice growers, but is especially important with growers who produce organic rice. At this time, there is only one available mosquito larvicide for organic rice which leaves biological control (mosquito fish), physical control (weed control) and cultural control (water management) as the only remaining mosquito management tools. Because proper timing and planning is essential for an effective IPM program, the District asks organic rice growers for an added level of commitment to addressing mosquito control issues in a cooperative manner.

MOSQUITO REDUCTION BMPS FOR RICE FIELDS

RI-1. Wherever feasible, maintain stable water level during mosquito season by ensuring constant flow of water into pond or rice field to reduce water fluctuation due to evaporation, transpiration, outflow, and seepage (Lawler and Lanzaro, 2005).

RI-2. Inspect and repair levees to minimize seepage (Lanzaro and Lawler, 2005; Lawler, 2005).

RI-3. Drain and eliminate borrow pits and seepage areas external to the fields (Lanzaro and Lawler, 2005; Lawler, 2005).

RI-4. Wherever feasible, maintain at least 4"–6" of water in the rice field after rice seedlings have begun to stand upright. Planned drainages should be coordinated with the District. If an unplanned drainage is necessary, notify the District as soon as possible to coordinate restocking of mosquito fish or to use alternative mosquito control measures.

RI-5. Wherever feasible, maintain vegetation on the outer–most portions of field levees and checks, specifically where they interface with standing water (Lanzaro and Lawler, 2005; Lawler, 2005).

RI-6. Control algae and weed growth as effectively as possible (Lawler, 2005).

RI-7. Communicate frequently with your county mosquito control officials regarding your crop management activities. For example: Draw–down of water levels, except drainage for harvest; Any drainage of fields to fallow fields; Initiation of post–harvest flooding for straw management or habitat objectives.

RI-8. Design fields with sufficient borrow pits along each internal levee to promote efficient drainage, and provide refuge for mosquito fish during low water.

CONVENTIONAL RICE PRODUCTION

RI-9. Notify MVCD prior to any pyrethroid insecticide applications to rice fields stocked with mosquito fish. The pyrethroid insecticides that can be applied to rice fields include lambda cyhalothrin (Warrior® Insecticide, Karate® Insecticide) or s–cypermethrin (Mustang® Insecticide) (Lanzaro and Lawler, 2005; Lawler, 2005).

ORGANIC RICE PRODUCTION

RI-10. Wherever feasible, maintain borrow pits (12"–18" deep) on both sides of each check throughout rice fields to provide refuge for mosquito fish during low water periods.

STORMWATER SYSTEMS

COMMON MOSQUITO DEVELOPMENT SITES

- Detention/retention basins
- Treatment wetlands
- Catch basins/storm drains
- Underground water storage devices
- Combined Sewer Systems
- Clogged sediment screens
- Blocked culverts
- Roadside ditches
- Beaver dams

COMMON MOSQUITO SPECIES

- Above ground/clean–water sources: *Culex tarsalis*
- Underground/polluted or nutrient rich water: *Culex pipiens*

SPECIAL CONCERNS

With the National Pollution Discharge Elimination System (NPDES) permit requirements taking the spotlight in the stormwater quality community, the fact that stormwater facilities are often ideal mosquito development sites and support large populations of vectors of diseases such as West Nile Virus in close proximity to urban and residential areas. It is critical to consider mosquito development in stormwater structures at the planning stages of new development, and to identify appropriate actions to address mosquito problems in existing facilities. Coordination with the NPDES program will be critical in the success of this endeavor.

GENERAL MOSQUITO REDUCTION PRINCIPLES

1. Maintain access for District staff to monitor and treat mosquito breeding sources.
2. Minimize emergent vegetation or surface debris in the water.
3. Contact the District for technical guidance or assistance in implementing mosquito reduction BMPs.
4. Contact the District for technical guidance or assistance in implementing mosquito reduction BMPs.

MOSQUITO REDUCTION BMPS FOR STORMWATER SYSTEMS

ABOVE GROUND STRUCTURES

SW-1. Build shoreline perimeters as steep and uniform as practicable to discourage dense plant growth (Metzger, 2004).

SW-2. Whenever possible, maintain stormwater ponds and wetlands at depths in excess of 4 feet (1.2 m) to limit the spread of invasive emergent vegetation such as cattails (*Typha spp.*) (Kwasny et. al., 2004; Metzger, 2004).

SW-3. Eliminate floating vegetation conducive to mosquito production (e.g., water hyacinth *Eichhornia spp.*, duckweed *Lemna* and *Spirodela spp.*, and filamentous algal mats) (Metzger, 2004).

SW-4. Perform routine maintenance to reduce emergent plant densities to facilitate the ability of mosquito predators (i.e., fish) to move throughout vegetated areas (Metzger, 2004).

SW-5. Make shorelines accessible to maintenance and vector control crews for periodic maintenance, control, and removal of emergent vegetation, as well as for routine mosquito monitoring and abatement procedures, if necessary (Metzger, 2004).

SW-6. Design and obtain necessary approvals for all stormwater ponds and wetlands to allow for complete draining when needed (Metzger, 2004).

SW-7. The effective swath width of most backpack or truck–mounted larvicide sprayers is approximately 20 feet (6 m) on a windless day. Because of these equipment limitations, all–weather road access (with provisions for turning a full–size work vehicle) should be provided along at least one side of large above–ground structures that are less than 25 feet (7.5 m) wide (Metzger, 2004).

SW-8. Access roads should be built as close to the shoreline as possible. Vegetation or other obstacles should not be permitted between the access road and the

stormwater treatment device that might obstruct the path of larvicides to the water (Metzger, 2004).

SW-9. Vegetation should be controlled (by removal, thinning, or mowing) periodically to prevent barriers to access (Metzger, 2004).

SW-10. Design structures so they do not hold standing water for more than 72 hours. Special attention to groundwater depth is essential (Metzger, 2004).

SW-11. Use the hydraulic grade line of the site to select a treatment BMP that allows water to flow by gravity through the structure. Pumps are not recommended because they are subject to failure and often require sumps that hold water (Metzger, 2004).

SW-12. Avoid the use of loose riprap or concrete depressions that may hold standing water (Metzger, 2004).

SW-13. Avoid barriers, diversions, or flow spreaders that may retain standing water (Metzger, 2004).

SW-14. Use concrete or liners in shallow areas to discourage unwanted plant growth where vegetation is not necessary (Metzger, 2004).

SW-15. Where feasible, compartmentalize managed treatment wetlands so that the maximum width of ponds does not exceed two times the effective distance (40 feet [12 m]) of land–based application technologies for mosquito control agents (Walton, 2003).

SW-16. Incorporate features that prevent or reduce the possibility of clogged discharge orifices (e.g., debris screens). The use of weep holes is not recommended due to rapid clogging (Metzger, 2004).

SW-17. Design distribution piping and containment basins with adequate slopes to drain fully and prevent standing water. The design slope should take into consideration buildup of sediment between maintenance periods. Compaction during grading may also be needed to avoid slumping and settling (Metzger, 2004).

SW-18. Catch Basins, drop inlets, storm drains, and other structures originally designed to not hold water should be regularly checked and maintained to function as designed.

SW-19. Basins designed to be dry but remain wet should be corrected by retrofit, replacement, repair, or more frequent maintenance.

SW-20. Coordinate cleaning of catch basins, drop inlets, or storm drains with mosquito treatment operations.

SW-21. Enforce the prompt removal of silt screens installed during construction when no longer needed to protect water quality.

UNDERGROUND STRUCTURES (SUMPS, VAULTS, DROP INLETS, CATCH BASINS)

SW-22. Completely seal structures that retain water permanently or longer than 72 hours to prevent entry of adult mosquitoes (Metzger, 2004).

SW-23. Stormwater structures utilizing covers should be tight fitting with maximum allowable gaps or 1/16 inch (2 mm) holes of to exclude entry of adult mosquitoes (Metzger, 2004).

SW-24. If the sump, vault, or basin is sealed against mosquitoes, with the exception of the inlet and outlet, submerge the inlet and outlet completely to reduce the available surface area of water for mosquito egg–laying (female mosquitoes can fly through pipes) (Metzger, 2004).

SW-25. Design structures with the appropriate pumping, piping, valves, or other necessary equipment to allow for easy dewatering of the unit if necessary (Metzger, 2004).

MANANGED WETLANDS

COMMON MOSQUITO DEVELOPMENT SITES

- Permanent wetlands for habitat or species conservation
- Constructed vernal pools and other wetlands
- Seasonal wetlands
- Duck clubs

COMMON MOSQUITO SPECIES

- Permanent wetlands: *Culex tarsalis*
- Seasonal wetlands: *Aedes* species

SPECIAL CONCERNS

Managed wetlands are being built and restored across northern California. Each varies depending on the habitat, water quality, recreational, economic, and other management goals, and may be subject to additional regulations including state and federal conservation easements and management plans. Mosquito Reduction BMPs attempt to balance the management goals of land managers, land owners, and other regulatory agencies with the need for effective mosquito control. The District is committed to working with wetland managers and state and federal agencies, to implement mosquito control practices in a cooperative manner.

GENERAL MOSQUITO REDUCTION PRINCIPLES

1. Maintain access for District staff to monitor and treat mosquito breeding sources.
2. Minimize emergent vegetation and surface debris on the water.
3. Contact the District for technical guidance, assistance in implementing mosquito reduction BMPs, or to coordinate flood–ups with mosquito control operations.

SPECIFIC MOSQUITO REDUCTION BMPS

DESIGN AND MAINTENANCE

MW-1. Maintain all open ditches by periodically regularly removing trash, silt, and vegetation to maintain efficient water delivery and drainage (Kwasny et. al., 2004).

MW-2. Provide reasonable access on existing roads and levees to allow mosquito abatement technician access for monitoring, abatement, and implementation of BMPs. Make shorelines of natural, agricultural, and constructed water bodies accessible to maintenance and vector control crews for periodic maintenance, control, and removal of emergent vegetation, as well as for routine mosquito monitoring and abatement procedures (Kwasny et. al., 2004).

MW-3. Inspect, repair, and clean water control structures of debris. Remove silt and vegetation build–up in front of structures that impedes drainage or water flow. Completely close, board or mud–up controls to prevent unnecessary water flow, except where water circulation is necessary (Kwasny et. al., 2004).

MW-4. Perform regular pump efficiency testing and make any necessary repairs to maximize output (Kwasny et. al., 2004).

MW-5. Construct, improve, or maintain ditches with 2:1 slopes and a minimum 4 foot bottom. Consider a 3:1 slope or greater to discourage burrowing animal damage, potential seepage problems, and prevent unwanted vegetation growth (Kwasny et. al., 2004). Other designs may be approved by the District depending on special circumstances.

MW-6. Construct, or improve, or maintain levees to quality standard that ensures stability and prevents unwanted seepage. Ideally build levees with >3:1 slopes & >80% compaction; consider >5:1 slope or greater in areas prone to over–land flooding and levee erosion (Kwasny et. al., 2004).

MW-7. Ensure adequately sized water control structures are in place. Increase size and number of water control structures if necessary to allow for complete draw–down and rapid flooding (Kwasny et. al., 2004; Walton, 2003).

MW-8. Inspect and repair levees at least annually (Kwasny et. al., 2004).

MW-9. Design managed wetland projects to include independent inlets and outlets for each wetland unit (Kwasny et. al., 2004).

MW-10. Construct or enhance swales so they are sloped from inlet to outlet and allow the majority of the wetland to be drawn down (Kwasny et. al., 2004).

MW-11. Install cross–levees to facilitate more rapid irrigation and flood–up. Build "underwater" levees that isolate irrigation water during the spring, but can be overtopped during fall and winter flooding (Kwasny et. al., 2004).

MW-12. Excavate deep channels or basins to maintain permanent water areas (> 2.5 feet deep) within a portion of seasonal managed wetlands. This provides year–round habitat for mosquito predators which can inoculate seasonal wetlands when they are irrigated or flooded (Kwasny et. al., 2004).

MW-13. Maintain separate permanent water reservoir that conveys water to seasonal wetlands. Provides year–round habitat for mosquito predators which can inoculate seasonal wetlands when they are irrigated or flooded (Kwasny et. al., 2004).

MW-14. Encourage populations of insectivorous birds (e.g swallows) and bats by preserving nesting and roosting areas (Kwasny et. al., 2004).

VEGETATION MANAGEMENT

MW-15. Control floating vegetation conducive to mosquito production (i.e., water hyacinth, water primrose, parrot's feather *Eichhornia spp.*, duckweed *Lemna* and *Spirodela spp.*, and filamentous algal mats) (Metzger, 2004).

MW-16. Perform routine maintenance to reduce problematic emergent plant densities to facilitate the ability of mosquito predators (i.e., fish) to move throughout vegetated areas, and allow good penetration of chemical control agents. (Kwasny et. al., 2004)

WATER MANAGEMENT

MW-17. Maintain stable water level during mosquito season by ensuring constant flow of water into pond or wetland to reduce water fluctuation due to evaporation, transpiration, outflow, and seepage (Kwasny et. al., 2004; Walton, 2003).

MW-18. Flood managed wetlands with water sources containing mosquito fish or other invertebrate predators. Water from permanent ponds can be used to passively introduce mosquito predators (Kwasny et. al., 2004).

MW-19. Rapidly irrigate wetlands keeping the time water enters the pond to complete drawdown between 4 and 10 days (Kwasny et. al., 2004).

MW-20. Extended duration irrigations (generally 14–17 days) may be considered for weed control (e.g. cocklebur). Additional measures to offset the potential for increased mosquito production may be needed.

MW-21. Delay fall flooding to avoid increasing late–season mosquito production (Kwasny et. al., 2004).

MW-22. Implement additional BMPs for wetlands that need to be flooded earlier than recommended in the fall. The wetlands targeted for early fall flooding should not be near urban centers and should not have a history of heavy mosquito production (Kwasny et. al., 2004).

MW-23. Flood managed wetland unit as fast as possible. Coordinate flooding with neighbors or water district to maximize flood–up rate (Kwasny et. al., 2004).

MW-24. Encourage water circulation by providing a constant flow of water equal to discharge at drain structure (Kwasny et. al., 2004).

MW-25. Flood managed wetland as deep as possible at initial flood–up (18–24"). Shallow water levels can be maintained outside of the mosquito breeding season (Kwasny et. al., 2004).

MW-26. Drain irrigation water into ditches or other water bodies with abundant mosquito predators. Prevent free flooding into fallow or dry fields (Kwasny et. al., 2004).

MW-27. Use a flood–drain–flood regime to control floodwater mosquitoes. Flood wetland to hatch larvae in the pond. Drain wetland to borrow or other ditch where larvae can be easily treated, drowned in moving water, or consumed by predators. Immediately re–flood wetland. (Kwasny et. al., 2004*). Note: This water management regime should be used only when it does not conflict with water quality regulations.*

MW-28. Evaluate necessity of irrigation, especially multiple irrigations, based on spring habitat conditions and plant growth. Reduce number and duration of irrigations when feasible (Kwasny et. al., 2004).

MW-29. Where feasible, draw–down managed wetland in late March or early April. Irrigate in late April or early May when weather is cooler and mosquitoes are less of a problem (Kwasny et. al., 2004).

MW-30. Irrigate managed wetland before soil completely dries to prevent soil cracking between spring draw–down and irrigation (Kwasny et. al., 2004).

MW-31. Stock managed wetlands, especially brood ponds or permanent wetlands, with mosquitofish or encourage habitat for naturalized populations. Utilize water sources with mosquitofish to passively transport predators to newly flooded habitats (Kwasny et. al., 2004).

MW-32. Maintain permanent or semi–permanent water where mosquito predators can develop and be maintained. Discourage use of broad spectrum pesticides (Kwasny et. al., 2004).

MW-33. Where feasible, have an emergency plan that provides for immediate drainage into acceptable areas if a public health emergency occurs (Walton, 2003).

MW-34. Minimize fluctuations in water level to prevent large areas of intermittently flooded substrate or isolated pools from being created, particularly during mosquito season which can start as early as March and extend through October depending on weather (Kwasny et. al., 2004).

COORDINATION WITH DISTRICT

MW-35. Consult with the District on agency–sponsored habitat management plans on private lands (e.g. Presley Program), and on the timing of wetland flooding on public and private lands—urge private landowners to do the same (Kwasny et. al., 2004).

MW-36. Identify problem locations for mosquito production with the District and work to implement mosquito BMPs. Identify potential cost–share opportunities to implement BMPs (Kwasny et. al., 2004).

MW-37. Consult with the District on the design of restoration and enhancement projects that have the possibility of effecting mosquito production or control operations (Kwasny et. al., 2004).

URBAN AND SUBURBAN MOSQUITO SOURCES

COMMON MOSQUITO DEVELOPMENT SITES

- Un–maintained swimming pools and spas
- Decorative ponds and fountains
- Bird baths
- Water–filled containers
- Clogged rain gutters
- Poorly designed or damaged landscape irrigation systems
- Cemetery vases
- Koi ponds
- Stored or waste tires

COMMON MOSQUITO SPECIES

- Cleaner water sources: *Culex tarsalis*
- Water with more organic material: *Culex pipiens*

SPECIAL CONCERNS

Urban and suburban mosquito sources are especially important because, sources may be in and around private residences which are not easily seen or accessed by control technicians and produce mosquitoes in areas of high population density. This can quickly lead to vector–borne disease transmission since the vector (mosquito) and host (human) are often in close proximity. Economic or social changes in a neighborhood can result in an increase in mosquito sources such as un–maintained swimming pools. Fortunately, many of the BMPs for residential areas are relatively inexpensive and easy to implement.

GENERAL MOSQUITO REDUCTION PRINCIPLES

1. Prevent or eliminate unnecessary standing water that remains for more than 72 –96 hours during mosquito season which can start as early as March and extend through October depending on weather.
2. Maintain access for District staff to monitor and treat mosquito breeding sources.
3. Contact the SYMVCD for technical guidance or assistance in implementing mosquito reduction BMPs.

SPECIFIC MOSQUITO REDUCTION BMPS

RESIDENTIAL AREAS

US-1. Drain all containers of standing water, including pet dishes, wading pools, potted plant drip trays, boats, birdbaths, tires, and buckets, at least once a week during mosquito season. Keep in mind that mosquitoes can develop in as little as 1/8" of standing water.

US-2. Use an approved disinfection process (chlorine, bromine) to prevent mosquito breeding in swimming pools and spas. Use skimmers and filter systems to remove egg rafts and mosquito larvae.

US-3. If a pool or spa is not going to be maintained for any reason, do one of the following: 1) drain the pool or spa completely of any water (note that in-ground pools may be damaged by being completely drained. Above-ground pools and spas generally may be drained without damage), 2) notify district so that the pool can be inspected regularly and treated with a larvicide and/or stocked with mosquito fish if needed.

US-4. Notify District of any ponds (including ponds with ornamental fish such as koi or goldfish) with permanent or seasonally permanent water. Allow district technicians to inspect and periodically stock mosquitofish or guppies to biologically control mosquito larvae.

US-5. Landscape irrigation drainage should be managed such that no water stands for more than 72 hrs during mosquito breeding season (generally April–October).

US-6. All underground drain pipes should be laid to grade to avoid low areas that may hold water for longer than 72 hrs.

US-7. Keep rain gutters clear of leaves and debris. Check for standing water in gutters after rain events during mosquito season.

US-8. Provide safe access for District technicians to all pools, spas, ponds, landscape irrigation structures, catch basins, storm drains, drainage pipes, sewer cleanouts, or any other potential mosquito breeding source.

US-9. Repair leaks or damaged drainage system components to prevent standing water for more than 72 hours during mosquito season.

US-10. Notify District of any condition that may produce mosquitoes on the property such as flooding, broken pipe, damaged septic tank cover, leaking outdoor faucet if unable to be fixed or results in standing water for more than 72 hours during mosquito season.

TIRE STORAGE

TR-1. Never allow water to accumulate in tires. Tires should be stored in a covered location or covered by a tarp in order to prevent the accumulation of water from rain, sprinklers, etc.

TR-2. Tires should never be stored in a pile. Tires should be stored on racks or in a stack not more than two rows wide.

TR-3. Tires should be stored in a manner that allows inspections of each individual tire.

TR-4. Waste tires should be picked up by the proper disposal entity on a regular basis.

TR-5. Those responsible for stored tires should inspect and dump out any water that may have accumulated inside tires on their premises on a weekly basis.

CEMETERY FLOWER VASES

CV-1. Use a water–absorbing polymer material (super–absorbent polyacrylamide) which turn standing water into a gel. This eliminates the chance of mosquito development yet allows cut flowers to remain fresh.

CV-2. Seek alternatives to in–ground or mounted flower vases which can hold water for 72–96 hours.

CV-3. Dump out all vases weekly during the spring, summer, and fall.

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SACRAMENTO-YOLO
MOSQUITO
& VECTOR
CONTROL
DISTRICT

FIGHT THE
BITE

OFFICE LOCATIONS AND HOURS OF OPERATION

SACRAMENTO COUNTY
8631 Bond Road
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